Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, Thane (W)(Autonomous)

T.Y.B.Sc. (IT) 2026-27

	Semester V	Credits		Semester VI	Credits
Major (Mandatory)			**Major (Mandatory)**		
BSA501	Advanced Web Programming	2	BSS601	Security in Computing	2
BSAP502	Advanced Web Programming Practical	2	BSSP602	Security in Computing Practical	2
BSS503	Software Project Management	2	BSM603	Machine Learning	2
BSNSP504	Next Generation Technologies and Software project management Practical	2	BSMP604	Machine Learning Practical	2
BSI505	IKS: Indian Knowledge Systems in Information Technology	2	BSD605	DevOps	2
Major (Elective)			**Major (Elective)**		
BST506	Internet of Things	2	BSG606	Geographic Information System	2
BSTP507	Internet of Things Practical	2	BSGP607	Geographic Information System Practical	2
BSE508	Enterprise Java	2	BSC608	Cloud Computing	2
BSEP509	Enterprise Java Practical	2	BSCP609	Cloud Computing Practical	2
BSL510	Linux System Administration	2	BSE610	Exploratory Data Analysis	2
BSLP511	Linux System Administration Practical	2	BSEP611	Exploratory Data Analysis Practical	2
Minor		2	**Minor**		2
BSN512	Artificial Intelligence	2	BSB612	Business Intelligence	2
BSNP513	Artificial Intelligence Practical		BSBP613	Business Intelligence Practical	
VSC BSM514	MERN Practical	2	**SEC**	-	
OJT BSO515	Project Dissertation	2	BSP514	Project	4
	Total	**22**			**22**

Dr. Yogeshwari Patil
Department Coordinator

Prof. Heena Chande
NEP Coordinator

Dr. Dilip Patil
Principal

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Syllabus: NEP 2020 w.e.f 2026-27

Proramme Name: **B.Sc. (Information Technology)**	**Semester: VI**
Course Category: Major Mandatory	
Name of the Dept: **Science and Technology**	
Course Title: Security in Computing	
Course Code: BSS601	Course Level:5.5
Type: Theory	
Course Credit: 02	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand the importance of Information protection. 2. To familiarize Intrusion Detection and Prevention Systems and to understand the security considerations for virtual machines and security aspects of cloud computing.	
Course Outcomes: After completion of the course learners will be able to: CO1. understand the importance of information protection and comprehending the evolution of information security. CO2. analyse Intrusion Detection and Prevention Systems, Voice over IP(VoIP) and PBX security and understanding the security considerations for virtual machines	
Description of the course:	This course introduces the basic concepts of **security in computing**. It explains why protecting information is important and how security has developed over time. Students learn about common threats, types of cyberattacks, risk analysis, and key security principles like the CIA Triad (Confidentiality, Integrity, and Availability). The course covers user authentication and authorization, as well as basic encryption methods such as symmetric and public-key cryptography. It also includes network security topics like switches, routers, firewalls, intrusion detection systems (IDS), and network hardening. In addition, students learn about VoIP and PBX security, telecom management, virtual machines, and cloud computing security. Overall, the course provides simple and practical knowledge to help protect computer systems and networks from threats.

Unit No.	Content	Hours
I	**Information Security Overview**: The Importance of Information Protection, The Evolution of Information Security, Justifying Security Investment, Threat Definition, Types of Attacks, Risk Analysis, Secure Design Principles: The CIA Triad and Other Models, Defense Models. **Authentication and Authorization**: Authentication, Authorization **Encryption:** A Brief History of Encryption, Symmetric-Key Cryptography, Public Key Cryptography, Public Key Infrastructure. Risk Remediation, Best Practices. **Network Device Security**: Switch and Router Basics, Network Hardening.	15
II	**Firewalls:** Overview, The Evolution of Firewalls, Core Firewall Functions, Additional Firewall Capabilities, Firewall Design. **Intrusion Detection and Prevention Systems:** IDS Concepts, IDS Types and Detection Models, IDS Features, IDS Deployment Considerations, Security Information and Event Management (SIEM). Voice over IP (VoIP) and PBX Security: Background, VoIP Components, VoIP Vulnerabilities and Countermeasures, PBX, TEM: Telecom Expense Management. **Virtual Machines and Cloud Computing:** Virtual Machines, Cloud Computing	15
	Total Hours	30

References:

Sr.No.	Title	Author/s Publisher	Publisher	Edition	Year
1	The Complete Reference: Information Security	Mark Rhodes- Ousley	McGraw-Hill	Second	2013
2	Essential Cybersecurity Science	Josiah Dykstra	O'Reilly	Fifth	2017
3	Principles of Computer Security: CompTIA Security+ and Beyond	Wm.Arthur Conklin, Greg White	McGraw Hill	Second	2010

