B.N.M. Institute of Technology

An Autonomous Institution under VTU, Approved by AICTE

Department of Mathematics

Syllabus

(For M. Tech in Computer Science Engineering)

Semester: I		
Course: ADVANCED MATHEMATICS		**Course Code: 25MMT211**
L:T:P:J	**3:1:0:0**	**CIA: 50**
Credits:	**04**	**SEA: 50**
Hours:	**40 hours for theory and 10 AAT sessions**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to develop the theoretical and practical knowledge of vector spaces, linear transformations, orthogonality and least squares, symmetric and quadratic forms, linear regression, dimensionality reduction with principal component analysis and classification with support Vector Machines in a comprehensive manner in various fields of engineering.

Module-1: Vector Spaces and Linear transformation	**No. of Hours**	**Blooms cognitive Levels**
Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate Vectors. **Linear transformation:** Introduction, properties and problems on linear transformations, Representation of transformations by matrices. **Problem Solving (Tutorials)**	**L :04** **T :04**	**L1** **L2** **L3**
Module-2: Orthogonality and least squares		
Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves). **Problem Solving (Tutorials)**	**L : 04** **T : 04**	**L1** **L2** **L3**
Module-3: Symmetric and Quadratic Forms		
Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics **Problem Solving (Tutorials)**	**L : 04** **T : 04**	**L1** **L2** **L3**
Module- 4: Linear Regression, Dimensionality Reduction with Principal Component Analysis		
Linear Regression: Bayesian linear regression, Maximum likelihood as an orthogonal projection. **Dimensionality Reduction with Principal Component Analysis:** Problem setting, Maximum variance perspective, Projection perspective, Eigenvector computation and Low-Rank approximations, Principal Component Analysis (PCA) in high dimension, Key steps of PCA in practice, latent variable perspective. **Problem Solving (Tutorials)**	**L : 04** **T : 04**	**L1** **L2** **L3**
Module-5: Classification with support Vector Machines:		
Separating hyperplanes, Primal support vector machine, Dual support vector machine, Kernals, Numerical solution. **Problem Solving (Tutorials)**	**L : 04** **T : 04**	**L1** **L2** **L3**

Sl. No.	AAT Components	Module	CO	PO
1	Finding Basis and dimension of a vector space.	1	1	1,2,5
2	Finding matrix representation of linear transformations.	1	1	1,2,5
3	Finding QR factorizations of a matrix.	2	2	1,2,5
4	Problems on least square method.	2	2	1,2,5
5	Finding Diagonalization of a square matrix	3	3	1,2,5
6	Finding the Singular value decomposition of a matrix	3	3	1,2,5
7	Finding linear regression for the given data	4	4	1,2,5
8	Principal Component Analysis	4	4	1,2,5
9	Analysis of Separating hyperplanes	5	5	1,2,5
10	Problems on Kernals.	5	5	1,2,5

Course Outcomes: After completing of the course, the students will be able to	
CO 1:	Apply the concepts of vector spaces and linear transformations to solve problems related to image magnification and rotation
CO 2:	Apply the Gram-Schmidt process for QR factorizations of a and least square approximation in solving linear system of equations.
CO 3:	Apply singular value decomposition (SVD) for data compression.
CO 4:	Solve problems related to linear regression and Principal Component Analysis.
CO 5:	Solve problems related to classification of data using support vector machines

CO - PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2			2							
CO 2	3	2			2							
CO 3	3	2			2							
CO 4	3	2			2							
CO 5	3	2			2							

Reference Books:

1. Linear Algebra and its Aplications, David C. Lay, Steven R. Lay and J. J. McDonald, 5th Edition 2015, Pearson Education Ltd.
2. Linear Algebra, Dr. Sudhir Kunar Pundier, First edition, 2015, CBS publishers and Distrbutors Pvt. Ltd.
3. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong ,2020 edition. Cambridge University Press.
4. Linear Algebra, Kenneth Hoffman, Ray Kunze, 2012 edition, PHI Learning Pvt. Ltd.

Web links and Video Lectures:

1. https://www.youtube.com/watch?v=2DX8Vp1Q2-0
2. https://kongunadu.digimat.in/nptel/courses/video/108104174/L22.html
3. https://youtu.be/yuE86XeGhEA
4. https://www.youtube.com/watch?v=hkCT-6KJAK0
5. https://www.youtube.com/watch?v=SRVswRH5Q7E

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: I

COURSE NAME: ADVANCED COMPUTER NETWORKS AND SECURITY

Course Code: 25MCS212	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Gain knowledge of the various aspects of network architecture and protocols, Network performance
2	Understand effective communication mechanisms
3	Students will learn about the issues in 802.11 LANs
4	Learn various congestion control algorithms.

Module 1	**BLL, CO**	**Teaching Hrs.**
Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective. **Foundation:** Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait ,Sliding Window, Concurrent Logical Channels.	**Apply CO1**	**08**
Module 2		
Internetworking I: Basic Internetworking (IP), What is an Internetwork? Service Model, Global Addresses, Datagram Forwarding in IP, subnetting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels. **Internetworking- II:** Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP.	**Apply CO2**	**08**
Module 3		
Wi-**Fi**: 802.11, Wireless LANs, The 802.11 Architecture, The 802.11 MAC Protocol, The IEEE 802.11 Frame, Mobility in the Same IP Subnet, Advanced Features in 802.11, Personal Area Networks: Bluetooth and Zigbee, Cellular Internet Access, An Overview of Cellular Network Architecture, 3G Cellular Data Networks: Extending the Internet to Cellular Subscribers, On to 4G: LTE, Mobility Management: Principles, Addressing, Routing to a Mobile Node, Mobile IP ,Managing Mobility in Cellular Networks, Routing Calls to a Mobile User, Handoffs in GSM, Wireless and Mobility Impact on Higher-Layer Protocols	**Analyze CO3**	**08**
Module 4		

Overview of Network Security: Cryptographic Building Blocks, Principles of Ciphers, Symmetric-Key Ciphers, Public-Key Ciphers, Authenticators, key Predistribution, Predistribution of Public Keys, Predistribution of Symmetric Keys, Authentication Protocols, Originality and Timeliness Techniques,	**Apply CO4**	**08**
Module 5		
Authentication and others: Public-Key Authentication Protocols, Symmetric-Key Authentication Protocols, Diffie-Hellman Key Agreement, Example Systems, Pretty Good Privacy (PGP),Secure Shell (SSH), Transport Layer Security (TLS, SSL, HTTPS),IP Security (IPsec), Wireless Security (802.11i),Firewalls, Strengths and Weaknesses of Firewalls	**Analyze CO4**	**08**

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS212.1	Apply various protocols to develop applications using the sockets API.	**Apply**
25MCS212.2	Demonstrate effective communication mechanisms in computer networks	**Apply**
25MCS212.3	Analyze the concepts and issues in Mobile and Wireless Networks	**Analyze**
25MCS212.4	Examine possible research opportunities and challenges within the network application and security.	**Analyze**

Textbooks

1. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach", 5 Edition, Elsevier 2014.
2. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e, Pearson Education, 2012.
3. William Stallings, Cryptography and Network Security, 6th Edition.

References:

1. Uyless Black, "Computer Networks, Protocols , Standards and Interfaces" 2 nd Edition PHI.
2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture", 6th Edition, PHI – 2014.
3. Behrouz A Forouzan, "TCP /IP Protocol Suite" 4th Edition – Tata McGraw-Hill

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

BNM Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

M. Tech Semester: I

Course Name: Advanced Data Base Management

Course Code: 25MCS213	**L: T: P: J: 3:0:1:1**	**CIE Marks 50**
Credits:	**4**	**SEE Marks 50**
Hours/Week (Total)	**5 (40)**	**Exam Hours 3Hrs**

Credits 4

Course Learning Objectives: The students will be able to

1	Strong foundation in advanced database concepts from an industry perspective
2	To the design and implement Distributed Databases.
3	To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports.
4	To familiarize concepts of Data mining and data warehousing.

Prerequisites: Fundamentals of Database Management Systems

Module-1	No. of Hours	Blooms Ccognitive Levels with CO mapping
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, types, and violations. **Object and Object-Relational Databases**: Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL	8	Understand
Module-2		
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures. **Distributed Database Concepts**: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases	8	Understand
Module-3		
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. **Big Data Technologies Based on MapReduce and Hadoop:** What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN.	8	Apply
Module-4		
Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts **Introduction to Information Retrieval and Web Search:** Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval	8	Apply

Module-5		
Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems. **Overview of Data Warehousing and OLAP**: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse	8	Analyze

List of Sample Experiments

1. Accessing the database
2. Advanced SQL
3. Accessing the database through Python: Advanced techniques
4. Introduction to Git
5. Create an app connected to a database
6. Familiarization of data mining tools.

