Nirmala Memorial Foundation College of Commerce and Science

(Autonomous)

Re-accredited by NAAC with B++, ISO 9001-2015 Certified, Recognised under section 2(f) & 12(B) of the UGC Act 1956

Permanently Affiliated to the University of Mumbai,

Syllabus

Bachelor of Science in Information Technology

(B.Sc. Information Technology)

(Semester V and VI)

(Program Code: UGIT01)

As Per New Education Policy (NEP) 2020

(To be implemented from the Academic Year 2026-2027)

Approved in the Academic Council Meeting held on **4th October 2025**

INTRODUCTION OF THE PROGRAMME

Information technology (IT) continues to be a dynamic and rapidly evolving field with high demand for skilled professionals. The demand for IT workers is driven by various factors, and the landscape may have evolved over a period of time. NEP envisages the multidisciplinary approach thus making IT much more applicable in all fields of life. This facilitates multi-institutional mobility of the students within India as well as abroad thus making the students attain different proficiency levels right from certificate to B.Sc. Honours with Research. This new syllabus under NEP will thus enables the students for higher education, research and career in the field of IT

Aims and Objectives

The aims and objectives of a Bachelor of Science (B.Sc.) program in Information Technology (IT) generally revolve around providing students with a comprehensive understanding of the principles, technologies, and applications within the field of information technology. The entire program collectively aims to produce graduates who are well-rounded IT professionals, capable of contributing to the design, development, and management of information technology systems in various industries. The specific details of the curriculum may vary among institutions offering B.Sc in Information Technology programs.

PROGRAM OUTCOME

By the end of the Bachelor of Science in Information Technology program, students will be able to:

- **Apply IT Knowledge –**

Demonstrate strong knowledge of computing fundamentals, programming, web development, cloud computing, artificial intelligence, and data management in solving real-world problems.

- **Problem-Solving & Innovation –**

Analyze, design, and implement IT solutions using modern technologies such as machine learning, generative AI, robotics process automation, IoT, and quantum computing.

- **Practical & Technical Skills –**

Gain hands-on expertise through practicals, projects, and tools in areas like cloud services (AWS, Azure, GCP), advanced programming (Java, Kotlin, Full Stack), data visualization, and enterprise applications.

- **Adaptability to Emerging Technologies –**

Stay future-ready by understanding and applying upcoming technologies like agentic AI, prompt engineering, deep learning, GIS, automation, and quantum innovations.

- **Professional & Ethical Responsibility –**

Develop awareness of cyber security, forensics, digital ethics, and responsible AI practices while ensuring data privacy, security, and regulatory compliance.

- **Teamwork & Communication –**

Work effectively in teams, communicate technical concepts clearly, and collaborate across disciplines in academic, industrial, and entrepreneurial environments.

- **Project Management & Entrepreneurship –**

Plan, design, and execute IT projects by applying management principles, entrepreneurial thinking, and innovative strategies for industry readiness.

- **Lifelong Learning –**

Engage in continuous learning by adapting to evolving technologies, frameworks, and industry trends for career growth, research, and higher studies.

- **AI & Data-Driven Decision Making –**

Apply AI, ML, and deep learning techniques to analyze large datasets, visualize insights, and make intelligent business or scientific decisions.

- **Automation & Process Optimization –**

Implement RPA and cloud-native solutions to optimize workflows, reduce manual effort, and increase operational efficiency across sectors.

- **Geospatial & IoT Applications –**

Design and apply IoT solutions and GIS technologies for smart cities, environmental monitoring, logistics, and real-time data applications.

- **Innovation in Human-Centric Computing –**

Build solutions in areas like HRM, CRM, ERP, and user-centric web/mobile apps using cloud, AI, and full-stack development tools.

SEMESTER V
COURSE STRUCTURE

VERTICAL		COURSE CODE	SUBJECT	CREDIT
Vertical 1	Major	NUIT501	Agentic AI	2
	Major	NUIT502	Indian Knowledge System With cyber Itelligence	2
	Major	NUIT503	Full Stack Development Practical	2
	Major	NUIT504	Cloud Computing	2
	Major	NUIT505	Cloud Computing Practical	2
Elective	E1	**	Cyber Security and Forensics	2
	E2	**	Cyber Security and Forensics Practical	2
	E3	NUIT506	Internet of Things	2
	E4	NUIT507	Internet of Things Practical	2
	E5	**	Advanced Java Technologies	2
	E6	**	Advanced Java Technologies Practical	2
Vertical 2	Minor	NUIT508	Data Science and Analytics	2
	Minor	NUIT509	Data Science and Analytics Practical	2
Vertical 3	Open Elective	**	***	***
Vertical 4	SEC	**	***	***
	VSC	NUIT510	Kotlin for Next-Gen Android App	2
Vertical 5	AEC	**	***	***
Vertical 6	CEP	NUCP501	Community Engagement Project	2
			Total Credits	**22**

SEMESTER VI
COURSE STRUCTURE

VERTICAL		COURSE CODE	SUBJECT	CREDIT
Vertical 1	Major	NUIT601	Security In Computing	2
	Major	NUIT602	Security In Computing Practical	2
	Major	NUIT603	Prompt Engineering and Generative AI	2
	Major	NUIT604	Big Data	2
	Major	UNIT605	No SQL Practical	2
Elective	E1	**	Linux Administration	2
	E2	**	Linux Administration Practical	2
	E3	NUIT606	Robotics Process Automation	2
	E4	NUIT607	Robotics Process Automation Practical	2
	E5	**	Geographical Information Systems	2
	E6	**	Geographical Information Systems Practical	2
Vertical 2	Minor	NUIT608	Machine Learning	2
	Minor	NUIT609	Machine Learning Practical	2
Vertical 3	Open Elective	**	***	***
Vertical 4	SEC	**	***	***
	VSC	**	***	***
Vertical 5	AEC	**	***	***
Vertical 6	OJT	NUOJT601	OJT	4
			Total Credits	**22**

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Bachelor of Science in Information Technology

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(Semester V)

(Program Code: UGIT01)

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Approved in the Academic Council Meeting held on **4th October 2025**