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Programme Name: **B.Sc (Information Technology)**	**Semester: VI**
Course Category: Major Mandatory	
Name of the Dept: **Science and Technology**	
Course Title: Security in Computing Practical	
Course Code: BSSP602	Course Level: 5.5
Course Credit: 02	
Total Hours: 60 Hours	
Total Marks: 50 Marks	
Course Objectives: 1. To provide hands-on experience in configuring and securing network devices using routing protocols, authentication mechanisms, ACLs, firewalls, IPS, and Layer 2 security features. 2. To develop practical skills in implementing network security measures to protect routers, switches, and network infrastructure against common cyber threats and attacks.	
Course Outcomes: After completion of the course learners will be able to: CO1: configure and verify secure network services including OSPF authentication, NTP, Syslog, AAA authentication, ACLs (IPv4 & IPv6), and Zone Based Firewalls on routers. CO2: implement and manage network defense mechanisms and Layer 2 security features to mitigate network attacks	
Description of the Course:	This practical course focuses on securing network devices like routers and switches. Students learn how to configure routing security (OSPF authentication), set up NTP and Syslog, and implement AAA authentication for secure login access. The course includes configuring and verifying IPv4 and IPv6 Access Control Lists (ACLs) to control network traffic and prevent unauthorized access. Students also practice setting up Zone-Based Firewalls and IOS Intrusion Prevention Systems (IPS) to protect networks from attacks. In addition, the practical covers Layer 2 security features such as securing Spanning Tree Protocol (STP), assigning the root bridge, and enabling port security to prevent common network attacks. Overall, the course develops hands-on skills to protect and secure network infrastructure.

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Sr No.	Content (List of Practicals)	Hours
1	**Configure Routers** a. OSPF MD5 authentication.	
2	**Configure Routers** a. NTP. b. to log messages to the syslog server.	
3	**Configure AAA Authentication** a. Configure a local user account on Router and configure authenticate on the console and vty lines using local AAA b. Verify local AAA authentication from the Router console and the PC-A client	
4	**Configuring Extended ACLs** a. Configure, Apply and Verify an Extended Numbered ACL	
5	**Configure IP ACLs to Mitigate Attacks** a. Verify connectivity among devices before firewall configuration. b. Use ACLs to ensure remote access to the routers is available only from management station PC-C. c. Configure ACLs on to mitigate attacks.	
6	**Configure IPV6 ACLs to Mitigate Attacks.**	
7	**Configuring a Zone-Based Policy Firewall**	
8	**Enable IOS IPS.**	
9	**Modify an IPS signature.**	
10	**Layer 2 Security** a. Assign the Central switch as the root bridge. b. Secure spanning-tree parameters to prevent STP manipulation attacks. c. Enable port security to prevent CAM table overflow attacks.	
	Total Hours	**60**

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Programme Name: **B.Sc. (Information Technology)**	**Semester VI**
Course Category: Major Mandatory	
Name of the Dept: **Science and Technology**	
Course Title: Machine Learning	
Course Code: BSM602	Course Level: 5.5
Type: Theory	
Course Credit: 2	
Hours Allotted: 30 Hours	
Total Marks: 50 Marks	

Course Objectives:

- To understand the fundamental concepts of Machine Learning
- To study and apply various Machine Learning algorithms
- To evaluate and improve Machine Learning models

Course Outcomes:

After the completion of course, learners will be able to

CO1: understand fundamental Machine Learning concepts and implement various algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, regression, and clustering techniques for solving data-driven problems.

CO2: evaluate and improve Machine Learning models using performance metrics, dimensionality reduction techniques like PCA, and association rule mining methods.

Description of the course:	This course introduces the core concepts and techniques of Machine Learning, focusing on supervised and unsupervised learning methods. It covers key algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, regression, and clustering techniques like K-means and hierarchical clustering. The course also includes model evaluation metrics, dimensionality reduction using PCA, and association rule mining for pattern discovery in data.