COs	Statement	Bloom's Cognitive level	POs/PSOs
25MCS213.1	Infer and represent the real-world data using Relational and object-oriented database.	Understand	1,2,3,6/2
25MCS213.2	Interpret the structures of Disk Storage, Files, Modern Storage, and distributed storage Architectures.	Understand	1,2,3,6/2
25MCS213.3	Apply the concepts of NoSQL and Big data Technologies for effective management of large real time data.	Apply	1,2,3,4,5/2
25MCS213.4	Identify and design suitable database for recent applications database for better interoperability.	Apply	1,2,3,4,5/2
25MCS213.5	Analyze rule set in the database to implement data warehousing and mining.	Analyze	3,4,12/2

Textbooks

1. Fundamentals of Database Systems, by Elmasri and Navathe, Pearson Education, 2013.
2. Database Management Systems, by Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill, 3rd Edition, 2013.

Reference Books

1. Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 6th Edition, 2010.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks. ● Average of 2 tests = 30 Marks	30
	AAT	Mini Project.	10
	Practical Component	Weekly Assessment	10
		Total Marks	**50**
SEA(50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students must answer 5 full questions.	**50**
		Total marks for the Course	**100**

B.N.M. Institute of Technology

An Autonomous Institution under VTU
Department of Computer Science and Engineering
M.Tech 1 SEM

COURSE NAME: RESEARCH ETHICS AND INNOVATION MANAGEMENT

Course Code	25MCS214	CIE Marks	50
Number of Contact Hours/ Week	3:0:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3 Hrs

Credits- 3

Course Objectives:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
- To explain several parametric tests of hypotheses and Chi-square test.
- To explain the art of interpretation and the art of writing research reports.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To discuss leading International Instruments concerning Intellectual Property Rights

Module-1	**Teaching Hours**
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration	8
Module-2	
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.	8
Module-3	
Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. **Data Collection:** Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	8

Module-4	
Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. **Chi-square Test:** Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.	8
Module-5	
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. **Intellectual Property:** The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO	8

Course Outcomes:

CO1: Discuss research methodology and the technique of defining a research problem.

CO2: Explain the functions of literature review in research, for developing theoretical and conceptual frameworks and writing a review.

CO3: Applying the various research designs, sampling designs, measurement and scaling techniques and different data collection methods for research.

CO4: Analyze the hypothesis tests, chi-square tests and art of interpretation and writing research reports

CO5: Discuss the various forms of IPR, its relevance and business impact, leading international instruments concerning IPR

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbooks

Research Methodology: Methods and Techniques C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018 Research Methodology a step-by step guide for beginners. (For the topic Reviewing the literature under module 2) Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011 Study Material (For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013
Reference Books
Research Methods: the concise knowledge base Trochim Atomic Dog Publishing 2005 Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications 2009

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Semester: I

COURSE NAME: ADVANCED DATA STRUCTURES AND ALGORITHMS

Course Code: 25MCS215	**L:T:P:J: 3:0:2:0**	**CIE Marks:**50
Credits:	4	**SEE Marks:**50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

- Understand the different asymptotic notations.
- Design dynamic programming and graph algorithms.
- Understand multithreaded and number theoretic algorithms and the heap's operations.
- Understand string matching algorithms and operations on tries.
- Explain the NP-complete problem and approximation algorithm.

Module 1	BLL, CO	Teaching Hrs
Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions. Recurrences -The substitution method, recursion-tree method, the master method.	**Understand CO1**	**10**
Module 2		
Dynamic Programming - Matrix-Chain multiplication, Elements of dynamic programming, longest common subsequences. Graph algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG.	**Apply CO2**	**10**
Module 3		
Multithreaded algorithms-Basics of dynamic multithreaded algorithm; Multithreaded merge sort. Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem. Heaps: Binary, Binomial, Fibonacci, leftist, Skew	**Apply CO2**	**10**
Module 4		
Advanced data structures: Tries (prefix trees) – insert, delete, search operations, K-d trees. String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm	**Apply CO3**	**10**
Module 5		
NP-Completeness: Polynomial time, Polynomial time verification, NP-Completeness and reducibility, NP-Complete problems. Approximation Algorithms: vertex cover problem, the set – covering problem, randomization and linear programming, the subset – sum problem.	**Analyze CO4**	**10**

Co. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS215.1	Understand growth of functions, asymptotic notations, and recurrences to evaluate algorithm efficiency.	Understand
25MCS215.2	Apply dynamic programming and graph algorithms to solve computational problems like matrix-chain multiplication and shortest paths	Apply
25MCS215.3	Develop multithreaded algorithms and solve number-theoretic problems using modular arithmetic and the Chinese remainder theorem	Apply
25MCS215.4	Utilize advanced data structures and string-matching algorithms to design efficient solutions for real-world problems	Apply
25MCS215.5	Analyze NP-complete problems and design approximation algorithms for vertex cover, set-covering, and subset-sum problems.	Analyze

Reference Books

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, Prentice Hall of India , 3rd Edition, 2012.
2. Mark Allan Weiss, Data Structures and Algorithms Analysis in C++, Pearson, 4th Edition, 2014
3. Aho, Hopcroft and Ullman Data structures and algorithms Pearson Education
4. Ellis Horowitz, SartajSahni, S.Rajasekharan, Fundamentals of Computer Algorithms, Universities press, 2nd Edition, 2007

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	Class work / viva	Record / Class work / viva	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Practical Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

BNM Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

M. Tech Semester: I

Course Name: DIGITAL IMAGE PROCESSING AND COMPUTER VISION

Course Code: 25MCS216	**L: T: P: J: 2 : 0 : 1 : 1**	**CIE Marks 50**
Credits:	**3**	**SEE Marks 50**
Hours/Week (Total)	**3 (40)**	**Exam Hours 3Hrs**

Credits 3/4

Course Learning Objectives: The students will be able to

1	Fundamental concepts of Image Processing
2	Segmentation and representation techniques for the region of interests.
3	Learn image enhancement techniques in spatial & frequency domain
4	How to recognize objects using pattern recognition techniques
5	Learn the restoration & compression models

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
. Image formation, Image transforms - Fourier transforms, Walsh, Hadamard, Discrete cosine, Hotelling transforms, Hough Transform for line detection.	8	**Apply CO 1**
Module-2: IMAGE ENHANCEMENT & RESTORATION		
Histogram modification techniques - Image smoothening Image Sharpening - Image Restoration-Degradation Model-Noise models Spatial filtering-Frequency domain filtering	8	**Apply CO 2**
Module-3		
Compression Models – Elements of information theory – Error free Compression – Image segmentation – Detection of discontinuities, Edge detection techniques, – Region based segmentation – Morphology	8	**Analyse CO 3**
Module-4: SHAPES AND REGIONS		
Binary shape analysis-connectedness - object labeling and counting-size filtering - distance functions-skeletons and thinning - deformable shape analysis - boundary tracking procedures active contours-shape models and shape recognition - centroidal profiles - handling occlusion boundary length measures - boundary descriptors - chain codes - Fourier descriptors - region descriptors - moments.	8	**Analyse CO 4**
Module-5: 3D VISION AND MOTION		

Methods for 3D vision - projection schemes - shape from shading - photometric stereo - shape from texture shape from focus active range finding surface representations - point-based representation volumetric representations 3D object recognition 3D reconstruction introduction to motion - triangulation - bundle adjustment - translational alignment - parametric motion-spline-based motion-optical flow-layered motion. Application: Photo album - Face detection-Face recognition-Eigen faces - Active appearance and 3D shape models of faces	8	**Analyse CO 5**

COs	Statement	Bloom's Cognitive level	POs/PSOs
25MCS216.1	The students will learn the fundamental concepts of Image Processing.	Apply	1,2,3/1,2
25MCS216.2	Help the students in Segmentation and representation techniques for the region of interests.	Apply	1,2,3/1,2
25MCS216.3	The students will learn image enhancement techniques in spatial & frequency domain	Analyse	1,2,3/1,2
25MCS216.4	The students will learn how to recognize objects using pattern recognition techniques	Analyse	1,2,3/1,2
25MCS216.5	The students will learn the restoration & compression models	Analyse	1,2,3/1,2

Text Books
1. Digital Image Processing, Gonzalez.R.C & Woods R.E.. 2. Computer & Machine Vision II, E. R. Davies
Reference Books Digital Image Processing using MATLAB

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks ● Average of 2 tests = 30 Marks	30
	Assignment	Average of 2 Assignments for 10 marks each	10
	AAT	Research /Article making	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Lab Project Assessment	Presentation and Demonstration of the project	**50**
		Total marks for the Course	**100**

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: II

COURSE NAME: ADVANCES IN OPERATING SYSTEMS

Course Code: 25MCS221	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Define the fundamentals of Operating Systems.
2	Explain distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
3	Illustrate distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
4	Identify the components and management aspects of Real time, Mobile operating Systems

Module 1	**BLL, CO**	**Teaching Hrs.**
Operating System Overview, Process description & Control: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Microsoft Windows Overview, Traditional UNIX Systems, Modern UNIX Systems, What is a Process?, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues.	**Understand CO1**	**08**
Module 2		
Threads, SMP, and Microkernel, Virtual Memory: Processes and Threads, Symmetric Multiprocessing (SMP), Micro Kernels, Windows Vista Thread and SMP Hours Management, Linux Process and Thread Management. Hardware and Control Structures, Operating System Software, UNIX Memory Management, Windows Vista Memory Management, Summary	**Apply CO2**	**08**
Module 3		
Multiprocessor and Real-Time Scheduling: Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX PreclsSl) Scheduling, Windows Vista Hours Scheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock	**Apply CO2**	**08**
Module 4		
Embedded Operating Systems: Embedded Systems, Characteristics of Embedded Operating Systems, eCOS, TinyOS, Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software Overview, Viruses, Worms, and Bots, Rootkits	**Apply CO3**	**08**
Module 5		