SEMESTER - V

Vertical - I

Name of the Course: Agentic AI

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces the fundamentals of Artificial Intelligence (AI)**,** including intelligent agents, environments, problem-solving through search strategies, logical reasoning, and basic neural networks. It further explores the evolution of AI from traditional approaches to generative and agentic AI, with emphasis on learning paradigms such as supervised, unsupervised, semi-supervised, and reinforcement learning. The course also provides a brief overview of multi-agent systems and orchestration concepts through case studies.
2	**Vertical:**	**Major**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand the fundamental concepts of Artificial Intelligence and intelligent agents. 2. Learn problem-solving techniques using search strategies, heuristics, and logical reasoning. 3. Explore the evolution of AI from traditional to generative to agentic systems. 3. Analyze the characteristics, structure, and orchestration of Agentic AI and Multi-Agent Systems. 5. Develop skills to apply AI techniques and orchestration strategies through real-world case studies.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Understand and explain the fundamental concepts of Artificial Intelligence and the role of intelligent agents in various environments. CO2: Apply problem-solving techniques using search strategies, heuristic functions, and logical inference methods. CO3: Analyze and differentiate the evolution of AI, from traditional AI to generative AI and agentic AI, along with their applications. CO4: Evaluate the characteristics, advantages, and challenges of Multi-Agent Systems and orchestration in Agentic AI. CO5: Design, implement, and assess AI-based solutions for real-world scenarios, such as sales forecasting, by leveraging orchestration strategies.	
9	**Modules:-** **Module 1 (15 hours):**	
	Introduction to Artificial Intelligence, Intelligent Agents: Agents and Environment, Nature of Environment, Structure of Agents. Solving Problems by Searching: Problem Solving Agents, Searching for Solutions, Uninformed Search, Informed Search Strategies, Heuristic Functions. Alpha-Beta Pruning, Logical Agents: Propositional Logic based	

	Agent, Knowledge Base Agent. Inference in First Order Logic: Forward and Backward Chaining, Introduction to Artificial Neural Network.	
	Module 2 (15 hours):	
	Introduction to Agentic AI, Characteristics of Agentic AI, Evolution from Traditional AI → Generative AI → Agentic AI, Foundational Elements of Agentic AI: Supervised Learning, Unsupervised Learning, Semi-supervised, Reinforcement Learning**.** Evolution of Agents (Reactive → Deliberative → Hybrid → Learning → Agentic). Multi-Agent Systems: introduction, Orchestrating Agentic AI Systems: importance, How to make orchestration successful. Steps for Successful Orchestration in Multi-Agent Systems, Case Study.	
10	**Text Books:** 1. Artificial Intelligence: A Modern Approach Stuart Russel and Peter Norvig Pearson Third 2015. 2. Building Applications with AI Agents: Designing and Implementing Multiagent Systems by Michael Albada.	
11	**Reference Books:** 1. Agentic AI An Executive's Guide to In-depth Understanding of Agentic AI. 2. Artificial Intelligence & Soft Computing for Beginners Anandita Das Bhattacharjee SPD First 2013. 3. "Agentic Artificial Intelligence: Harnessing AI Agents to Reinvent Business, Work and Life" – A Pragmatic Map for the Age of Agents	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks Class participation : 5 marks Total: 20 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Indian Knowledge System with Cyber Intelligence

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces the foundations of Indian Knowledge Systems (IKS) and their relevance to modern computing, cyber security, artificial intelligence, and information management. Students explore Indian traditions of knowledge, logic, mathematics, ethics, and decision-making through concepts such as Pramana, Nyaya logic, Panini's grammar, Aryabhata's computational methods, and Kautilya's analytical frameworks. The course also examines cyber ethics, cyber forensics, information governance, AI-based security, and contemporary applications of Indian knowledge systems in technology and digital security.
2	**Vertical:**	**Major**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To understand the fundamental concepts and significance of Indian Knowledge Systems and their relevance in technology. 2. To explore Indian traditions of logic, reasoning, mathematics, and computational thinking. 3. To analyze ethical, governance, and security perspectives from Indian philosophical traditions. 4. To apply principles of IKS in cyber security, artificial intelligence, and intelligent decision-making systems.	
8	**Course Outcomes :** After successful completion of this course, students will be able to: CO1: Explain the principles of Indian Knowledge Systems, Pramana, and traditional schools of knowledge and reasoning. CO2: Analyze Indian contributions to mathematics, logic, computational thinking, and formal language systems. CO3: Apply Indian ethical principles and knowledge frameworks to cyber security, cyber forensics, and information governance. CO4: Evaluate the role of Indian logic and decision-making models in artificial intelligence, security applications, and emerging technologies.	
9	**Modules:-** **Module 1 (15 hours):**	
	Foundations of IKS : Meaning and Importance of IKS, Relevance of IKS in Technology and Security, Pramana: Perception, Inference, Comparison, and Testimony, Knowledge traditions in Nyaya, Vedanta, and Mimamsa, Decimal number system, place value, and concept of Zero, Pingala's binary patterns and combinatorics, Aryabhata's computational methods and algorithmic thinking, Fundamentals of Nyaya logic and Indian syllogism	

	,Inference methods and reasoning models, Comparison of Indian and Western logic, Kautilya's analytical and decision-making frameworks, Applications of Indian logic in expert systems, AI, and knowledge-based computing ,Panini's Ashtadhyayi and rule-based grammar, Formal grammar, generative systems, and programming language concepts	
	Module 2 (15 hours):	
	Cyber Ethics through Indian Philosophy: Digital Responsibility, Privacy and Ethical Use of Information. Cyber Crime and Indian Values: Common Cyber Crimes, Awareness and Prevention using Ethical Principles. Cyber Forensics and Evidence Management: Introduction to Cyber Forensics, Collection and Preservation of Digital Evidence. Information Governance and Security: Information Protection Strategies, Security Policies and Best Practices. AI, Cyber Security and Indian Knowledge Systems: Introduction to AI in Security, Indian Logic Systems and Intelligent Decision Making. Future Trends and Case Studies: Digital India and Cyber Security, Case Studies Inspired by Indian Security Practices	
10	**Text Books:** 1. Kapil Kapoor and Avadesh Kumar Singh, Indian Knowledge Systems: Education, Culture and Science, D.K. Printworld. 2. B. Mahadevan, Vinayak Rajat Bhat and Nagendra Pavana R., Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning. 3. S. R. Sarma and B. Mahadevan, Indian Knowledge Systems, McGraw Hill Education.	
11	**Reference Books:** 1. Subhash Kak and T. R. N. Rao, Computing Science in Ancient India, Munshiram Manoharlal Publishers. 2. Bimal Krishna Matilal, The Character of Logic in India, State University of New York Press. 3. Radhakrishnan and Charles A. Moore, A Sourcebook in Indian Philosophy, Princeton University Press. 4. Kautilya, Arthashastra (Translated Editions).	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Case Study on Module I or Module II Total: 20 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration:1 hour** **Project and Viva Voce :-** 1. A project should be done based on the objectives of subject. 2. A report of minimum 50 pages should be prepared. 3. The report should have a font size of 12, Times new roman and 1.5 line spacing. The headings should have font size 14. 4. The report should be hard bound. 5. The students will have to present the project during the examination. 6. A certified copy of the project report is essential to appear for the examination.	