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Unit No.	Content	Hours
I	Introduction to Machine Learning: Machine Learning(ML), Need for Machine Learning, ML from Knowledge-driven to Data Driven, Applications of Machine Learning, Problems suitable for Machine Learning, Advantages, Disadvantages and Challenges of Machine Learning, Challenges of ML. General architecture of ML systems, Underlying Concepts in Machine Learning: Inductive Learning, Generalization, Bias and Variance, Overfitting and Underfitting, Parametric and Non Parametric algorithms . Types of Machine Learning: Supervised and Unsupervised Learning, Workflow, Semi supervised Learning, Reinforced Learning, Introduction to Classification Algorithms: Concept of Classification, Binary classification, Multi-Class Classification, Multi Label Classification K-Nearest Neighbor Method: need and Working of KNN, Computing Distance, Pros and Cons of KNN. Decision Tree based Algorithm: Terminologies and assumptions, Working of Decision Trees, ID3 Algorithm, Attribute selection Methods(Entropy, Gini Impurity, Information Gain)	15
II	Performance Evaluation: Classification Metrics-Accuracy, Sensitivity, Precision, F1 Score, ROC/AUC Curve, Cross Validation Dimensionality Reduction: Crieteria for Reduction, Feature Reduction and Selection, Principal Component Analysis(PCA) Probabilistic Learning: Introduction to Bayes Learning, Interpretation of Bayes Rule, Benefits and shortfalls of Bayesian Learning, Naïve Bayes Classifier, Characteristics of Naïve Bayes Support Vector Machines: Working of SVM, SVM Concepts :Support Vectors, Hard Margin, soft Margin, Kernels, Advantages and Disadvantages of SVM Regression Methods: Linear Regression Models, Logistic Regression Unsupervised Learning: Concept of unsupervised Learning, Importance and Challenges of unsupervised Learning, Clustering and its applications Hierarchical Clustering: Introduction, Types of Hierarchical Clustering, Issues with Hierarchical Clustering Partition algorithm: K-means Clustering, steps of K-means Clustering, Issues, Strength and Weakness of K-means clustering. Association rule Mining: Basic Concepts, Market Basket Analysis, and Apriori algorithm.	15
	Total Hours	30

References:

Sr. No	Title	Author	Publisher	Edition	Year
1.	Machine Learning: Concepts, Techniques and Applications	T V Geetha S, Sendhilkumar	CRC Press, Taylor and Francis	First	2023
2.	Machine Learning for Decision Sciences with Case Studies in Python	S. Sumathi, Suresh V. Rajappa	CRC Press, Taylor and Francis	First	2022
3.	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media, Inc.	First	2016
4.	Machine Learning	S Sridhar	Oxford University Press	First	2021
5.	Machine Learning	Ruchi Doshi, Kamal Kant Hiran	BPB	First	2021

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Programme Name: **B.Sc. (Information Technology)**	**Semester: VI**
Course Category: Major Mandatory	
Name of the Dept: **Science & technology**	
Course Title: Machine Learning Practical	
Course Code: BSMP604 Course Level:5.5	
Type: Practical	
Course Credit: 2	
Hours Allotted: 60 Hours	
Total Marks: 50 Marks	
Course Objectives: • To implement and analyze Machine Learning algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, and regression models for classification and prediction tasks. • To apply clustering and dimensionality reduction techniques such as K-means, hierarchical clustering, and PCA for data analysis and pattern discovery. • To evaluate the performance of Machine Learning models using metrics like accuracy, precision, recall, and F1 score.	
Course Outcomes: After the completion of the course learners will able to: **CO1:** implement and apply Machine Learning algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, and regression models to solve classification and prediction problems. **CO2:** apply clustering and dimensionality reduction techniques like K-means, hierarchical clustering, and PCA for data analysis. **CO3:** evaluate Machine Learning models using performance metrics such as accuracy, precision, recall, and F1 score.	
Description the course:	This course focuses on implementing Machine Learning algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, regression, clustering methods, and evaluating models using performance metrics and PCA.

Sr. No.	Content (List of Practicals)	Hours
1.	Implementing a K-Nearest Neighbor (KNN) algorithm (e.g. to classify handwritten digits).	
2	Building a decision tree model using the ID3 algorithm (e.g. to predict whether a customer will churn or not).	
3.	Developing a Support Vector Machine (SVM) model (e.g. to classify email messages as spam or not spam).	
4.	Building a Naïve Bayes classifier (e.g. to classify movie reviews as positive or negative sentiment).	
5.	Implementing linear regression (e.g. to predict housing prices based on features such as size and location).	
6.	Using logistic regression (e.g. to predict whether a credit card transaction is fraudulent or not).	
7.	Evaluating a classification model using metrics such as accuracy, precision, recall, and F1 score.	
8.	Applying hierarchical clustering (e.g. to group customer segments based on their purchasing behavior).	
9.	Implementing the K-means clustering algorithm (e.g. to identify distinct clusters in a customer demographic dataset).	
10.	Utilizing Principal Component Analysis (PCA) for dimensionality reduction to improve the efficiency and interpretability of a model.	
	Total Hours	60

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Programme Name: **B.Sc. (Information Technology)**	**Semester: VI**
Course Category: Major Mandatory	
Name of the Dept: **Science and Technology**	
Course Title**:** DevOps	
Course Code: BSD605	Course Level: 5.5
Type: Theory	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand the concepts and principles of DevOps and its role in improving collaboration between development and operations teams. 2. To study continuous delivery, release automation, and DevOps toolchains used to automate software development and deployment processes.	
Course Outcomes: After completion of the course learners will be able to: CO1. explain DevOps practices and continuous delivery models used in modern software development. CO2. apply DevOps tools and techniques to improve software deployment and operational efficiency.	
Description of the course:	The course covers DevOps adoption strategies, business case development, and optimization of the software delivery pipeline. It also explores innovation through DevOps platforms, microservices architecture, and API-driven ecosystems in modern enterprises.