Kernel Organization: Using Kernel Services, Daemons, Starting the Kernel, Control in the Machine , Modules and Device Management, MODULE Organization, MODULE Installation and Removal, Process and Resource Management, Running Process Manager, Creating a new Task , IPC and Synchronization, The Scheduler , Memory Manager , The Virtual Address Space, The Page Fault Handler , File Management. The windows NT/2000/XP kernel: Introduction, The NT kernel, Objects , Threads, Multiplication Synchronization, Traps, Interrupts and Exceptions, The NT executive , Object Manager, Process and Thread Manager , Virtual Memory Manager, I/o Manager, The cache Manager Kernel local procedure calls and IPC, The native API, subsystems.	**Analyze CO3**	**08**

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS221.1	Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system	Understanding
25MCS221.2	Learn the various resource management techniques for distributed systems	Applying
25MCS221.3	Identify the different features of real time and mobile operating system.	Applying
25MCS221.4	Modify existing open-source kernels in terms of functionality or features used.	Applying

Textbooks

1. William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2013.
2. Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2014.
3. **Reference Books**
1. Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008
2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2006.
3. Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

1BNM Institute of Technology

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Dept. of Computer Science and Engineering

M. Tech Semester: II

Course Name:

Course Code: 25MCS222	**L: T: P: J: 3:0:1:1**	**CIE Marks 50**
Credits:	**4**	**SEE Marks 50**
Hours/Week (Total)	**5(50)**	**Exam Hours 3Hrs**

Credits 3/4

Course Learning Objectives: The students will be able to

1	To introduce students to the foundational concepts of data science and business intelligence, including data preparation, analysis, and visualization.
2	To equip learners with knowledge of statistical methods and predictive modeling for actionable insights
3	To provide hands-on experience in machine learning, data mining, and business analytics using modern tools.
4	To develop the ability to analyze domain-specific data and apply BI strategies effectively in business environments.
5	To prepare students for real-world data problems through the integration of big data technologies and project-based learning.

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Data Science lifecycle & BI principles: Understanding problem framing, data acquisition, cleaning, integration, transformation, storage (e.g. DW/marts) **Exploratory Data Analysis**: statistics, distributions, outlier detection, correlation, hypothesis testing **Practical Component:** Load and clean a real-world dataset (e.g., COVID, Kaggle retail dataset) EDA in Python (pandas, seaborn, matplotlib)	10	**Apply**
Module-2		
Descriptive to inferential statistics: sampling, z-tests, t-tests, ANOVA, chi-square **Regression techniques**: multiple, logistic, nonlinear; model validation (cross-validation, metrics) **Data Visualization**: visualization (matplotlib, seaborn, Power BI/Tableau) **Practical Component:** Create dashboards in Tableau or Power BI	10	**Apply**
Module-3		
Supervised learning: Bayesian Classifier, decision trees, ensemble methods (bagging, boosting) **Unsupervised learning**: clustering, association rules, time-series forecasting (ARIMA, moving averages) **Data mining processes**: KDD stages; data pre-processing; comparison of mining systems **Practical Component:** Build classification models (churn prediction) Cluster customer behavior data	10	**Apply**
Module-4		

OLAP & architectural design: schemas (star, snowflake), cubes, roll-up, drill-down **Business Intelligence & its tools** – BI lifecycle, dashboards, advanced visualization, storytelling with data, decision-support systems. **Practical Components:** Design and simulate OLAP cube operations Create domain-based dashboards (HR, Sales, Finance)	10	**Apply**
Module-5		
Data Governance & Metadata Management, Self-Service BI Tools, Operational BI & Real-time Analytics; **Capstone Project**: Real-world case study involving full data lifecycle—from collection to BI presentation **Practical Components:** Implementation of project.	10	**Analyze**

COs	Statement	Bloom's Cognitive level	POs/PSOs
25MCS222.1	Apply the data science lifecycle to real-world problems by framing objectives, acquiring and preparing data, and performing exploratory data analysis using statistical techniques and visualization tools.	L3	1, 2, 5
25MCS222.2	Build and validate statistical and machine learning models for various data-driven problems.	L3	1, 2, 3, 5
25MCS222.3	Apply supervised and unsupervised models for prediction and insights.	L3	1, 2, 5, 11
25MCS222.4	Design and deploy BI solutions across functional business domains using OLAP and dashboards.	L3	1, 3, 5, 6
25MCS222.5	Analyze the problems present in the field of data science and implement scalable big data solutions and complete end-to-end capstone projects demonstrating industry-readiness.	L4	1,2,3,4,5,6,7,8,9,10,11,12/1,2

Text Books

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2nd Edition, 2019.
2. Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence: A Managerial Perspective on Analytics", Pearson, 4th Edition, 2018.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning: with Applications in R", Springer, 2nd Edition, 2021.
4. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 3rd Edition, 2022.
5. Andrew Ng, "Machine Learning Yearning", deeplearning.ai, Draft Edition, 2018. (Available as free download)

Reference Books

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 3rd Edition, 2011.

2. Martin Kleppmann, "Designing Data-Intensive Applications", O'Reilly Media, 1st Edition, 2017.
3. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", Wiley, 3rd Edition, 2013.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 1st Edition, 2016.
5. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for Data Scientists", O'Reilly Media, 2nd Edition, 2020.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks ● Average of 2 tests = 15 Marks	15
		AAT	10
	Lab Program Assessment	Weekly Assessment	10
		IA test	15
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions.	**50**
		Total marks for the Course	**100**

BNM Institute of Technology

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Dept. of Computer Science and Engineering

M. Tech Semester: II

Course Name: Deep Learning

Course Code: 25MCS223	**L: T: P: J: 2:0:2:0**	**CIE Marks 50**
Credits:		**SEE Marks 50**
Hours/Week (Total)	**4**	**Exam Hours 3 Hrs**

Credits 4

Course Learning Objectives: The students will be able to

1	Explain the fundamentals of the Basics: Learning Algorithms
2	Identify the deep learning algorithms which are more appropriate for various types of learning
3	Various types of learning tasks in various domains.
4	Implement deep learning algorithms and solve real-world problems

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.	8	**Understand CO 1**
Module-2		
Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, BackPropagation. Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, SemiSupervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout	8	**Apply CO 2**
Module-3		
Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.	8	**Analyze CO 3**
Module-4		
Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory	8	**Analyze CO 3**
Module-5		

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision, NLP, Speech.	8	**Analyze CO 3**

COs	Statement	Bloom's Cognitive Level	POs/PSOs
25MCS223.1	Illustrate the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.	L2	1, 2, 3
25MCS223.2	Apply deep learning models using Regularization techniques and illustrate the learning processes.	L3	1, 2, 3
25MCS223.3	Analyze deep learning models using convolutional operations.	L4	1, 2, 3
25MCS223.4	Analyze sequential data to build recurrent and recursive models.	L4	1, 2, 3
25MCS223.5	Analyze performance metrics of Deep Learning Techniques and solve real-world problems.	L4	1, 2, 3

Text Books

1. Zhang, Aston, et al. "Dive into deep learning." arXiv preprint arXiv:2106.11342 (2021).
2. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016. https://www.deeplearningbook.org/lecture_slides.html

Reference Books

1. Balas, Valentina Emilia, et al., eds. Handbook of deep learning applications. Vol. 136. New York: Springer, 2019.

Web links and Video Lectures (if any)

https://www.coursera.org/learn/neural-networks-deep-learning
https://onlinecourses.nptel.ac.in/noc20_cs62/preview
https://www.youtube.com/watch?v=VyWAvY2CF9c
https://www.youtube.com/watch?v=7sB052Pz0sQ
https://www.youtube.com/watch?v=Mubj_fqiAv8

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks ● Average of 2 tests = 15 Marks	15
		AAT-Quiz, Presentations, Term Paper, Open-ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses	10
	Lab Program	Weekly Assessment	10
		IA test	15

	Assessment		
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions.	**50**
		Total marks for the Course	**100**

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: II

COURSE NAME: SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

Course Code: 25MCS224	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Define the fundamentals of Operating Systems.
2	Explain distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
3	Illustrate distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
4	Identify the components and management aspects of Real time, Mobile operating Systems