Name of the Course: Full Stack Development Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides hands-on experience in building modern web applications using front-end and back-end technologies. Students will learn HTML5, CSS3, JavaScript ES6, and React for front-end development, Node.js and Express for back-end services, and database integration using MongoDB/MySQL. The course also covers authentication, file handling, and deployment of full-stack applications. By the end, students will have developed and deployed a complete MERN stack project.
2	**Vertical:**	**Major**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To introduce responsive web design using HTML5 and CSS3. 2. To develop programming skills in JavaScript ES6 and DOM manipulation. 3. To build dynamic user interfaces with React components, state management, and routing. 4. To design REST APIs using Node.js and Express with database integration. 5. To implement authentication, file uploads, and deployment in full-stack projects.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Design responsive front-end applications using HTML5, CSS3, and JavaScript. CO2: Build interactive web applications using React with state management and routing. CO3: Develop RESTful APIs with Node.js and Express connected to a database. Implement secure authentication and file handling in web applications. CO4: Deploy a full-stack MERN project to a hosting platform with working features.	
9	**Modules:-** **Module 1 (15 hours):**	
	Practical 1: HTML5 & CSS3 Create a responsive portfolio webpage using HTML5 & CSS3. **Practical 2:** JavaScript ES6 Features Demonstrate ES6 features in a simple application. **Practical 3:** DOM Manipulation & Form Validation Create a registration form with JS validation. **Practical 4:** React Components & State Build a To-Do List app using React. **Practical 5:** React Router	

	Implement multiple pages using React Router.	
	Module 2 (15 hours):	
	Practical 6: Node.js + Express Basics Develop a simple REST API with Node.js & Express. **Practical 7:** Database CRUD (MongoDB/MySQL) Connect Express app with a database and perform CRUD. **Practical 8:** Authentication with JWT Implement user login & signup with authentication. **Practical 9:** File Upload Upload and serve images/files in a web app. **Practical 10:** Full Stack Mini Project + Deployment Develop and deploy a MERN full-stack project.	
10	**Text Books:** 1. Web Development with Node and Express by Ethan Brown. 2. Learning React: Modern Patterns for Developing React Apps by Alex Banks and Eve Porcello	
11	**Reference Books:** 1. Full-Stack React, TypeScript, and Node by David Choi. 2. MongoDB: The Definitive Guide by Kristina Chodorow.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**
14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration: 2 hours** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12 marks Q3. Journal and Viva 05 marks	

Name of the Course: Cloud Computing

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides a comprehensive foundation in cloud computing and virtualization technologies. It covers the essential concepts, characteristics, and architecture of cloud computing along with its infrastructure, services, and applications. Students will gain an understanding of cloud deployment models, security challenges, and management practices. The course also introduces virtualization, the core technology enabling cloud computing, by exploring its types, benefits, hypervisors, and virtual machine architecture. Through this course, learners will develop both conceptual knowledge and practical insights into how cloud and virtualization technologies support modern IT solutions and business environments.
2	**Vertical:**	**Major**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand the fundamental concepts and evolution of cloud computing. 2. Explain the architecture, infrastructure, and service models of cloud computing. 3. Analyze the essential characteristics and benefits of cloud computing. 4. Explore virtualization concepts, types, and their role in cloud environments. 5. Evaluate cloud security, management, and applications with real-world use cases.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Describe the basics, architecture, and working principles of cloud computing. CO2: Differentiate between various types of cloud deployment and service models. CO3: Explain virtualization concepts, hypervisors, and virtual machine architecture. CO4: Assess the benefits, challenges, and security aspects of cloud environments. CO5: Apply cloud and virtualization knowledge to identify suitable solutions for business and IT scenarios.	
9	**Modules:-** **Module 1 (15 hours):**	
	Introduction to Cloud Computing: Definition, Evolution, Need, Advantages and Limitations Essential Characteristics and Architecture of Cloud Computing Types of Cloud: Public, Private, Hybrid, Community Service Models: IaaS, PaaS, SaaS	

	Working of Cloud Computing: Resource Allocation, Load Balancing, Distributed Computing Cloud Security: Authentication, Authorization, Encryption, Firewalls, Backup and Disaster Recovery Cloud Management, Applications and Cloud Service Providers Introduction to Virtualization: Definition, Evolution, Need and Benefits Characteristics and Types of Virtualization Virtual Machine (VM): Definition, Features, Components, Types and Architecture Virtual Machine Monitor (VMM): Role, Functions and Architecture Hypervisors: Type I (Bare-Metal) and Type II (Hosted) Hypervisors Comparison of Type I and Type II Hypervisors	
	Module 2 (15 hours):	
	Introduction to Docker and Kubernetes: Introduction to Containerization, Virtual Machines vs Containers, Benefits of Containers, Introduction to Docker, Docker Architecture, Docker Images, Docker Containers, Dockerfile Basics, Docker Networking, Docker Volumes, Docker Compose, Introduction to Kubernetes, Need for Kubernetes, Kubernetes Architecture, Pods, Deployments, Services, Kubernetes Networking, Kubernetes Storage, kubectl Basics, Docker and Kubernetes Integration.	
10	**Text Books:** 1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter,TATA McGraw- Hill , New Delhi – 2010 2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008	
11	**Reference Books:** 1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010 2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks Class participation : 5 marks Total: 20 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Cloud Computing Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides a comprehensive foundation in cloud computing and virtualization technologies. It covers the essential concepts, characteristics, and architecture of cloud computing along with its infrastructure, services, and applications. Students will gain an understanding of cloud deployment models, security challenges, and management practices. The course also introduces virtualization, the core technology enabling cloud computing, by exploring its types, benefits, hypervisors, and virtual machine architecture. Through this course, learners will develop both conceptual knowledge and practical insights into how cloud and virtualization technologies support modern IT solutions and business environments.
2	**Vertical:**	**Major**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand the fundamental concepts and evolution of cloud computing. 2. Explain the architecture, infrastructure, and service models of cloud computing. 3. Analyze the essential characteristics and benefits of cloud computing. 4. Explore virtualization concepts, types, and their role in cloud environments. 5. Evaluate cloud security, management, and applications with real-world use cases.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Describe the basics, architecture, and working principles of cloud computing. CO2: Differentiate between various types of cloud deployment and service models. CO3: Explain virtualization concepts, hypervisors, and virtual machine architecture. CO4: Assess the benefits, challenges, and security aspects of cloud environments. CO5: Apply cloud and virtualization knowledge to identify suitable solutions for business and IT scenarios.	
9	**Modules:-**	

	Module 1 (15 hours):	
	Practical 1: Installation of Ubuntu Linux on Virtual Machine **Practical 2:** Perform Basic Linux Commands in Ubuntu. **Practical 3:** Install Docker and Use hello-world image. **Practical 4:** Run Ubuntu docker and perform basic command on ubuntu. **Practical 5:** Create a Dockerfile in Windows	
	Module 2 (15 hours):	
	Practical 6: Run MYSQL in docker and perform query in MYSQL in docker. **Practical 7:** Installing Kubernetes and Verifying the Cluster **Practical 8:** Deploy a BusyBox Application Using a YAML File **Practical 9:** Deploying an Nginx Application in Kubernetes **Practical 10:** Deploy MySQL in Kubernetes	
10	**Text Books:** 1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter,TATA McGraw- Hill , New Delhi – 2010 2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008	
11	**Reference Books:** 1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010 2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**