Unit No.	Content	Hours
I	DevOps: An Overview: Origins, Roots, Practices, Culture. DevOps in the Ascendency: Accelerating Agile Practices in Today's Software Factory, Embracing DevOps in the Application Economy, DevOps as a Critical Requirement, Banking on DevOps Practices, DevOps: A Key Component of Business Agility, DevOps: A Practice for Champions. IT Impasse: A World of 'Wicked' Business Problems, The Emergence of Agile Development, Modern Application Architectures, Ending the Technical Impasse. DevOps Foundations: What Characterizes DevOps Culture?, Lean Thinking to Reduce Waste, DevOps Metrics. Build: Case Study: IceMobile, From Little API Acorns Big Things Grow, API Management: Stakeholders and Requirements, APIs Are Products, Managing the API Lifecycle, API Management: Essential Integrations, Taking a Strategic Approach, Building an API Future, Faster. Test: Case Study: AutoTrader.com, Testing Times, Agile Testing Trifecta. .	15
II	Deploy: Case Study: Citrix, Obstacles to Continuous Delivery, Continuous Delivery Maturity, Accelerating Maturity: Three Ways, Essential Tool chain Integrations, Release Automation: Capability Checklist, Recommendations and Action Plan. Manage: CaseStudy: ANZBank, MoreChange, MoreComplexity, New IT Operations Imperatives, Toward Agile Operations Adopting DevOps: Developing the Playbook. Developing a Business Case for a DevOps Transformation: Developing The Business Case, Completing The Business Model Canvas, Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partnerships, Cost Structures. DevOps Plays for Optimizing the Delivery Pipeline:	15

	DevOps as an Optimization Exercise, Core Themes, The DevOps Plays, Specializing Core Plays. Practical DevOps: DevOps and Enterprise Architecture, DevOps and Information Security, DevOps and IT Service Management, DevOps and Lean Startup. DevOps Plays for Driving Innovation: Optimize to Innovate, The Uber Syndrome, Innovation and the Role of Technology, Core Themes, Play: Build a DevOps Platform, Play: Deliver Microservices Architectures, Play: Develop an API Economy, Play: Organizing for Innovation	
	Total Hours	**30**

References:

Sr.No	Title	Author/s	Publisher	Edition	Year
1.	DevOps for Digital Leaders	Aruna Ravichandran Kieran Taylor Peter Waterhouse	A press		2016
2.	The DevOps Adoption Playbook	Sanjeev Sharma	Wiley, IBM Press		2017

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Programme Name: B.Sc. (Information Technology)	**Semester: VI**
Course Category: Major Elective	
Name of the Dept: **Science and Technology**	
Course Title: Geographic Information System	
Course Code: BSG606	Course Level: 5.5
Type: Theory	
Course Credit: 02	
Hours Allotted: 30 Hours	
Total Marks: 50 Marks	
Course Objectives: **1:** To understand the fundamental concepts of GIS and the representation of geographic phenomena and spatial data. **2:** To develop knowledge of spatial data management, spatial analysis, and visualization techniques used in GIS applications.	
Course Outcomes: After completion of the course learners will be able to: CO1: explain GIS concepts and manage spatial data using appropriate database models and referencing systems. CO2: to perform basic spatial analysis and visualize geographic data using GIS techniques.	
Description of the course:	This course introduces the fundamental concepts of Geographic Information Systems (GIS) and spatial data representation. Students learn how geographic data is captured, stored, analyzed, and visualized using GIS tools and database systems. The course also covers spatial referencing, spatial analysis techniques, and map-based data visualization for real-world applications.