Module 1	**BLL, CO**	**Teaching Hrs.**
Patterns: What is a Pattern? What Makes a Pattern? Pattern Categories, Relationships between Patterns, Pattern Description, Patterns and Software Architecture**.**	**Understand CO1**	**08**
Module 2		
Architectural Patterns: Introduction, From Mud to Structure, Layers, Pipes and Filters, Distributed Systems, Broker-Structure and dynamics basics, Interactive Systems, Model-View- Controller. Presentation-Abstraction-Control.	**Apply CO2**	**08**
Module 3		
Design Patterns: Introduction, Structural Decomposition, Whole-Part, Access Control, Proxy, Management, Command Processor, View Handler, Communication, Forwarder-Receiver, Client- Dispatcher-Server, Publisher-Subscriber.	**Apply CO2**	**08**
Module 4		
Idioms: Introduction, What Can Idioms Provide? Idioms and Style, Where Can You Find Idioms? Counted Pointer - Case study**.** **Pattern Systems:** What is a Pattern System? Pattern Classification, Pattern Selection, Pattern Systems as Implementation Guidelines.	**Apply CO3**	**08**
Module 5		
Patterns and Software Architecture: Introduction, Patterns in Software Architecture, Enabling Techniques for Software Architecture, Non-functional Properties of Software Architecture. **The Pattern Community:** The Roots, Leading Figures and their Work, The Community	**Analyze CO3**	**08**

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS224.1	Comprehend patterns for software architecture, system architecture Skelton, design pattern, Catalog, pattern systems and community	Understanding
25MCS224.2	Interpret architectural patterns, designs patterns, Idioms, software architecture, organizing patterns into pattern systems.	Applying
25MCS224.3	Identify design patterns, architectural patterns and software architectural style.	Applying
25MCS224.4	Demonstrate architectural patterns, design pattern concepts, pattern systems and software architecture.	Applying

Textbooks

1. Pattern-Oriented Software Architecture: A System of Patterns, by Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Summerland and Michael Stal, Volume 1, Wiley series in Software Design Patterns.Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2014.

Reference Books

1. Software Architecture Patterns by Mark Richards, O'Reilly, February 2015.
2. Software Architecture in Practice (3rd edition), by Len Bass, Paul Clements, and Rick Kazman, Addison-Wesley, 2012.
3. Design Patterns: Elements of Reusable Object-Oriented Software, by Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Addison-Wesley, 1995.

e- Books:

https://pdfroom.com/books/pattern-oriented-software-architecture-a-system-of-patterns-volume-1pdf/jN2R0aDodvW

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

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M.Tech Semester: II

Course Name: Ethical Hacking

Course Code: 25MCS2251	**L: T: P: J 3:0:0:0**	**CIA Marks: 50**
Credits:	**3**	**SEA Marks: 50**
Hours/Week (Total)	**3 (40)**	**SEA Duration: 03 Hours**

Course Learning Objectives: The students will be able to

1	Learn the Fundamentals of computer networking. TCP/IP protocol stack.
2	Be familiar with the Installation of attacker and victim system.
3	Be exposed to Cryptographic hash functions
4	Understand the Social engineering attacks and Denial of service attack techniques.

Module-1	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack. IP addressing and routing. TCP and UDP. IP subnets**.** Routing protocols. IP version 6**.**	8	L3 (Apply)
Module-2		
Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, who is, host, dig, dnsenum and NMAP tool. Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.	8	L3 (Apply)
Module-3		
Introduction to cryptography, private-key encryption, public-key encryption. Cryptographic hash functions, digital signature and certificate, applications**.**	8	L4 (Analyze)
Module-4		
Steganography, biometric authentication, network-based attacks, DNS and Email security. Packet sniffing using wireshark and burpsuite, password attack using burp suite. Social engineering attacks and Denial of service attacks	8	L4 (Analyze)
Module-5		
Elements of hardware security: side-channel attacks, physical inclinable functions, hardware trojans. Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution, etc. Attack on web servers: password attack, SQL injection, cross site scripting. Case studies: various attacks scenarios and their remedies.	8	L4 (Analyze)

Course Outcomes: After completing the course, the students will be able to	
25MCS2251.1	Apply the ethical hacking fundamentals.
25MCS2251.2	Utilize the fundamentals to create a secure hacking environment. System Hacking.
25MCS2251.3	Analyze the Cryptographic hash functions.
25MCS2251.4	Analyze and deploy Wireshark and burpsuite, password attack using burp suite
25MCS2251.5	Analyze the various attacks scenarios and their remedies.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	Activity	NPTEL Ethical Hacking Course Certificate	20
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

Additional Assessment Tools (AAT) – Quiz, Presentations, Term Paper, Open ended experiments, Mini Projects, Two-minute video on latest topic, Short MOOC courses

Text Books

1. Data and Computer Communications -- W. Stallings.
2. Data Communication and Networking -- B. A. Forouzan
3. TCP/IP Protocol Suite -- B. A. Forouzan
4. UNIX Network Programming -- W. R. Stallings

Reference Books

1. Introduction to Computer Networks and Cybersecurity -- C-H. Wu and J. D. Irwin
2. Cryptography and Network Security: Principles and Practice -- W. Stallings

BNM Institute Of Technology
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Dept. of Computer Science &Engineering

M.Tech Semester: II

Course Name: Industrial Internet of Things **Course Code: 25MCS2252**

L:T:P:J	**3: 0:0:0**	**CIA Marks:**50
Credits:	**3**	**SEA Marks:**50
Hours/Week (Total)	**40**	**SEA Duration:**03Hours

Course Learning Objectives: The students will be able to

1	Explain the foundational concepts of sensing and actuation, communication and networking technologies, and the architecture and components of Industrial Internet of Things (IIoT) systems
2	Analyze Industrial IoT (IIoT) business models, interpret reference architectures, and describe the layered structure of IIoT systems—including sensing, processing, and communication layers.
3	Evaluate advanced IIoT communication and networking technologies, and apply fundamental concepts of big data analytics, machine learning, and software-defined networking
4	Utilize R and Julia for data analysis, manage industrial data using Hadoop, and apply concepts of software-defined networking, fog computing, and cybersecurity to IIoT systems.
5	Assess the application of Industrial IoT technologies across various domains and evaluate the role of emerging technologies such as UAVs, AR/VR, and real-world case studies in enhancing industrial operations.

Module-1	**No. of Hours**	**Blooms Cognitive Levels**
Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.	**8**	**Apply CO1**
Module-2		
IIoT-Introduction, Industrial IoT: Business Model and Reference Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II,IIoT Processing-Part I, Part II, IIoT Communication-Part I.	**8**	**Apply CO2**
Module-3		
Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III,Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II.	**8**	**Apply CO3**
Module-4		
R and Julia Programming, Data Management with Hadoop, Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II,Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT-Application Domains: Factories and Assembly Line, Food Industry.	**8**	**Apply CO4**
Module-5		
Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management, Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.	**8**	**Apply CO5**

Course Outcomes: After completing the course, the students will be able to	
25MCS2252.1	Analyze and design Industrial Internet of Things (IIoT) systems by understanding and applying key concepts of sensing, actuation, communication protocols, and networking architectures.
25MCS2252.2	Analyze Industrial Internet of Things (IIoT) architectures by understanding key business models, reference architectures, and functional layers.
25MCS2252.3	Evaluate and implement advanced Industrial IoT (IIoT) communication and networking strategies, and apply big data analytics and machine learning techniques for intelligent decision-making in IIoT environments using SDN.
25MCS2252.4	Develop and manage data-driven Industrial IoT (IIoT) applications using R and Julia programming, implement big data solutions with Hadoop, apply Software Defined Networking (SDN) in IIoT, and evaluate fog computing and security mechanisms.
25MCS2252.5	Analyze and evaluate the application of Industrial IoT (IIoT) technologies across diverse industrial domains and by exploring real-world case studies

Text Books
1) S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. Availability:https://www.amazon.in/Introduction-IoT-SudipMisra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1
Reference Books
1) S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press. Availability: https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid= 1627359971&sr=8-3 3) Research Papers 1.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 30 marks ● Average of 2 Tests = 30 Marks	30
	NPTEL Certificate+ AAT (Project, Assignment, Quiz, Presentation)	NPTEL Certificate course on Introduction to IOT Project	10 10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

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M. Tech Semester: II

Course Name: Social Network Analysis

Course Code: 25MCS2253	**L: T: P: J: 3:0:0:0**	**CIE Marks 50**
Credits:	**03**	**SEE Marks 50**
Hours/Week (Total)	**3 (40)**	**Exam Hours 3Hrs**

Credits 3

Course Learning Objectives: The students will be able to

1	Understand the basic Aspects of Networks, Central Themes
2	Learn the Strong and Weak Ties and Mechanisms Underlying Homophily
3	Understand the Reasoning about Behaviour in a Game, Best Responses and Dominant Strategies, Nash Equilibrium
4	Understand the Structure of the Web and Link Analysis and Web Search
5	Learn the Power Laws and Rich-Get-Richer Phenomena