14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration: 2 hours** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12 marks Q3. Journal and Viva 05 marks

Elective

Name of the Course: Cyber security and Forensics

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces the fundamental concepts of Cyber Security and Cyber Forensics, focusing on the CIA triad, threats, vulnerabilities, cyber crimes, and security policies. It provides an overview of cyber warfare, cyber terrorism, and Internet governance challenges. The second module emphasizes Digital Forensics, including the lifecycle of forensic investigations, evidence handling, cyber laws, forensic tools, and challenges in mobile and cloud forensics. The course equips students with the knowledge and skills to understand, analyze, and address cyber threats while following ethical and legal frameworks..
2	**Vertical:**	**Elective**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand the basic concepts of cyber security, threats, vulnerabilities, and layers of security. 2. Learn about various forms of cyber crimes, harmful acts, and motives of attackers. 3. Analyze the importance of security policies, Internet governance, and legal frameworks. 4. Gain knowledge of cyber forensics processes including evidence collection, preservation, and investigation. 5. Explore digital forensic tools, challenges, and applications in mobile and cloud environments.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Explain cyber security concepts, CIA triad, and types of threats and attacks. CO2: Identify different types of cyber crimes, including warfare, terrorism, espionage, and financial fraud. CO3: Apply knowledge of cyber security policies and legal aspects such as the IT Act (India). CO4: Demonstrate understanding of the cyber forensics lifecycle, digital evidence handling, and investigation process. CO5: Evaluate forensic tools and techniques for analyzing digital crimes, mobile device security, and emerging challenges.	
9	**Modules:-** **Module 1 (15 hours):**	
	Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks,	

	passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.	
	Module 2 (15 hours):	
	Cyber Forensics: Introduction, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics. Introduction to Cyber Forensics – scope and need, Cyber Crimes – identity theft, financial fraud, cyber stalking, Cyber laws and IT Act (India) – overview, Forensic investigation process – collection, preservation, analysis, reporting, Digital forensic tools – EnCase, FTK, Autopsy (basic awareness), Mobile device security & forensics challenges.	
10	**Text Books:** 1. Guide to computer forensics and investigations, Bill Nelson, Amelia Philips and Christopher Steuart, course technology,5th Edition,2015. 2. Computer Security: Principles and Practice, William Stallings, Pearson Education.	
11	**Reference Books:** 1. Incident Response and computer forensics, Kevin Mandia, Chris Prosise, Tata McGrawHill,2nd Edition,2003. 2. Guide to Computer Forensics and Investigations, Cengage Learning Nelson, Phillips, Steuart.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks Class participation : 5 marks Total: 20 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Cyber security and Forensics Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides hands-on training in Cyber Security and Digital Forensics techniques used for investigating cyber incidents and digital evidence. Students learn network traffic analysis, packet capturing, email forensics, browser forensics, data acquisition, deleted file recovery, memory analysis, data carving, and steganography using industry-standard tools such as Wireshark, EnCase, Autopsy, Sysinternals, and forensic imaging devices. The course emphasizes practical skills required for identifying, collecting, preserving, analyzing, and presenting digital evidence in cybercrime investigations.
2	**Vertical:**	**Elective**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To understand the fundamentals of cyber security and digital forensics investigation. 2. To develop skills in capturing, monitoring, and analyzing network traffic using forensic tools. 3. To perform digital evidence acquisition and recovery using forensic imaging and analysis techniques. 4. To apply digital forensic methods for investigating cyber incidents and analyzing digital evidence.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Capture and analyze network packets to identify network activities and potential security threats. CO2: Perform digital forensic investigations and acquire forensic images while maintaining evidence integrity. CO3: Recover, inspect, and analyze deleted files, browser artifacts, emails, and system activities using forensic tools. CO4: Apply data carving and steganography techniques to identify, recover, and examine concealed digital information.	
9	**Modules:-** **Module 1 (15 hours):**	
	Practical 1: Capturing and analyzing network packets using Wireshark (Fundamentals) : - Identification the live network - Capture Packets - Analyze the captured packets	

	Practical 2: Solve the Case study (image file) provide in lab using Encase Investigator or Autopsy **Practical 3:** Perform data acquisition using: USB Write Blocker + Encase Imager, SATA Write Blocker + Encase Imager, Falcon Imaging Device **Practical 4:** Recovering and Inspecting deleted files - Check for Deleted Files - Recover the Deleted Files - Analyzing and Inspecting the recovered files Perform this using recovery option in ENCASE and also Perform manually through command line **Practical 5:** Web Browser Forensics - Web Browser working - Forensics activities on browser - Cache / Cookies analysis - Last Internet activity .
	Module 2 (15 hours):
	Practical 6: Email Forensics - Mail Service Providers - Email protocols - Recovering emails - Analyzing email header **Practical 7:** Using Sysinternals tools for Network Tracking and Process Monitoring : Check Sysinternals tools Monitor Live Processes Capture RAM Capture TCP/UDP packets Monitor Hard Disk Monitor Virtual Memory and Cache Memory **Practical 8:** Analyze the packets provided in lab and solve the questions using Wireshark : What web server software is used by www.snopes.com? About what cell phone problem is the client concerned? According to Zillow, what instrument will Ryan learn to play? **Practical 9:** Use Data Carving tool. **Practical 10:** Using Steganography tools.
10	**Text Books:** 1. Nelson Phillips, Christopher Steuart and Andy Clark, "Guide to Computer Forensics and Investigations", 6th Edition, Cengage Learning. 2. Bill Nelson, Amelia Phillips and Christopher Steuart, "Computer Forensics and Investigations", Cengage Learning. 3. Jason Luttgens, Matthew Pepe and Kevin Mandia, "Incident Response and Computer Forensics", McGraw-Hill Education.
11	**Reference Books:** 1. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet", 3rd Edition, Academic Press. 2. Brian Carrier, "File System Forensic Analysis", Addison-Wesley Professional. 3. EC-Council, "Computer Forensics: Investigating Network Intrusions and Cyber Crime", Cengage Learning. 4.