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Unit No.	Content	Hours
I	**Introduction to Geographic Information Systems** Nature of GIS, Defining GIS, GISystems, GIScience and GIApplications, Spatial Data and Geoinformation, Geographic phenomena and types of geographic phenomena, Geographic fields and geographic objects, Boundaries and representation of geographic features. **Spatial Data Models and Database Management** Models and modelling of the real world, Maps and spatial databases, Vector data model, Raster data model (regular tessellations), Topology and spatial relationships, Scale and resolution, Database Management Systems (DBMS), Relational data model and querying relational databases, Linking GIS with DBMS and spatial database functionality.	15
II	**Spatial Referencing and Data Preparation** Reference surfaces for mapping, Coordinate systems, Map projections, Coordinate transformations, Satellite-based positioning (GPS basics), Spatial data input methods (direct and indirect data capture), Data quality concepts (positional and attribute accuracy), Data preparation and combining data from multiple sources. **Spatial Analysis and Visualization** Classification of GIS analytical capabilities, Spatial selection queries, Measurement and classification, Overlay functions (vector and raster overlay), Neighbourhood functions and proximity analysis, Network analysis and interpolation, Data visualization and GIS maps, Visualization strategies and mapping qualitative and quantitative data	15
	Total Hours	**30**

References:

Sr. No	Title	Author	Publisher	Edition	Year
1.	Principles of Geographic Information Systems-An Introductory Text Book	Editors: Otto Huisman and Rolf A.	The International Institute of Geoinformation Science and Earth Observation	Fourth	2009
2.	Principles of Geographic Information Systems	P.A Burrough and R.A.McDonnell	Oxford University Press	Third	1999
3.	Introduction to Geographic Information Systems	Chang Kang-tsung (Karl),	McGrawHill	7th	2013

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Programme Name: **B.Sc. (Information Technology)** **Semester: VI**	
Course Category: Major Elective	
Name of the Dept: **Science & Technology**	
Course Title: Geographical Information System Practical	
Course Code: BSGP607 Course Level: 5.5	
Type: Practical	
Course Credit: 02	
Hours Allotted: 60 Hours	
Total Marks: 50	
Course Objectives 1. To familiarize students with the installation and working environment of Quantum GIS (QGIS) and enable them to manage vector and raster spatial datasets. 2. To develop practical skills in spatial data processing, georeferencing, digitization, spatial queries, and basic spatial analysis using GIS tools.	
Course Outcomes: After completion of the course learners will be able to: CO1. create, edit, manage, and analyze vector and raster spatial data using QGIS software. CO2. perform GIS operations such as georeferencing, spatial queries, map creation, and spatial analysis for real-world geographic data applications.	
Description of the course:	This practical course introduces students to the use of Quantum GIS (QGIS) for handling and analyzing geographic data. Students learn to create, manage, and analyze vector and raster datasets, perform georeferencing, digitization, and spatial queries. The course also develops skills in map creation, spatial analysis, and working with real-world geographic datasets using GIS tools.

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Sr No.	Content (List of Practicals)	Hours
1.	Familiarizing Quantum GIS: Installation of QGIS, datasets for both Vector and Raster data, Maps	
2.	Creating and Managing Vector Data: Adding vector layers, setting properties, formatting, calculating line lengths and statistics	
3.	Exploring and Managing Raster data: Adding raster layers, raster styling and analysis, raster mosaicking and clipping	
4.	Making a Map, Working with Attributes, Importing Spreadsheets or CSV files Using Plugins, Searching and Downloading OpenStreetMap Data .	
5.	Working with attributes, terrain Data	
6.	Working with Projections and WMS Data	
7.	Georeferencing Topo Sheets and Scanned Maps Georeferencing Aerial Imagery Digitizing Map Data	
8.	Managing Data Tables and Spatial data Sets: Table joins, spatial joins, points in polygon analysis, performing spatial queries	
	Total Hours	**60**

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Programme Name: **B. Sc(Information Technology)**	**Semester: VI**
Course Category: Major Elective	
Name of the Dept: **Science and Technology**	
Course Title**: Cloud Computing**	
Course Code: BSC608	Course Level: 5.5
Type: Theory	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand and use cloud services, virtualization, task scheduling algorithms, and the MapReduce programming model for cloud computing applications. 2. To develop and manage private cloud systems while understanding the legal and societal impact of cloud computing technologies.	
Course Outcomes: After completion of the course learners will be able to: **CO1:** analyze cloud computing architectures, vulnerabilities, and applications, and design workflows using the MapReduce programming model. **CO2:** apply virtualization concepts, cloud resource management, scheduling algorithms, cloud storage systems, and security measures to develop secure cloud applications while understanding their legal and societal impact.	
Description of the course:	Cloud Computing syllabus introduces the basic concepts and technologies used to deliver computing services over the internet. It covers topics such as cloud architecture, service models (IaaS, PaaS, SaaS), deployment models (public, private, hybrid), virtualization, cloud storage, and security. The syllabus also explains benefits, challenges, and applications of cloud computing in modern IT systems.