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Overview: Aspects of Networks, Central Themes and Topics **Graphs** Basic Definitions, Paths and Connectivity, Distance and Breadth-First Search, Network Datasets: An Overview	08	**Understand**
Module-2		
Strong and Weak Ties: Triadic Closure, The Strength of Weak Ties, Tie Strength and Network Structure in Large-Scale Data, Tie Strength, Social Media, and Passive Engagement, Closure, Structural Holes, and Social Capital, Advanced Material: Betweenness Measures and Graph Partitioning**. Networks in their Surrounding Contexts:** Homophily, Mechanisms Underlying Homophily: Selection and Social Influence, Affiliation, Tracking Link Formation in On-Line Data, A Spatial Model of Segregation	08	**Apply**
Module-3		
Games: What is a Game? Reasoning about Behaviour in a Game, Best Responses and Dominant Strategies, Nash Equilibrium, Multiple Equilibria: Coordination Games, Multiple Equilibria: The Hawk-Dove Game. **Mixed Strategies:** Examples and Empirical Analysis, Pareto-Optimality and Social Optimality, Advanced Material: Dominated Strategies and Dynamic Games	08	**Apply**
Module-4		
The Structure of the Web: The World Wide Web, Information Networks, Hypertext, and Associative Memory, The Web as a Directed Graph, The Bow-Tie Structure of the Web, The Emergence of Web 2.0. **Link Analysis and Web Search:** Searching the Web: The Problem of Ranking, Link Analysis using Hubs and Authorities, PageRank, Applying Link Analysis in Modern Web Search, Applications beyond the Web, Advanced Material: Spectral Analysis, Random Walks, and Web Search	08	**Apply**
Module-5		

Power Laws and Rich-Get-Richer Phenomena: Popularity as a Network Phenomenon, Power Laws, Rich-Get-Richer Models, The Unpredictability of Rich-Get-Richer Effects, The Long Tail, The Effect of Search Tools and Recommendation Systems, Advanced Material: Analysis of Rich-Get-Richer Processes. **Applications of Social Networks:** Fraud, Crime, terrorism etc.	08	**Apply**

COs	Statement	Bloom's Cognitive level	POs/ PSOs
25MCS2253.1	Explore notation and terminology used in Social Networks	APPLY	
25MCS2253.2	Analyse basic principles behind Social Network analysis algorithms	APPLY	
25MCS2253.3	Design applications like web search using algorithms of social networks	APPLY	
25MCS2253.4	Apply social networks on real world applications	APPLY	

Text Books

1. David Easley and John Kleinberg. "Networks, Crowds, and Markets: Reasoning About a Highly Connected World." Cambridge University Press 2010. ISBN: 978-05211953311.
2. Stanley Wasserman and Katherine Faust. "Social Network Analysis. Methods and Applications." Cambridge University Press, 1994. ISBN: 978-0521387071
3. Eric Kolaczyk, Gabor Csardi, " Statistical Analysis of Network Data with R", Springer, 2014. ISBN: 978-1-4939-0983-4
4. Newman, Mark, "Networks", Oxford university press, 2018. ISBN:978-0199206650

BNM Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

M. Tech Semester: II

Course Name: Wireless and Ad-hoc Networks

Course Code: 25MCS2254	**L: T: P: J: 4:0:0:0**	**CIE Marks 50**
Credits: 4		**SEE Marks 50**
Hours/Week (Total)	**4**	**Exam Hours 3Hrs**

Credits 4

Course Learning Objectives: The students will be able to

1	Explain fundamental principles of Ad-hoc Networks.
2	Discuss a comprehensive understanding of Ad-hoc network protocols.
3	Outline current and emerging trends in Ad-hoc Wireless Networks.
4	Analyze energy management in ad-hoc wireless networks.

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas.	10	**CO1**
Module-2		
Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.	10	**CO2**
Module-3		
Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.	10	**CO3**
Module-4		
Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks.	10	**CO4**
Module-5		

Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.	10	**CO5**

COs	Statement	Bloom's Cognitive level	POs/PSOs
25MCS2254.1	Construct their own wireless network.	Apply	1,2,3,12/1,3
25MCS2254.2	Evaluate the existing network and improve its quality of service.	Apply	1,2,3,12/1,3
25MCS2254.3	Choose appropriate protocol for various applications.	Apply	1,2,3,12/1,3
25MCS2254.4	Examine security measures present at different level.	Apply	1,2,3,12/1,3
25MCS2254.5	Interpret energy consumption and management.	Apply	1,2,3,12/1,3

Text Books

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011

Reference Books

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks ● Average of two tests – scaled down to 25 Marks	25
		AAT	25
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions.	**50**
		Total marks for the Course	**100**

BNM Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: II

Course Name: Advanced Web Technologies		**Course Code: 25MCS2261**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand and apply modern frontend technologies such as React.js or Angular to build interactive user interfaces.
2	Design and implement secure RESTful APIs using backend frameworks like Node.js and Express.
3	Integrate frontend and backend components to build dynamic full stack applications.
4	Employ real-time web technologies and advanced web features such as WebSockets, GraphQL, and PWAs.
5	Implement DevOps practices including containerization, CI/CD pipelines, and cloud deployment of web applications.

Module-1: Modern Front Development	**No. of Hours**	**Blooms cognitive Levels with CO mapping**
Introduction to Single Page Application (SPA), Modern JavaScript (ES6+ Features: Arrow Functions, Promises, Async/wait, Modules), Introduction to React JS/Angular: Components, Props/Inputs, State, Events, React Hooks/Angular Directives, Routing(React/Angular Router), Component Lifecycle and performance optimization.	**8**	**Apply CO1**
Sample Programs: Build a SPA with routing and state management.		
Module-2: Backend with Node.js and Express.js		
Introduction to Server-side JavaScript with Node.js, Express.js fundamentals: routing, middleware, templating, RESTful APIs: GET, POST, PUT, DELETE, connecting to databases: MongoDB / MySQL, Authentication using JWT / Sessions.	**8**	**Apply CO2**
Sample Programs: Develop a REST API with Express + MongoDB		
Module-3: Full Stack Integration		
Connecting frontend (React/Angular) with backend (Express.js), State management using Context API or Redux, Asynchronous communication with Axios / Fetch API, Deployment-ready build and environmental configuration.	**8**	**Analyze CO3**
Sample Programs: Create a Full Stack CRUD App (MERN Stack suggested).		
Module-4: Advanced Topics in Web Technologies		
WebSocket's and real-time applications (chat, notifications), GraphQL vs REST, Progressive Web Apps (PWA) – service workers, offline support Web security: Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), HTTPS, CORS, Secure Headers.	**8**	**Apply CO4**
Sample Programs: Real-time chat app with Socket.IO		

Module-5: DevOps, Testing & Deployment		
Introduction to CI/CD pipelines, Containerization with Docker, Deployment to cloud platforms: Vercel, Netlify, Heroku, or AWS, Testing basics: Unit testing (Jest/Mocha), API testing (Postman), Performance tuning & analytics	**8**	**Apply CO5**
Sample Programs: Dockerize and deploy a full stack app with CI/CD basics.		

Course Outcomes: After completing the course, the students will be able to	
23CSE1723.1	Design and develop single-page applications using modern frontend frameworks.
23CSE1723.2	Build scalable and secure backend services using Node.js and Express.js.
23CSE1723.3	Connect frontend and backend for full-stack development.
23CSE1723.4	Implement real-time features and secure authentication mechanisms.
23CSE1723.5	Deploy full stack applications with containerization and CI/CD practices.

Textbooks

1. Learning React by Alex Banks and Eve Porcello, O'Reilly Media.
2. Node.js Design Patterns by Mario Casciaro, Packt Publishing.
3. MDN Web Docs, React.js Docs, Express.js Docs.

Reference Books

1. Anthony Accomazzo, Nate Murray, Ari Lerner, "Fullstack React: The Complete Guide to ReactJS and Friends" FullStack.io publisher.
2. Kristina Chodorow, "MongoDB: The Definitive Guide", O'Reilly Media publisher.
3. Nigel Poulton, "Docker Deep Dive", Leanpub publisher.

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 3 ● Each Theory test will be conducted for 30 marks ● Average of 3 tests = 30 Marks	30
	AAT	Presentation / Demonstration of mini project	20
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions	**50**
		Total marks for the Course	**100**

BNM Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

M. Tech Semester: II

Course Name: Automation Testing (Selenium with Java)

Course Code: 25MCS2262	**L: T: P: J: 3:0:0:0**	**CIE Marks 50**
Credits:	**03**	**SEE Marks 50**
Hours/Week (Total)	**3 (40)**	**Exam Hours 3Hrs**

Credits 3

Course Learning Objectives: The students will be able to

1	Understand the fundamental criteria for test cases.
2	Learn about the test management and test automation techniques.
3	Apply test metrics and measurements in the real world scenario.
4	Design of test cases.