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**
14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration:2 hour** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12 marks Q3. Journal and Viva 05 marks	

Name of the Course: Internet of Things

Sr. No.	Heading	Particulars
1	**Description the course:**	The Internet of Things (IoT) course introduces students to the concepts, architecture, and applications of IoT systems that connect the physical and digital worlds. It covers how everyday objects, devices, and sensors collect, process, and exchange data over the internet to enable intelligent decision-making. This course provides a balanced mix of theoretical understanding and hands-on practice, helping students build skills in IoT system design, communication protocols, and data processing. Students will learn to integrate sensors, actuators, microcontrollers (such as Arduino or Raspberry Pi), and cloud platforms to develop working IoT prototypes.
2	**Vertical:**	**Elective**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To understand the concept of the Internet of Things and its communication protocols 2. To explore different techniques of prototyping embedded devices and their physical design 3. To gain knowledge about various business models and funding options for Internet of Things startups.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Explain the concept of the Internet of Things, its applications in real-life scenarios and understand the communication protocols of the internet and design efficient web-connected devices CO2: Understand the communication protocols of the internet and design efficient web-connected devices. CO3: Understand the business models and funding options available for startups in the Internet of Things domain and apply them to real-life scenario	
9	**Modules:-** **Module 1 (15 hours):**	
	The Internet of Things: Definition and Application of IoT, Design Principles for Connected Devices: Calm and Ambient Technology, Magic as Metaphor, Graceful Degradation, Affordances. Internet Communications: The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static and Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports, HTTP Ports, HTTP, HTTPS. Thinking About Prototyping: Sketching, Costs versus Ease of Prototyping, Changing Embedded Platform, Mass Personalization, Mixing Open and Closed Source, Tapping into	

	the Community. Prototyping Embedded Devices: Sensors, Actuators, Scaling Up the Electronics, Embedded Computing Basics: Microcontrollers, System-on-Chips, Arduino, Raspberry Pi.	
	Module 2 (15 hours):	
	Prototyping the Physical Design: Non digital Methods, Laser Cutting, Choosing a Laser Cutter, Hinges and Joints, 3D Printing, CNC Milling, Repurposing/Recycling. Prototyping Online Components: API, Mashing Up APIs, Scraping, Polling, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol. Techniques for Writing Embedded Code: Memory Management, Types of Memory, Making the Most of Your RAM, Performance and Battery Life, Libraries Business Models: The Business Model Canvas, Funding an Internet of Things: Venture Capital, Government Funding, Crowd funding, Lean Startups. Moving to Manufacture: Designing Printed circuit boards, Software Choices, The Design Process, Manufacturing Printed Circuit Boards, Etching Boards, Milling Boards.	
10	**Text Books:** 1. Designing the Internet of Things by Adrian McEwen, Hakim Cassimally, WILEY Publisher, First Edition,2014 2. Internet of Things – Architecture and Design by Raj Kamal, McGraw Hill Publisher, First Edition,2017	
11	**Reference Books:** 1. Getting Started with the Internet of Things by Cuno Pfister, O'Reilly Publisher,Sixth Edition,2018 2. Getting Started with Raspberry Pi by Matt Richardson and Shawn Wallace,SPD Publisher, 3rd Edition,2016	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks Class participation : 5 marks Total: 20 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Internet of Things Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	The Internet of Things (IoT) course introduces students to the concepts, architecture, and applications of IoT systems that connect the physical and digital worlds. It covers how everyday objects, devices, and sensors collect, process, and exchange data over the internet to enable intelligent decision-making. This course provides a balanced mix of theoretical understanding and hands-on practice, helping students build skills in IoT system design, communication protocols, and data processing. Students will learn to integrate sensors, actuators, microcontrollers (such as Arduino or Raspberry Pi), and cloud platforms to develop working IoT prototypes.
2	**Vertical:**	**Elective**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Hands-on Understanding of IoT Concepts 2. Familiarity with IoT Hardware Platforms: 3. Sensor and Actuator Integration. 4. Programming for IoT Devices.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Apply fundamental IoT concepts to build simple IoT-based systems. CO2: Demonstrate the ability to configure and operate IoT hardware platforms such as Raspberry Pi CO3: Interface and test sensors and actuators with microcontrollers in an IoT environment. CO4: Write and debug code for IoT devices to perform data acquisition, processing, and communication.	
9	**Modules:-** **Module 1 (15 hours):**	
	Starting Raspbian OS, Familiarizing with Raspberry Pi Components and interface, Connecting to ethernet, Monitor, USB. **Practical 1:** Displaying different LED patterns with Raspberry Pi. **Practical 2:** Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi **Practical 3:** Interfacing 16X2 LCD with Raspberry Pi to display different messages. **Practical 4:**	

	Raspberry Pi Based Oscilloscope. **Practical 5:** Controlling Raspberry Pi with WhatsApp.	
	Module 2 (15 hours):	
	Practical 6: Fingerprint Sensor interfacing with Raspberry Pi. **Practical 7:** Raspberry Pi GPS Module Interfacing. **Practical 8:** IoT based Web Controlled Home Automation using Raspberry Pi. **Practical 9:** Interfacing Pi Camera with Raspberry Pi. **Practical 10:** Interfacing Raspberry Pi with RFID.	
10	**Text Books:** 1. Designing the Internet of Things :Adrian McEwen, Hakim Cassimally WILEY First 2014. 2. Official Raspberry Pi Beginner's Guide: Gareth Halfacre Raspberry Pi Press First2018.	
11	**Reference Books:** 1. Programming the Raspberry Pi by Simon Monk McGraw Hill Third 2021 2. Getting Started with Raspberry Pi: Matt Richardson and Shawn WallaceGetting Started with Raspberry Pi by Matt Richardson and Shawn Wallace,SPD Publisher, 3rd Edition,2016	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**
14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration:2 hour** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12 marks Q3. Journal and Viva 05 marks	

Name of the Course: Advanced Java Technologies

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces students to Enterprise Java (Java EE) for developing scalable, distributed, and dynamic web applications. In Module 1, learners gain a solid foundation in Java EE architecture, Servlets, JDBC, state management, JSP, Expression Language, and JSTL for creating interactive web-based applications. Module 2 focuses on advanced enterprise technologies including Enterprise JavaBeans (EJB), JNDI, persistence frameworks, Java Persistence API (JPA), and Hibernate ORM. By the end of the course, students will be able to design, implement, and deploy enterprise-level applications using modern Java EE standards and frameworks.
2	**Vertical:**	**Elective**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand Java EE architecture and enterprise application components. 2. Develop dynamic web applications using Servlets, JSP, and JDBC. 3. Implement session handling, cookies, and file operations. 4. Work with EJBs, JNDI, and enterprise components. 5. Apply JPA and Hibernate for database persistence.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Describe Java EE architecture and components. CO2: Build web applications using Servlets, JSP, and JDBC. CO3: Manage sessions, cookies, and file handling. CO4: Develop enterprise components using EJB and JNDI. CO5: Implement data persistence using JPA and Hibernate.	
9	**Modules:-** **Module 1 (15 hours):**	
	Introduction to Java EE & Architecture: What is an Enterprise Application, Java Enterprise Edition Overview, Java EE Technologies & Evolution, GlassFish Server, Java EE Architecture, System Architectures (Types), Java EE Server and Containers Servlets & Dynamic Web Content: Need for Dynamic Content, What are Servlets? Role & Features, What Servlets Can Do, Servlet API & Servlet Skeleton, Servlet Life Cycle, Simple Welcome Servlet, Working with Servlets using Annotations (vs Deployment Descriptor) JDBC & Database Connectivity: What is JDBC?, JDBC Architecture, Accessing Databases in Servlets, Servlet GUI + Database Example	