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Unit No.	Content	Hours
I	**Introduction to Cloud Computing –** Introduction, Historical developments, Building Cloud Computing Environments. **Principles of Parallel and Distributed Computing –** Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. **Virtualization –** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.	15
II	**Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. **Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure.Distributed software engineering, Distributed systems issues, Client-server computing, Architectural patterns for distributed systems, Software as a service	15
	Total Hours	**30**

References:

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Mastering Cloud Computing Foundations and Applications Programming	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi	Elsevier	-	2013
2.	Cloud Computing Concepts, Technology & Architecture	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini	Prentice Hall	-	2013
3.	Distributed and Cloud Computing, From Parallel Processing to the Internet of Things	Kai Hwang, Jack Dongarra, Geoffrey Fox	MK Publishers	--	2012

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Programme Name: **B.Sc. (Information Technology)**	**Semester: VI**
Course Category: Major Elective	
Name of the Dept: **Science and Technology**	
Course Title**:** Cloud Computing Practical	
Course Code: BSCP609	Course Level: 5.5
Type: Practical	
Course Credit: 2 credits	
Hours Allotted: 60 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand the basic concepts and services of cloud computing. 2. To gain hands-on experience in developing and deploying cloud-based applications and web services.	
Course Outcomes: After completion of the course learners will be able to: CO1: develop and deploy basic cloud-based applications and web services. CO 2: use cloud platforms and virtualization tools for storage and computing services.	
Description of the course:	Cloud Computing practical provides hands-on experience in creating and managing cloud environments. Students learn virtualization, cloud platforms, clustering, and deployment of applications on cloud services. These practical's help in understanding how cloud infrastructure, virtual machines, and distributed systems work in real-world applications.

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Sr No	Content (List of Practicals)	
1	Implement Windows / Linux Cluster.	
2	Developing application for windows Azure.	
3	Implementing private cloud with Xen Server.	
4	Implementing operating system on Xen Server.	
5	Implement Hadoop .	
6	Develop applications using GAE.	
7	Implement VMWARE ESXI server.	
8	Native virtualization using Hyper V.	
9	Implementing operating system on Hyper V.	
10	Using OpenNebula to manage heterogeneous distributed data center infrastructure.	
	Total Hours	60

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Programme Name: **B.Sc. (Information Technology)** **Semester: VI**	
Course Category/Vertical: Major Elective	
Name of the Dept: **Science and Technology**	
Course Title**:** Exploratory Data Analysis	
Course Code: BSE610 Course Level: 5.5	
Type: Theory	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To introduce the concepts and techniques of Exploratory Data Analysis (EDA) for understanding data characteristics, assumptions, and patterns. 2. To develop the ability to perform data preparation, univariate, bivariate, and multivariate analysis for discovering relationships, handling missing data, and identifying patterns in datasets.	
Course Outcomes: After completion of the course learners will be able to: CO1: apply EDA techniques to summarize, visualize, and interpret datasets using statistical measures and graphical representations. CO2: analyze relationships among variables and perform data preparation and dimensionality reduction techniques to support data-driven decision making.	
Description of the course:	This course introduces the fundamental concepts and techniques of Exploratory Data Analysis (EDA) for understanding and summarizing datasets. It covers data preparation, handling missing values, and identifying outliers, along with univariate, bivariate, and multivariate analysis using statistical measures and visualization techniques. The course also introduces correlation analysis and dimensionality reduction concepts such as PCA to discover patterns and relationships in data.

Unit No.	Content	Hours
I	**Introduction to Exploratory Data Analysis (EDA) :** Definition of EDA, difference between EDA with classical and **Bayesian Analysis**, comparison of EDA with Classical data summary measures, goals of EDA, Underlying assumptions in EDA, importance of EDA in data exploration techniques, introduction to different techniques to test the assumptions involved in EDA, role of graphics in data exploration, introduction to unidimensional, bidimensional and multidimensional graphical representation of data **Data preparation:** Introduction to data exploration process for data preparation, data discovery, issues related with data access, characterization of data, consistency and pollution of data, duplicate or redundant variables, outliers and leverage data, noisy data, missing values, imputation of missing and empty places, with different techniques, missing pattern and its importance, handling non numerical data in missing places.	15
II	**Univariate Analysis :** Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Variance, SD, IQR),Shape of Data: Skewness (Pearson's coefficients) and Kurtosis, Distribution Analysis : Normal distribution, Binomial, and Poisson; Probability Density Functions (PDF) and Cumulative Distribution Functions (CDF). **Multivariate Analysis & Visualization :** Discovering relationships between variables and dimensionality reduction. **Bivariate Analysis: Continuous vs. Continuous:** Pearson and Spearman Correlation. Categorical vs. Categorical: Chi-square test and Contingency tables. Categorical vs. Continuous: Z-test, T-test, and ANOVA basics. Multivariate Exploration: Heatmaps for correlation matrices, Pair plots, and Parallel Coordinates. **Dimensionality Introduction:** The "Curse of Dimensionality," Intuition behind Principal Component Analysis (PCA) as an EDA tool.	15
	Total Hours	**30**

References:

1. Exploratory Data Analysis, Tukey, J. W. (1977). Exploratory Data Analysis. Reading, MA: Addison-Wesley.
2. Python for Data Analysis, McKinney, W. (2018). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed.). Sebastopol, CA: O'Reilly Media.
3. Practical Statistics for Data Scientists, Bruce, P., Bruce, A., & Gedeck, P. (2020). Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python (2nd ed.). Sebastopol, CA: O'Reilly Media.
4. An Introduction to Statistical Learning, James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An Introduction to Statistical Learning with Applications in R (2nd ed.). New York, NY: Springer.