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
The Value of Test Automation: Why Do We Need Test Automation? From Waterfall to Agile Software Development The Cost of Software Complexity Refactoring Continuous **Improvement From Manual to Automated Testing:** First Attempt: Record and Playback Getting the Most Out of Test Automation Differences Between Manual and Automated Tests **People and Tools:** Choosing the Right Tools Who Should Write the Tests? The Variety of Tools	08	**Understand**
Module-2		
Reaching Full Coverage: How Do You Measure Coverage? Gaining Value Before Reaching Full Coverage What Do We Do When We Have Full Coverage? How Do We Get to 100% Coverage? Reversing the Wheel My Road Map to Successful Automation Project **Business Processes:** Running the Tests on Regular Basis Handling Bugs That Are Found by the Automation Continuous Integration Acceptance Test Driven Development (ATDD)Continuous Delivery and Continuous Deployment	08	**Apply**
Module-3		
Preparing for the Tutorial: Prerequisites and Presumptions Applicability of the Process or Existing Test Automation Systems Overview of the Process Getting to Know the SUT Preparing the Environment for the Tutorial Using Git Through Visual Studio **Test Automation and Architecture:** Test Architecture Considerations Understanding the SUT Architecture Alternatives and Considerations in a Layered Architecture Real-World Architecture **Isolation and Test Environments:** Isolation Problems and Solutions Isolation Techniques **The Big Picture:** The Relationships Between Software Architecture and Business Structure The Relationships Between Software Architecture and Organizational Structure with Test Automation	08	**Apply**
Module-4		
Designing the First Test Case : Choosing the First Test to Automate The Scientific Method for Designing a Test Case	08	**Apply**

Start Coding the First Test: Creating the Project Write the Pseudo-code Getting the Code to Compile Model Code Review **Completing the First Test:** Running the Test to Find What to Implement First Adding Selenium to the Project Implementing the MVC Forum Client Constructor Implementing Register New User AND Login Hitting the Isolation Problem Implementing Create Discussion and Analysing the Failure Completing the Test **Investigating Failures:** Integrating with Latest Version of MVC Forum Improving the Error Reporting Logging and Other Evidence Collection Adding Nested Visual Logger to MVC Forum Tests Investigating Challenging Failures		
Module-5		
Adding More Tests: Writing the Next Tests Making Additional Improvements Supporting Multiple Users and Browsers Additional Improvement Opportunities Adding More Tests **Continuous Integration:** Is It Really Necessary? Creating the Test Build Process Changing the Development Processes and Culture Decreasing the Test Run Duration Covering a Broader Matrix **Acceptance Test Driven Development:** Overview on ATDD Being More Agile. The Process Using the Acceptance Tests as Documentation Introducing ATDD in an Existing Project	08	**Apply**

COs	Statement	Bloom's Cognitive level	POs/ PSOs
25MCS2262.1	Understand the concepts of software testing.	UNDERSTAND	
25MCS2262.2	Illustrate basic framework used in automation testing.	APPLY	
25MCS2262.3	Identify functionality and usage of various tools in automation testing.	APPLY	
25MCS2262.4	Analyze applications of automation testing in real time scenario.	APPLY	
25MCS2262.5	Design a use case in automation testing using Selenium	APPLY	

Text Books

Textbooks:

1. Arnon Axelrod, "Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects", APress,2018.

References:

1. Mark Fewster, Dorothy Graham, "Software Test Automation: Software Test Automation", Addison-Wesley, 1999.
2. Bruce A. Posey and Daniel Mosley,"Just Enough Software Test Automation", Prentice Hall PTR, 2002.

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: III

COURSE NAME: DevOps and Cloud Infrastructure

Course Code: 25MCS2264	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To introduce DevOps principles and practices in modern software engineering.
2	To understand the architecture and deployment of applications using cloud computing.
3	To implement Continuous Integration and Continuous Deployment (CI/CD) pipelines.
4	To manage infrastructure using Infrastructure as Code (IaC) on cloud platforms.
5	To monitor, scale, and secure cloud-native applications

Module 1	**BLL, CO**	**Teaching Hrs.**
DevOps Fundamentals: Introduction to DevOps: Culture, Principles, Lifecycle, Agile vs DevOps, Version Control Systems: Git, GitHub/GitLab, DevOps Toolchain Overview, DevOps Metrics (Lead Time, Deployment Frequency, MTTR, etc.)	**Understand CO1**	**10**
Module 2		
Cloud Computing Essentials: Cloud Architecture and Service Models (IaaS, PaaS, SaaS), Overview of Public Cloud Providers: AWS, Azure, GCP, Cloud Storage, Networking, and Security Concepts, Cloud Deployment Models: Public, Private, Hybrid, Multi-cloud, Hands-on: Launching Instances and Deploying Simple Apps in Cloud	**Apply CO2**	**10**
Module 3		
CI/CD Pipelines: CI/CD Concepts and Workflow, Tools: Jenkins, GitHub Actions, GitLab CI, Integration with Cloud Services, Build Automation Tools: Maven, Gradle, Deployment Automation, Hands-on: Setting up a CI/CD pipeline for a sample app.	**Apply CO2**	**10**
Module 4		
Containerization and Infrastructure as Code (IaC): Introduction to Containers: Docker, Images, Volumes, Networking, Docker Compose for Multi-container Applications, Introduction to Kubernetes: Pods, Services, Deployments, Infrastructure as Code: Terraform, AWS CloudFormation Basics, Hands-on: Containerize and Deploy on Kubernetes (minikube/cloud).	**Apply CO3**	**10**
Module 5		
Monitoring, Observability & Security: Monitoring Tools: Prometheus, Grafana, Cloud-native logging tools (CloudWatch, Stackdriver), Log Management using ELK Stack, Introduction to	**Analyze CO3**	**10**

DevSecOps, Cloud Security Best Practices, Secrets Management and Identity Management (IAM), Hands-on: Basic Monitoring & Alerting for a Cloud App.		

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS2264.1	Explain the principles and practices of DevOps and its benefits in software delivery.	Understanding
25MCS2264.2	Demonstrate cloud deployment and integration of services using major cloud platforms	Applying
25MCS2264.3	Design and implement CI/CD pipelines for cloud-based applications..	Applying
25MCS2264.4	Deploy and manage containerized applications using Docker and Kubernetes.	Applying
25MCS2264.5	Monitor and secure DevOps workflows in cloud environments.	Applying

Textbooks

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations" By Gene Kim, Patrick Debois, John Willis, and Jez Humble
2. "Cloud Computing: Concepts, Technology & Architecture" By Thomas Erl (Covers foundational cloud concepts and cloud service models)

Reference Books

1. "Terraform: Up & Running" by Yevgeniy Brikman
2. "Kubernetes Up & Running" by Brendan Burns, Joe Beda, Kelsey Hightower
3. "Learning Docker" by Pethuru Raj, Jeeva S. Chelladhurai

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: III

COURSE NAME: CYBER SECURITY AND DIGITAL FORENSICS

Course Code: 25MCS231	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To summarize the concepts of cyber forensics and its applications in different contexts.
2	To investigate incidents and areas affected due to cybercrime.
3	To illustrate tools used in cyber forensic
4	To infer legal perspectives in cyber security
5	To apply the policies, security standards, and IPR issues on a cybercrime incident.

Module 1	**BLL, CO**	**Teaching Hrs.**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyber offenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.	**Understand CO1**	**10**
Module 2		
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security, Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	**Apply CO2**	**10**
Module 3		
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).	**Understand CO3**	**10**
Module 4		
Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics	**Understand CO4**	**10**

Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.		
Module 5		
Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of 20082020 / 23 Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.	**Understand CO4**	**10**

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS231.1	Identify the proliferations of cybercrime in various computing systems orchestrated by cyber criminals/attackers	Understanding
25MCS231.2	Analyze the influence cyber-forensics in investigating the given cybercrime	Applying
25MCS231.3	Infer legal issues and socio-economic impact due to cybercrime.	Understanding
25MCS231.4	Examine relevant network defense / web application tool to solve given cyber security problem.	Understanding

Textbooks:

1. Sunit Belapure, Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Wiley India Pvt Ltd 2013
2. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Introduction to information security and cyber laws, Dreamtech Press 2015

References:

1. Thomas J. Mowbray, Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions John Wiley & Sons 2013
2. James Graham, Ryan Olson, Rick Howard , Cyber Security Essentials CRC Press 2010

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: III

COURSE NAME: SOFTWARE DEFINED NETWORKS

Course Code: 25MCS232	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the basic knowledge of software defined networks.
2	Learn about the basics of Open flow protocols.
3	Apply the concept of software defined network in the advance trends.