	Request Handling & State Management: RequestDispatcher Interface & Methods, RequestDispatcher Application, Cookies: Types, Uses, Creation in Servlets, Servlet Example: Dynamic Color Change, Sessions: What & Why, HttpSession Lifecycle, Session Tracking in Servlets, Servlet Session Example Java Server Pages (JSP): Why JSP? JSP vs Servlets, Disadvantages of JSP, JSP Architecture and Lifecycle, How JSP Executes, JSP Basics: Comments, JSPDocument, Elements, GUI Example Action Elements & Expression Language: Action Elements, Page Inclusion and Forwarding, Passing Parameters, JavaBeans in JSP, Implicit Objects, EL Syntax & Scope, Unified EL and Expression Language JSTL (Java Standard Tag Library): Drawbacks of Scriptlets, How JSTL Resolves Them, Disadvantages of JSTL, Using Tag Libraries	
	Module 2 (15 hours):	
	Enterprise JavaBeans (EJB) Enterprise Bean Architecture, Benefits of EJB, Types of Enterprise Beans, Accessing Beans, Enterprise Bean Applications, Packaging Beans **Session Beans** When to Use Session Beans, Stateless Stateful and Singleton Session Beans, Remote vs Local Interfaces, Bean Lifecycle, Examples of All Bean Types, Packaging and Deployment **Java Naming and Directory Interface (JNDI)** What is Naming Service? Directory Service?, Introduction to JNDI, Namespace in Java EE, Basic Lookup, Resources in JNDI, Datasource Definition in Java EE **Persistence & ORM Concepts** What is Persistence?, Persistence in Java, Why ORM?, Current Standards in Persistence, Object Relational Mapping (ORM) **Java Persistence API (JPA)** Introduction to JPA, Architecture & How It Works, JPA Specifications, Application Requirements, Creating Database & Tables, Web App Setup, Persistence Unit (persistence.xml), JavaBeans & JSP Integration, Running JPA Applications **Hibernate Framework** What is Hibernate? Why Hibernate?, Hibernate vs JPA, Components and Architecture, How Hibernate Works?, Requirements & Development Workflow, Database Setup, Web App Configuration, Hibernate Config File and Mapping Classes, JavaBeans JSPs and Running the Application	
10	**Text Books:** 1. Ivan Bayross – Practical Java EE Projects Using NetBeans (BPB Publications) 2. Antonio Goncalves – Beginning Java EE 7 (Apress)	
11	**Reference Books:** 1. Jim Keogh – The Complete Reference J2EE (McGraw-Hill) 2. Gavin King & Christian Bauer – Java Persistence with Hibernate (Manning Publications)	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr**

	Class participation : 5 marks Total: 20 marks	**duration**
14	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Advanced Java Technologies Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides practical knowledge of Java Enterprise Application Development using Servlets, JSP, JDBC, JSTL, Expression Language, JPA/Hibernate, and Enterprise JavaBeans (EJB). Students learn to develop dynamic web applications, manage user sessions and cookies, interact with databases, implement authentication systems, and build enterprise-level applications using Java EE technologies. The course emphasizes hands-on experience in designing, developing, and deploying scalable web-based solutions.
2	**Vertical:**	**Elective**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To understand the concepts of Java Enterprise programming using Servlets, JSP, JDBC, JPA/Hibernate, and EJB. 2. To develop dynamic web applications using Servlets and JSP technologies. 3. To implement database connectivity and persistence mechanisms for web applications. 4. To design and deploy enterprise-level applications using modern Java EE technologies.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: **CO1:** Develop and deploy web applications using Servlets, JSP, and session management techniques. **CO2:** Implement database-driven applications using JDBC for user registration, authentication, and data processing. **CO3:** Apply JSTL, Expression Language, and JPA/Hibernate to create dynamic and persistent web applications. **CO4:** Develop enterprise applications using EJB components and integrate them with Servlets and JSP for business processing.	
9	**Modules:-** **Module 1 (15 hours):**	
	Practical 1: Basic Servlet Create a simple servlet that displays a welcome message using doGet(). **Practical 2:** Servlet with Database (JDBC) Develop a servlet to register user details (Username, Password, Email) and store them in a database using JDBC. **Practical 3:** Login Servlet with Request Dispatcher Create a login servlet that validates user credentials and forwards to another servlet using	

	Request Dispatcher. **Practical 4:** Session Management Demonstrate session tracking in servlet by displaying whether the user is visiting for the first time or not. **Practical 5:** Cookies in Servlet Create a servlet to count and display the number of visits using cookies.	
	Module 2 (15 hours):	
	Practical 6: JSP Basics Develop a JSP page to display form input using intrinsic objects (request, session, application). **Practical 7:** JSP with JDBC (Login/Registration) Create a JSP-based login and registration module using JDBC for authentication. **Practical 8:** JSTL and Expression Language Create a JSP application that uses JSTL and EL to perform operations and display values dynamically. **Practical 9:** JPA/Hibernate CRUD Develop a simple application using JPA/Hibernate to store and retrieve employee or product details. **Practical 10:** EJB Application Create a simple Stateful or Stateless Session Bean (e.g., Currency Converter or Shopping Cart) and access it via a servlet or JSP.	
10	**Text Books:** 1. Ivan Bayross, Web Enabled Commercial Application Development Using Java, BPB Publications. 2. Herbert Schildt, Java: The Complete Reference, McGraw-Hill Education. 3. Bryan Basham, Kathy Sierra and Bert Bates, Head First Servlets and JSP, O'Reilly Media.	
11	**Reference Books:** 1. James Keogh, J2EE: The Complete Reference, McGraw-Hill Education. 2. Eric Jendrock et al., The Java EE Tutorial, Oracle Press. 3. Gavin King and Christian Bauer, Java Persistence with Hibernate, Manning Publications. 4. Richard Monson-Haefel, Enterprise JavaBeans, O'Reilly Media.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**
14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration:2 hour** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12 marks Q3. Journal and Viva 05 marks	