Sheth T. J. Education Society's
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Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: **B.Sc. (Information Technology)** **Semester: VI**	
Course Category/Vertical: Major Elective	
Name of the Dept: **Science and Technology**	
Course Title**:** Exploratory Data Analysis Practical	
Course Code: BSEP611 Course Level: 5.5	
Type: Practical	
Course Credit: 2 credits	
Hours Allotted: 60 Hours	
Marks Allotted: 50 Marks	
Course Objectives: • To introduce the concepts and techniques of Exploratory Data Analysis (EDA) for understanding data characteristics, assumptions, and patterns. • To develop the ability to perform data preparation, univariate, bivariate, and multivariate analysis for discovering relationships, handling missing data, and identifying patterns in datasets.	
Course Outcomes: After completion of the course learners will be able to: CO1: apply EDA techniques to summarize, visualize, and interpret datasets using statistical measures and graphical representations. CO2: analyze relationships among variables and perform data preparation and dimensionality reduction techniques to support data-driven decision making.	
Description of the course:	This course introduces the fundamental concepts and techniques of Exploratory Data Analysis (EDA) for understanding and summarizing datasets. It covers data preparation, handling missing values, and identifying outliers, along with univariate, bivariate, and multivariate analysis using statistical measures and visualization techniques. The course also introduces correlation analysis and dimensionality reduction concepts such as PCA to discover patterns and relationships in data.

Unit No.	Content (List of Practicals)	Hours
	1.Managing Data Frames with the dplyr package 2 Use dplyr Grammar for inbuilt data set car. 3 Use group by(), %>%,mutate(), rename(),arrange(), filter(), select() 4 Use the data set air quality from inbuilt data sets library. a) Use summary statistics and find the important key values from the output b) Use boxplot and find the interquartile range. Interpret the boxplot and inner and outer fencing of outliers c) Check the missing value in the data set and fine the suitable solution for the missing values. d) Using histogram, find the distribution of data and give proper comment over the dataset. 5 Use bar plot and identify the difference between bar plot and histograms. Conclude the appropriate use of bar plot and histogram. 6 Explore the two dimensional data 7 Scatter plot between two variables 8 Five number summary in exploratory data analysis 9 Multiple histogram and multiple boxplots, Multiple scatter plots and colouring the graph 10 Lattice system in R environment and Graphical window in R and its uses	
	Total Hours	**60**

References:

1. Exploratory Data Analysis, Tukey, J. W. (1977). Exploratory Data Analysis. Reading, MA: Addison-Wesley.
2. Python for Data Analysis, McKinney, W. (2018). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed.). Sebastopol, CA: O'Reilly Media.
3. Practical Statistics for Data Scientists, Bruce, P., Bruce, A., & Gedeck, P. (2020). Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python (2nd ed.). Sebastopol, CA: O'Reilly Media.

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Programme Name: **B.Sc. (Information Technology)**	**Semester: VI**
Course Category/Vertical: Minor	
Name of the Dept: **Science and Technology**	
Course Title**:** Business Intelligence	
Course Code: BSB612	Course Level: 5.5
Type: Theory	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand the concepts and techniques of Business Intelligence, Decision Support Systems, and Data Mining for analyzing business data and supporting effective decision-making processes. 2. To apply analytical models to extract knowledge and support organizational knowledge management and expert system development.	
Course Outcomes: After completion of the course learners will be able to: CO1. understand the basic concept of Business Intelligence, Decision Support System and mathematical models for decision making. Understand concept of data mining, CO2. identify, organize and prepare data for mining purpose as well as implement various data mining algorithm. and understand various concepts related to BI like knowledge management, expert system.	
Description of the course:	This course provides an introduction to Business Intelligence and Decision Support Systems used for organizational decision making. It covers the concepts of data, information, and knowledge, along with the architecture and ethical considerations of business intelligence systems. The course explains the decision-making process and the development of decision support systems using mathematical models. Students will also learn the fundamentals of data mining, including classification and clustering techniques. In addition, the course introduces Knowledge Management concepts, organizational learning, and the role of information technology in managing knowledge. Finally, the course explores Expert Systems, including their structure, applications, and development using knowledge engineering techniques.