Module 1	**BLL, CO**	**Teaching Hrs.**
Introduction: Significance and Scope of the course, Importance of the course in societal, political and economic growth of the nation, Impact of the course on societal and ethical issues and career perspective. Implication and Scope of Software defined networking in connecting device and how it is changing the way communications networks are managed, maintained, and secured. Impact of the course on current Innovations and Research trends. **Basic Packet-Switching Terminology:** The Modern Data Center- Traditional Switch Architecture- Autonomous and Dynamic Forwarding Tables- Evolution of Switches and Control Planes- Cost- SDN Implications for Research and Innovation- Data Center Innovation.	**Understand CO1**	**10**
Module 2		
The Evolution of Networking Technology- Forerunners of SDN - Software Defined Networking OpenFlow- Sustaining SDN Interoperability- Network Virtualization- Fundamental Characteristics of SDN- SDN Operation- SDN Devices- SDN Controller- SDN Applications- Alternate SDN Methods.	**Apply CO2**	**10**
Module 3		
OpenFlow Overview: OpenFlow 1.0 and OpenFlow Basics-OpenFlow 1.1 Additions- OpenFlow 1.2 Additions- OpenFlow 1.3 Additions- OpenFlow Limitations- Potential Drawbacks of Open SDN- SDN via APIs- DN via Hypervisor-Based Overlays- SDN via Opening Up the Device- Network Functions Virtualization- Alternatives Overlap and Ranking. **SDN in the Data Center:** Data Center Demands- Tunneling Technologies for the Data Center- Path Technologies in the Data Center- Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center.	**Apply CO2**	**10**

Module 4		
Open SDN versus Overlays in the Data Center: Real-World Data Center- SDN in Other Environments- Wide Area Networks- Service Provider and Carrier Networks- Campus Networks- Hospitality Networks- Mobile Networks- Optical Networks	**Apply CO3**	**10**
Module 5		
Software Defined Networking For Internet-Of-Things: Why SDN for the IoT? –SDN Simplicity for the IoT-SDN architecture for IoT - SDN—Scalability for the IoT-SDN Traffic Flow Optimization for the IoT-Security and Connectivity- The Telco Role Amazon Web Services for IoT.	**Analyze CO3**	**10**

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS232.1	Summarize the simple switching architecture and components	Understanding
25MCS232.2	Illustrate basic framework used in open flow switch ..	Apply
25MCS232.3	Identify functionality and usage of various protocols in open flow architecture.	Understanding
25MCS232.4	Analyze applications of SDN in data centre..	Analyze
25MCS232.5	Infer architecture of SDN that will be used in IOT.	Analyze

Textbooks:

1. Paul Göransson, Chuck Black, Software Defined Networks A Comprehensive Approach, Elsevier,2014.
2. By Perry Lea, Internet of Things for Architects: Architecting IoT solutions , Packet publishing 2018.
3. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Publisher: Addison-Wesley 2015 ISBN: 9780134175393.

References:

1. Paul Goransson, Chuck Black, Software Defined Networks: A Comprehensive Approach, 1st Edition, MK
2. Thomas D. Nadeau, SDN: Software Defined Networks, 1st Edition, Oreilly.

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

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Dept. of Computer Science and Engineering

M. Tech Semester: III

Course Name: AUGMENTED AND VIRTUAL REALITY

Course Code: 25MCS2341	**L: T: P: J: 3:0:0:0**	**CIE Marks 50**
Credits:	**03**	**SEE Marks 50**
Hours/Week (Total)	**3 (40)**	**Exam Hours 3Hrs**

Credits 3/4

Course Learning Objectives: The students will be able to

1	Describe how VR systems work and list the applications of VR.
2	Understand the design and implementation of the hardware that enables VR systems tobe built.
3	Understand the system of human vision and its implication on perception and rendering.
4	Explain the concepts of motion and tracking in VR systems
5	Develop a game or short film to understand/implement all the concepts learnt

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality **Case Studies:** Study the use of Virtual Reality at NASA	8	**Apply**
Module-2		
Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR **Case Studies** GHOST (General Haptics Open Software Toolkit) software development toolkit.	8	**Apply**
Module-3		
Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR. **Case Studies:** Sweeping coverage of eye movements	8	**Apply**
Module-4		
Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates **Case Studies:** Automatic stitching of panoramas in Virtual Reality	8	**Apply**
Module-5		
Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking-Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies **Case Studies:**	8	**Apply**

A virtual Study Use Case- NICE, An Educational Experience		
Laboratory Component: 1) Create a 3D object and Apply different geometric Transformations using Mouse/Keyboard 2) Create animation for a 3D object (transformation, color, texture, etc.) 3) Bouncing ball on multiple 2D/3D platforms 4) Develop First Person Controller to a Scene 5) Create a 3D Character movement 6) Create a menu driven interface for adding and removing objects from a Scene 7) Build a cubic room, whose sides are made out of six planes. The room should be 15x15x15 Unity units. At the center of the roof of the room, place a point source of light. This light should change color by pressing the Tab key. 8) Finding target using 2D Ray-caster 9)Create a loading bar (health bar, progress bar, start bar) 10)Create and show motion effect using time scale and scripts for 2D images.		

COs	Statement	Bloom's Cognitive level	POs/PSOs
25MCS2341.1	Apply the concepts of VR systems work and list the applications of VR.	**Apply**	1, 5,12
25MCS2341.2	Design and implementation of the hardware that enables VR systems to be built.	**Apply**	1, 5,12
25MCS2341.3	Implement the system of human vision and its implication on perception and rendering.	**Apply**	1, 2, 3, 4, 5, 6
25MCS2341.4	Apply the concepts of motion and tracking in VR systems	**Apply**	1, 2, 3, 4, 5, 6, 8 10,12
25MCS2341.5	Develop a game or short film to understand/implement all the concepts learnt	**Apply**	1,2,3,4,5,6,8,9, 10,12

Text Books

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

Web links and Video Lectures (if any)

e-Books:

http://lavalle.pl/vr/book.html

MOOC Courses:

https://nptel.ac.in/courses/106/106/106106138/

https://www.coursera.org/learn/introduction-virtual-reality

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks ● Average of 2 tests = 15 Marks	15
		AAT	10
	Lab Program Assessment	Weekly Assessment	10
		IA test	15
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions.	**50**
		Total marks for the Course	**100**

B N M Institute of Technology

Dept. of Computer Science and Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

M. Tech Semester: III

COURSE NAME: Foundation for Cloud IoT and Edged ML

Course Code: 25MCS2342	**L: T:P: J: 3:0:0:0**	**CIE Marks:** 50
Credits:	3	**SEE Marks:** 50
Hours:	50	**SEE Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	To introduce DevOps principles and practices in modern software engineering.
2	To understand the architecture and deployment of applications using cloud computing.
3	To implement Continuous Integration and Continuous Deployment (CI/CD) pipelines.
4	To manage infrastructure using Infrastructure as Code (IaC) on cloud platforms.
5	To monitor, scale, and secure cloud-native applications

Module 1	**BLL, CO**	**Teaching Hrs.**
DevOps Fundamentals: Introduction to DevOps: Culture, Principles, Lifecycle, Agile vs DevOps, Version Control Systems: Git, GitHub/GitLab, DevOps Toolchain Overview, DevOps Metrics (Lead Time, Deployment Frequency, MTTR, etc.)	**Understand CO1**	**10**
Module 2		
Cloud Computing Essentials: Cloud Architecture and Service Models (IaaS, PaaS, SaaS), Overview of Public Cloud Providers: AWS, Azure, GCP, Cloud Storage, Networking, and Security Concepts, Cloud Deployment Models: Public, Private, Hybrid, Multi-cloud, Hands-on: Launching Instances and Deploying Simple Apps in Cloud	**Apply CO2**	**10**
Module 3		
CI/CD Pipelines: CI/CD Concepts and Workflow, Tools: Jenkins, GitHub Actions, GitLab CI, Integration with Cloud Services, Build Automation Tools: Maven, Gradle, Deployment Automation, Hands-on: Setting up a CI/CD pipeline for a sample app.	**Apply CO2**	**10**
Module 4		
Containerization and Infrastructure as Code (IaC): Introduction to Containers: Docker, Images, Volumes, Networking, Docker Compose for Multi-container Applications, Introduction to Kubernetes: Pods, Services, Deployments, Infrastructure as Code: Terraform, AWS CloudFormation Basics, Hands-on: Containerize and Deploy on Kubernetes (minikube/cloud).	**Apply CO3**	**10**
Module 5		
Monitoring, Observability & Security: Monitoring Tools: Prometheus, Grafana, Cloud-native logging tools (CloudWatch, Stackdriver), Log Management using ELK Stack, Introduction to DevSecOps, Cloud Security Best Practices, Secrets Management and	**Analyze CO3**	**10**

Identity Management (IAM), Hands-on: Basic Monitoring & Alerting for a Cloud App.		

CO. No	Course Outcome: After completing the course, the students will be able to	Blooms Level
25MCS2342.1	Explain the principles and practices of DevOps and its benefits in software delivery.	Understanding
25MCS2342.2	Demonstrate cloud deployment and integration of services using major cloud platforms	Applying
25MCS2342.3	Design and implement CI/CD pipelines for cloud-based applications..	Applying
25MCS2342.4	Deploy and manage containerized applications using Docker and Kubernetes.	Applying
25MCS2342.5	Monitor and secure DevOps workflows in cloud environments.	Applying

Textbooks

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations" By Gene Kim, Patrick Debois, John Willis, and Jez Humble
2. "Cloud Computing: Concepts, Technology & Architecture" By Thomas Erl (Covers foundational cloud concepts and cloud service models)

Reference Books

1. "Terraform: Up & Running" by Yevgeniy Brikman
2. "Kubernetes Up & Running" by Brendan Burns, Joe Beda, Kelsey Hightower
3. "Learning Docker" by Pethuru Raj, Jeeva S. Chelladhurai

Marks Distribution for Assessment:

CIA (50)	Component	Description	Marks
	Test	● Total Number of Test: 2 [Each test will be conducted for 50 marks and scaled down to 30 Marks] ● Average of 2 tests = 30 Marks	30
	Assignment	Presentations	10
	AAT	QUIZ	10
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Theory Exam	Exam will be conducted for 100 marks and scaled down to 50 Marks	**50**
		Total marks for the Course	**100**

BNM Institute of Technology

Dept. of Computer Science and Engineering

Choice Based Credit System (CBCS and Outcome Based Education (OBE)

Semester: III

Course Name: Robotic Process Automation		**Course Code: 23MCS2343**
L: T: P: J	2:0:2:0	**CIA Marks:** 50
Credits:	**3**	**SEA Marks:** 50
Hours/Week (Total)	**4**	**SEA Duration:** 03 Hours

Course Learning Objectives: The students will be able to

1	Understand the purpose and benefits of Robotic Process Automation.
2	Learn the creation of process flows using RPA platforms.
3	Describe the various types of Sequence and Control flow.
4	Create software bots for automating tasks.
5	Apply the concepts of RPA for developing various application bots.