Semester- V

Vertical – II
Minor

Name of the Course: Data Science and Analytics

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces the fundamentals of data science, statistics, and Python programming along with practical applications in data analytics and intelligent systems. Students will learn how to process, analyze, and visualize data, apply basic statistical methods, and explore core concepts of predictive modeling, classification, clustering, and applications in real-world domains such as image recognition and natural language processing.
2	**Vertical:**	**Minor**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To introduce the fundamental concepts of data science and its technology stack. 2. To develop skills in statistical methods for analyzing and interpreting data. 3. To provide hands-on experience with Python for data analysis and visualization. 4. To explain predictive modeling and key analytical techniques for data-driven decision-making. 5. To familiarize students with applications of data analytics in real-world domains.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Understand the core concepts, frameworks, and tools of data science. CO2: Apply statistical techniques for effective data processing and error analysis. CO3 Use Python to perform data analysis and create meaningful visualizations. CO4: Build and evaluate basic predictive and classification models for data-driven insights. CO5: Demonstrate the ability to apply analytical concepts to real-world applications such as image recognition and natural language processing.	
9	**Modules:-** **Module 1 (15 hours):**	
	Unit 1: Data Science Basics, Statistics and Python Data Science, Data Science Technology Stack, Storage Tools, Data Lakes, Data Warehouses, Spark, Python, R, Scala, Data Science Frameworks, CRISP-DM, Layered Framework, Business Layer, Utility Layer, Statistics for Data Science, Data Processing, Errors, Cause-and-Effect Analysis, Business Knowledge from Data Lakes, Retrieve Superstep, Assess Superstep, Python for Data Analysis, Data Visualization, Matplotlib, Seaborn.	
	Module 2 (15 hours):	

	Unit 2: Machine Learning and Applications Machine Learning, Hypothesis Testing, Model Training and Testing, Overfitting and Underfitting, Cross-Validation, Linear Regression, Logistic Regression, Decision Trees, Clustering, Random Forests, Neural Networks, Image Recognition, Natural Language Processing, Reporting Results, Graphs, Visuals, Business Insights.	
10	**Text Books:** 1. **Python for Data Analysis** – Wes McKinney, O'Reilly Media, 2nd Edition, 2018 2. **Introduction to Machine Learning with Python** – Andreas C. Müller & Sarah Guido, O'Reilly Media, 1st Edition, 2016	
11	**Reference Books:** 1. **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow** – Aurélien Géron, O'Reilly Media, 2nd Edition, 2019 2. **Data Science from Scratch: First Principles with Python** – Joel Grus, O'Reilly Media, 2nd Edition, 2019	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks Class participation : 5 marks Total: 20 marks	**Format of Question Paper:** **External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Data Science and Analytics Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides hands-on experience with modern data engineering and optimization techniques. Students will learn to ingest, clean, transform, and visualize data from various formats and sources such as CSV, JSON, MySQL, and more. Key tools include Cassandra, R, Python, and Power BI. The course emphasizes real-world applications like warehouse location planning, balance sheet processing, and the HORUS data model. Students will also explore data visualization, time hubs, satellites, and advanced preprocessing techniques.
2	**Vertical:**	**Minor**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand and implement data ingestion pipelines across multiple formats (CSV, JSON, MySQL). 2. Learn to preprocess, clean, and organize data for analysis and transformation. 3. Use R for exploratory data analysis, pattern recognition, and attribute extraction. 4. Apply data science techniques like clustering for business optimization. 5. Visualize business intelligence insights using Power BI.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Convert raw data into structured formats compatible with the HORUS data model. CO2: Clean, preprocess, and organize datasets efficiently using modern techniques. CO3: Perform data exploration and attribute analysis using R. CO4: Optimize real-world operations (e.g., warehouse location) using data-driven techniques. CO5: Design compelling Power BI dashboards for business reporting and insights.	
9	**Modules:-** **Module 1 (15 hours):**	
	Practical 1: Creating and using database in Cassandra **Practical 2:** Write the programs for the following: 1. Text Delimited CSV to HORUS format 2. JSON to HORUS format 3. MySQL database to HORUS format	

	Practical 3: Data Cleaning and Preprocessing 1. Fixers Utilities 2. Data Binning or Bucketing 3. Outlier Detection **Practical 4:** Data Exploration and Analysis using R 1. Perform data processing using R 2. Program to retrieve different attributes of data 3. Data pattern. **Practical 5:** Data-Driven Optimization Programs 1. Use clustering to determine new warehouse location 2. Plan location of warehouse from the given data 3. Process balance sheet to ensure only good data is processed	
	Module 2 (15 hours):	
	Practical 6: Building Data Vault Components: Creating Time Hub, Links, and Satellites **Practical 7:** Perform Data Transformation Operations Using ETL Tools. **Practical 8:** Organize and Structure Data for Effective Analysis. **Practical 9:** Generate Data for Business Intelligence and Analytical Applications. **Practical 10:** Develop Interactive Reports and Dashboards Using Power BI.	
10	**Text Books:** 1. **Data Science for Business** – Foster Provost & Tom Fawcett, O'Reilly Media, 1st Edition, 2013 2. **Mastering Apache Cassandra** – Nishant Neeraj, Packt Publishing, 3rd Edition, 2020	
11	**Reference Books:** 1. **R for Data Science** – Hadley Wickham & Garrett Grolemund, O'Reilly Media, 1st Edition, 2016 2. **Collect, Combine, and Transform Data Using Power BI and Power Query in Excel** – Gil Raviv, Microsoft Press, 1st Edition, 2018	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**

14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration:2 hour** Practical Slip: Q1. From Module 1 12 marks Q2. From Module 2 12 marks Q3. Journal and Viva 06 marks

Vertical – IV

VSC

Name of the Course: Kotlin for Next-Gen Android App

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides hands-on experience in developing Android applications using Kotlin and Android Studio. Students will explore essential Android components such as Activities, Fragments, Layouts, UI elements, Intents, Services, SQLite database, Media APIs, and background threading. Through practical exercises, learners will gain skills in user interface design, navigation, data storage, device permissions, notifications, and handling multimedia, with an emphasis on real-world app development scenarios.
2	**Vertical:**	**VSC**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand and apply Android resources including colors, strings, dimensions, and drawables. 2. Develop interactive user interfaces using layouts and various UI components. 3. Utilize Intents, Event Listeners, and Adapters to create responsive applications. 4. Work with Android system components like Services, Broadcast Receivers, Notifications, and SQLite databases.	
8	**Course Outcomes :** By the end of this course, the learner will be able to: CO1: Create Android applications using Activities, Fragments, and navigation techniques. CO2: Design intuitive UIs with different layouts and components like Buttons, CheckBoxes, and AppBars. CO3: Implement data storage and retrieval using SQLite and manage background operations effectively. CO4: Build apps that utilize system features such as Services, Notifications, and BroadcastReceivers.	
9	**Modules:-** **Module 1 (15 hours):**	
	Practical 1: Programming Resources: Working with Android resources: Colors, Themes, Strings, Drawables, Dimensions, and Images	