Unit No.	Content	Hours
I	Business intelligence: Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence Decision support systems: Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system Mathematical models for decision making: Structure of mathematical models, Development of a model, Classes of mode	15
II	Data mining: Definition of data mining, Representation of input data, Data mining process, Analysis methodologies Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression, Neural networks, Support vector machines Clustering: Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) in Knowledge Management, Knowledge Management Systems Implementation, Roles of People in Knowledge Management. Expert Systems: Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert System	15
	Total Hours	**30**

References:

Sr.No	Title	Author/s	Publisher	Edition	Year
1.	Business Intelligence: Data Mining and Optimization for Decision Making	Carlo Vercellis	Wiley	First	2009
2.	Decision support and Business Intelligence Systems	Efraim Turban, Ramesh Sharda, Dursun Delen	Pearson	Ninth	2011
3.	Fundamental of Business Intelligence	GrossmannW, Rinderle-Ma	Springer	First	2015

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Programme Name: **B.Sc. (Infromation Technology)**	**Semester: VI**
Course Category: Minor	
Name of the Dept: **Science and Technology**	
Course Title**:** Business Intelligence Practical	
Course Code: BSBP613	Course Level: 5.5
Type: Practical	
Course Credit: 2 credits	
Hours Allotted: 60 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To understand and implement Data Warehousing concepts and cube models for building data warehouse systems 2. To apply Data Mining techniques to analyze and visualize business data	
Course Outcomes: After completion of the course learners will be able to: CO1. perform ETL process for any system with different data sources as well as setup the schedule for execution. and Perform data analysis. CO2: use what-if analysis and reporting tools for data visualization and decision-making. and Apply machine learning algorithms for data classification, clustering, and regression.	
Description of the course:	This course focuses on practical implementation of Data Warehousing and Data Mining techniques. Students will learn how to import and integrate data from different sources such as Excel, SQL Server, and Oracle, and perform ETL processes to construct a data warehouse. The course includes creating staging areas, designing cubes, executing MDX queries, and performing data analysis using pivot tables and charts in Microsoft Excel. It also introduces data mining techniques such as classification, clustering, and regression for extracting meaningful insights from data warehouse datasets.

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content (List of Practicals)	Hours
1	Import the legacy data from different sources such as (Excel, SqlServer, Oracle etc.) and load in the target system. (You can download sample database such as Adventureworks, Northwind, foodmart etc.)	
2	Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver.	
3	Create the Data staging area for the selected database	
4.	Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model	
5	Create the ETL map and setup the schedule for execution	
6	Execute the MDX queries to extract the data from the data warehouse.	
7	Import the data warehouse data in Microsoft Excel and create the Pivot table and Pivot Chart	
8	mport the cube in Microsoft Excel and create the Pivot table and Pivot Chart to perform data analysis.	
9	Apply the what –if Analysis for data visualization. Design and generate necessary reports based on the data warehouse data.	
10	Perform the data classification using classification algorithm	
11	Perform the data clustering using clustering algorithm	
12	Perform the Linear regression on the given data warehouse data	
13	Perform the Linear regression on the given data warehouse data	
	Total Hours	**60**

Scheme of Examination

Course with Credit	External Examination	Internal Examination	Total
Credit 4	**60 marks**	**40 marks**	**100 marks**
Credit 2	**30 marks**	**20 marks**	**50 marks**

Internal Examination Structure(Theory)

Internal examination	40 marks	20 marks
Project Presentation/Case Study /Quiz/Group Discussion	10 marks	5 marks
Assignment /Active class Participation/Attendance	10 marks	5 marks
Class test	20 marks	10 marks
Total	40 marks	20 marks

Structure for Class Test(For 10 Marks)

For 10 Marks	
Q1. Multiple Choice Questions	**5 Marks**
Q2. Answer in one or two sentences	**5 Marks**

Structure for Class Test(For 20 Marks)

For 20 Marks	
Q1. Multiple Choice Questions	**10 Marks**
Q2. Answer in one or two sentences	**10 Marks**

External Examination (For 60 Marks)

Q. No.	External	Marks: 60
Q .1	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 3	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 4	Answer the following questions (Any 3) A B C D E **F**	15 Marks

External Examination (For 30 Marks)

Q. No.	External	Marks: 30
Q .1	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2	Answer the following questions (Any 3) A B C D E F	15 Marks

Practical External Exam: 50 marks
A Certified copy journal is essential to appear for the practical examination.

1	Practical Question 1	20
2	Practical Question 1	20
3	Journal	5
4	Viva Voce	5

OR

1	Practical Question 1	40
2	Journal	5
3	Viva Voce	5