Module-1: Introduction to RPA	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
What is RPA, History of RPA, Scope and Benefits, Components of RPA, RPA Platforms- The future of automation, Record and Play, Downloading and installing UiPath Studio, Working with UiPath Studio, Task Recorder, Applications of RPA	**8**	**Understand CO1**
Sample Programs: Program to Reversing a String		
Module-2: Working with RPA Studio		
The User Interface, Variables - Managing Variables, Collections, Data Types, The Arguments Panel - Using Arguments -, Types of workflows/files, File operation with step-by-step example-CSV/Excel – Creating message boxes, Reading and writing data to applications.	**8**	**Apply CO2**
Sample Programs: Creation of Message boxes and Assigning activities.		
Module-3: RPA Workflows		
Sequencing the workflow Activities-Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation exercises.	**8**	**Apply CO3**
Sample Programs: Programs using Control Flow statements – If – For – Whiles.		
Module-4: Automation and Control		
Finding and attaching windows, Act on controls - mouse and keyboard activities - Performing automation tasks – Act on controls - mouse and keyboard activities, Exercises involving automating actions involving keyboard and mouse controls.	**8**	**Apply CO4**
Sample Programs: Automating the Window Controls. Automating Mouse and Keyboard controls. Moving Files from Source to Destination.		

Module-5: Advanced Automation Activities		
Data Scrapping and Screen Scrapping, When to use OCR, Types of OCR available, How to use OCR, Scraping advanced techniques - Selectors - Defining and Assessing Selectors – Automation tasks with PDFs and Data tables – Web Scrapping and Extraction – Exercises involving OCR activity and Web scrapping.	**8**	**Apply CO5**
Sample Programs: Web Scrapping. Screen scrapping of Google Contacts. Message Automation.		

Course Outcomes: After completing the course, the students will be able to	
23MCS2343.1	Understand the basic concepts and platforms of RPA.
23MCS2343.2	Experiment with RPA platforms and build activities.
23MCS2343.3	Construct RPA workflows and perform data manipulation.
23MCS2343.4	Apply various Screen control techniques to automate screen activities.
23MCS2343.5	Build software bots to perform advanced automation tasks.

Textbooks

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant
3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

Marks Distribution for Assessment:

CIA	**Component**	**Description**	**Marks**
50	Test	Total Number of Test: 2 Each Theory test will be conducted for 30 Marks Average of 2 tests = 30 Marks	30
	Weekly Assignment	Lab Record	10
		Performance	5
		Viva	5
		Total Marks	**50**
SEA	**Component**	**Description**	**Marks**
50	Theory Exam	5 Questions to answer of 20 Marks (6M * 5= 30M) 2 Questions from each module with internal choice. Student should answer one full question from each module.	30
	Execution Part	Writeup – 20 Marks Conduction – 40 Marks Viva Voce – 10 Marks	70
		Total marks for the Course	**100**

BNM Institute of Technology

An Autonomous Institution under VTU

Dept. of Computer Science and Engineering

M. Tech Semester: III

Course Name: PROCESS MINING

Course Code: 25MCS2344	**L: T: P: J: 3:0:0:0**	**CIE Marks 50**
Credits:	**03**	**SEE Marks 50**
Hours/Week (Total)	**3 (40)**	**Exam Hours 3Hrs**

Credits 3

Course Learning Objectives: The students will be able to

1	Use Fluxicon Disco to analyze event log data, identify process patterns, and explain how process mining differs from data mining in practical scenarios.
2	Construct process models using Petri nets and apply the Alpha algorithm on event logs, demonstrating the ability to discover workflows with process mining tools.
3	Develop BPMN diagrams and causal nets from event logs, applying quality criteria to evaluate and annotate discovered process models
4	Perform conformance checking on event data to identify discrepancies between real and modeled processes and analyze deviations effectively.
5	Mine decision points, bottlenecks, and social networks, and integrate various process mining perspectives to generate holistic process insights.

Module-1	**No. of Hours**	**Blooms Cognitive Levels with CO mapping**
Process Mining: Data Science in Action: Data Science and Big Data, Different Types of Process Mining, How Process Mining Relates to Data Mining, Learning Decision Trees, Applying Decision Trees, Association Rule Learning, Cluster Analysis, Evaluating Mining Results, Introducing Fluxicon & Disco. Welcome to Process Mining: Data Science in Action, Process Mining: Data Science in Action Getting Started! ,How is Process Mining Different from Data Mining, Real-life Process Mining **Case Study:** Study of Real-life Process Mining through Fluxicon Disco and example scenarios	8	**Apply CO1**
Module-2		
Process Modeling and Discovery Techniques: Event Logs and Process Models, Petri Nets (1/2), Petri Nets (2/2), Transition Systems and Petri Net Properties, Workflow Nets and Soundness, Alpha Algorithm: A Process Discovery Algorithm, Alpha Algorithm: Limitations, Introducing ProM and Disco **Self-learning:** Using Event Data to Tear Down the Towers of Babel in Process Management	8	**Apply CO2**
Module-3		
Advanced Process Discovery and Modeling:Four Quality Criteria For Process Discovery, On The Representational Bias of Process Mining,	8	**Analyze CO3**

Business Process Model and Notation (BPMN), Dependency Graphs and Causal Nets, Learning Dependency Graphs, Learning Causal Nets and Annotating Them, Learning Transition Systems, Using Regions to Discover Concurrency Self-learning: Process Mining in the Large: Smart Data Scientists Are More Important Than Big Computers!!		
Module-4		
Process Discovery and Conformance Checking: Two-Phase Process Discovery and Its Limitations, Alternative Process Discovery Techniques, Introduction to Conformance Checking, Conformance Checking Using Causal Footprints, Conformance Checking Using Token-Based Replay, Token Based Replay: Some Examples, Aligning Observed and Modeled Behavior, Exploring Event Data **Self-learning:** Conformance Checking: Positive and Negative Deviants	8	**Apply CO4**
Module-5		
Advanced Perspectives in Process Mining: Mining Decision Points, Discovering Data Aware Petri Nets, Mining Bottlenecks, Mining Social Networks, Organizational Mining, Combining Different Perspectives, Comparative Process Mining Using Process Cubes, Refined Process Mining Framework **Self-learning:** Holistic Process Mining: Integrating Different Perspectives	8	**Apply CO5**

COs	Statement	Bloom's Cognitive level	POs/PSOs
25MCS2344.1	Apply process mining tools like Fluxicon Disco to analyze real-life event logs and differentiate process mining techniques from traditional data mining methods.	Apply	PO1, PO2, PO4, PO5
25MCS2344.2	Apply the Alpha algorithm and Petri nets to discover and model business processes from event logs using tools such as ProM and Disco.	Apply	PO1, PO2, PO4, PO5
25MCS2344.3	Analyze advanced process discovery methods, including BPMN and causal nets, to model and annotate complex process behaviors from event data.	Analyze	PO1, PO2, PO3, PO4, PO5, PO11
25MCS2344.4	Apply conformance checking techniques such as token-based replay and causal footprints to align observed behavior with process models and detect deviations.	Apply	PO1, PO2, PO4, PO5, PO11
25MCS2344.5	Apply advanced mining techniques to identify decision points, bottlenecks, and organizational structures, integrating multiple perspectives for comprehensive process analysis.	Apply	PO1, PO2, PO3, PO4, PO5, PO6, PO11

Text Books
1. **"Process Mining: Data Science in Action"**, Wil van der Aalst, Springer, 2016 (2nd edition)
Reference Books **1.** *Process Mining in Action: Principles, Use Cases and Outlook*, Lars Reinkemeyer,Springer International Publishing,2020, **ISBN-13:** 978-3030401740 2. **"Process Mining in Action: Principles, Use Cases and Outlook"**,Lars Reinkemeye , Springer, 2019
Web links and Video Lectures 1. https://www.coursera.org/learn/process-mining 2. https://www.celonis.com/ebook/process-mining-for-dummies

Marks Distribution for Assessment:

CIA (50)	**Component**	**Description**	**Marks**
	Written Test	● Total Number of Test: 2 ● Each Theory test will be conducted for 50 marks ● Average of 2 tests = 30 Marks	30
		AAT (MOOC course certificate)	20
		Total Marks	**50**
SEA (50)	**Component**	**Description**	**Marks**
	Written Exam	Theory exam will be conducted for 100 marks and scaled down to 50 Marks. The question paper will have 10 full questions each of 20 marks. Students have to answer 5 full questions.	**50**
		Total marks for the Course	**100**