	Practical 2: Programming Activities and Fragments: Activity life cycle demonstration (onCreate, onStart, onResume, etc.). Implement multiple activities and navigate using Intent. **Practical 3:** Implement UI using different layouts. **Practical 4:** Programming UI Elements: Use basic UI components: TextView, EditText, Button, ImageView, CheckBox, RadioButton, Switch. AppBar with Toolbar. **Practical 5:** Programming Menus, Dialogs, and Dialog Fragments Options menu and context menu. AlertDialog and custom dialog.	
	Module 2 (15 hours):	
	Practical 6: Programs on Intents, Events, Listeners, and Adapters,Explicit and implicit Intents. Handling click events with setOnClickListener. Using adapters for ListView/RecyclerView. **Practical 7:** Programs on Services, Notifications, and Broadcast Receivers**:**Background service demo, Push notification example, Simple BroadcastReceiver (e.g., detect airplane mode). **Practical 8:** SQLite Database:Create a table, insert, update, delete, and display data. **Practical 9:** Programming Threads, Handlers, and Async Tasks, Create a thread in Kotlin, Use Handler to update UI from background, Async programming with Coroutine. **Practical 10:** a) Media API: Play audio/video from local storage. b) Security and Permissions: Request runtime permissions (Camera, Storage, Location).	
10	**Text Books:** 1. Android Programming for Beginners,John Horton Publisher Packt Third 2021. 2. Head First Android Development, Dawn Griffiths, David Griffiths, O'Reilly Second 2017.	
11	**Reference Books:** 1. Android System Programming, Roger Ye Packt First 2017 2. Fundamentals of Android App Development, Sujit Kumar Mishra	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**Format of Question Paper:** **External Examination (30 Marks)– 2 hr duration**

14	**Format of Question Paper:** **Semester End Examination: 30 Marks. Duration:2 hour** Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12 marks Q3. Journal and Viva 05 marks

Nirmala Memorial Foundation College of Commerce and Science

(Autonomous)

Re-accredited by NAAC with B++, ISO 9001-2015 Certified, Recognised under section 2(f) & 12(B) of the UGC Act 1956

Permanently Affiliated to the University of Mumbai,

Syllabus

Community Engagement Project

(CEP)

(To be implemented from the Academic Year 2026-2027)

Approved in the Academic Council Meeting held on ***3rd June 2026***

Vertical – VI

Name of the Course: Community Engagement Project

Sr. No.	Heading	Particulars
1	**Description the course:**	The National Education Policy (NEP) 2020 emphasizes experiential learning, service learning, community engagement, and socially relevant education. Consequently, Community Engagement Projects (CEP) have been introduced as an important component of undergraduate programs. While the intent of CEP is highly valuable, professional degree programs such as B.Sc. Information Technology face a unique challenge. Earlier, students in Information Technology have undertaken major technical projects involving: Software Development, Web Technologies, Mobile Applications, IoT Solutions, Artificial Intelligence, Data Analytics, Networking Solutions, Embedded Systems. These projects serve multiple purposes: Skill development, Portfolio building, Placement preparation, Industry readiness, Higher education opportunities, Innovation and entrepreneurship With the introduction of CEP, there is concern that replacing technical projects entirely with community-oriented documentation-based activities may reduce opportunities for students to demonstrate technical competencies expected by employers and industry. Therefore, a balanced implementation model is proposed. The current interpretation of CEP often focuses primarily on community activities such as: Awareness campaigns, Surveys, Community visits, Training programs. While these activities contribute to social responsibility, they may not adequately demonstrate the technical competencies expected from Information Technology graduates. The challenge is therefore: "How can CEP objectives be achieved without compromising the technical rigor, employability, and professional growth of Information Technology students?"
2	**Vertical:**	CEP
3	**Type:**	Project
4	**Credits:**	2 credits
5	**Hours Allotted:**	30 Hours (Field Work+ Survey) + 15hrs (Discussion + Report Writing) : Total – 45 Hours
6	**Marks Allotted:**	50 Marks
7	**Modules:-**	
	Component Weightage Distribution: • Technical Design & Development - 40% • System Implementation - 20% • Testing & Validation -15% • Community Need Assessment - 10% • Community Deployment & Impact Assessment - 10% This creates an approximate balance of: • 80% Technical Component • 20% Community Engagement Component	

	Examples of CEP-Integrated Technical Projects **Example 1:** Digital Literacy Learning Application for Senior Citizens Community Need: Limited digital literacy among senior citizens. Technical Solution: Android application containing, regional language support, Video tutorials, Interactive quizzes, Voice assistance Community Component: User testing by senior citizens, Feedback collection, Impact assessment . **Example 2:** Smart Water Tank Monitoring System Community Need: Water wastage in residential societies. Technical Solution: IoT-based monitoring system. Community Component: Installation in society, Data collection, User feedback. **Example 3:** Local Vendor E-Commerce Platform Community Need: Small vendors lack digital visibility. Technical Solution: Web-based marketplace. Community Component: Vendor onboarding, Training, Sales impact analysis	
10	**Report Structure :** 1. **Introduction & Community Analysis** o Project Background, Community Problem Identification, Need Assessment, Existing & Proposed System, Objectives, Scope. 2. **Literature Review & Requirement Analysis** o Literature Survey, Related Work, Requirement Gathering, Functional and Non-Functional Requirements. 3. **System Design & Development** o Architecture, UML Diagrams, Database & Hardware Design, Technology Stack, Development Methodology, Module Design, Front-end, Back-end, Database Implementation, Hardware Integration. 4. **Testing, Validation & Deployment** o Unit Testing, Integration Testing, User Acceptance Testing, Performance Testing, Results, Pilot Deployment, User Training. 5. **Impact Assessment, Conclusion & Future Scope** o Beneficiary Profile, Feedback Analysis, Impact Assessment, Sustainability, Technical & Community Outcomes, Project Contributions, Limitations, Future Enhancements.	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Internal Evaluation :** Attendance, Community interactions completion and interaction with Supervisor : 10 Marks Overall Report quality: 10 Marks **Total: 20 Marks**	**External Evaluation :** Objectives, Literature Review , Methodology, Data Analysis, Conclusion and Recommendations - 15 Marks Overall Project Report Structure and Style - 5 Marks Presentation Skills & Communication – 10 Marks **Total 30 Marks**

Letter Grades and Grade Points:

Semester GPA/ Program CGPA Semester/ Program	% of Marks	Alpha-Sign / Letter Grade Result		Grade Points
9.00-10.00	90.0-100	O	(Outstanding)	10
8.00-<9.00	80.0-<90.0	A+	(Excellent)	9
7.00-<8.00	70.0-<80.0	A	(Very Good)	8
6.00-<7.00	60.0-<70.0	B+	(Good)	7
5.50-<6.00	55.0-<60.0	B	(Above Average)	6
5.00-<5.50	50.0-<55.0	C	(Average)	5
4.00-<5.00	40.0-<50.0	P	(Pass)	4
Below 4.00	Below 40	F	(Fail)	0
Ab (Absent)	-	AB	(Absent)	0

Signature of BOS Chairman
Ms. Vaishali Mishra
BOS (Information Technology)

Signature of Faculty Member
Ms. Hiral Parakhiya
(Information Technology)

Signature of I/C Principal
Dr. Swiddle D'Cunha