HSNC University Mumbai

(2025-2026)

Ordinances and Regulations

With Respect to

Choice Based Credit System (CBCS)

For the Program Under

The Faculty of Science and Technology

For the Course

Information Technology

Curriculum – Third Year Undergraduate Program

Semester-V and Semester -VI

2025-2026

Part 1- Preamble

The revised and restructured curriculum for the B.Sc. (IT) under NEP is integrated course as systematically designed considering the current industry needs in terms of skills sets demanded under new technological environment. It also endeavors to align the programme structure and course curriculum with student aspirations and corporate expectations. The proposed curriculum is more contextual, industry affable and suitable to cater the needs of society and nation in present day context. The B.Sc. Information Technology programme was started in 2001 with an aim to make the students employable and impart industry oriented training. The main objectives of the course are:

- To think analytically, creatively and critically in developing robust, extensible and highly maintainable technological solutions to simple and complex problems.
- To apply their knowledge and skills to be employed and excel in IT professional careers and/or to continue their education in IT and/or related post graduate programmes.
- To be capable of managing complex IT projects with consideration of the human, financial and environmental factors.
- To work effectively as a part of a team to achieve a common stated goal.
- To adhere to the highest standards of ethics, including relevant industry and organizational codes of conduct.
- To communicate effectively with a range of audiences both technical and non-technical.
- To develop an aptitude to engage in continuing professional development.

The new syllabus is aimed to achieve the objectives. The syllabus spanning four years covers the industry relevant courses. The students will be ready for the jobs available in different fields like:

- **Software Development (Programming)**
- **Website Development**
- **Mobile app development**
- **Embedded System with Internet of Things**
- **Network Security**
- **Software Testing**
- **Networking**
- **Database Administration**
- **System Administration**
- **Cyber Law Consultant**
- **Virtualization**
- **Devops (Development & Operation)**
- **Entrepreneurship Development &Management**
- **Green IT and many other.**

We sincerely believe that any student taking this programme will get very strong foundation and exposure to basics, advanced and emerging trends of the subject. We wholeheartedly thank all experts who shared their valuable feedbacks and suggestions in order to improvise the contents, we have sincerely attempted to incorporate each of them.

1. **Process adopted for curriculum designing:**

The Department conducted multiple meetings with academic partners, industry partners and BOS Members. After discussion with them personally, via mail, via messages, the changes in the syllabus were introduced. The course design focusses on immediate employability of the student after graduation.

2. **Salient features, how it has been made more relevant:**

After discussion and interaction with industry and academic experts, many innovative changes are introduced in the syllabus. Innovative and advanced teaching on Software Project Management, Embedded System with Internet of Things,Enterprise Networking, Introduction to Artificial Intelligence, Linux System Administration, NOSQL DB, Data mining & Business Intelligence, Cyber Laws, Compliance & Frameworks. New subjects like Virtual Reality, Cryptography & Information Security, Mobile & Cloud Computing, Virtualization Concepts &Applications, DevOps and Entrepreneurship Development &Management are introduced. Community-based program (Social Responsibility), Career Skill Development, Soft Skills and Hands - on Training approach has been adopted.

3. **Learning Outcomes:**

The revised syllabus is expected to provide students with a strong foundation in Technology, Mathematical and Scientific fundamentals required to develop problem solving ability. It is expected to train students in comprehending, analyzing, designing, and creating novel products that provide solution frameworks to the real-world problems.

It will inculcate in students, the ability to gain multidisciplinary knowledge, modern tools usage and skills necessary for designing, developing and deploying software and hardware based applications. Our graduates should be able to set up various entrepreneurship ventures which in turn will facilitate employability. At the end of six semesters in UG program ,learners will acquire hands - on expertise in subjects like - Programming languages, Hardware concepts, Operating System ,Networking ,Database Management System, Software Engineering and SQA, Project Management, Security , Data Analytics , IoT , Virtual Reality, Cyber Law, Virtualization Concepts , Mobile & Cloud Computing, Artificial Intelligence and Machine Learning, Entrepreneurship and Business Management.Understanding and knowledge of basic concepts of IT with systems and applications such as algorithms, data structures, data handling, data communication and computation.Development of ability to identify, formulate and design solutions to computational challenges.Students will be empowered with superior expertise set of cutting edge innovation so that they are placed with prestigious IT companies like TCS , Infosys , Capgemini , Wipro, Datamatics, Pagadi, Wealth Vigyan, Skillsher, Peacommerce, LTI, Pi Techniques, Atos Syntel, Tatvic Analytics and many more.

4. Input from stakeholders:

There are modifications suggested in syllabus by industry personnel, alumni, and students. Subjects which have greater market applicability like Core Java, Database Management System, Web Programming and Applied Mathematics have been upgraded with latest technologies. New subjects like Android Programming, Data Analytics using R programming and Digital Marketing are incorporated, Virtual Reality, Cryptography & Information Security, Mobile & Cloud Computing, Virtualization Concepts &Applications, DevOps and Entrepreneurship Development & Management are introduced. Students are introduced to Statistics and Marketing concepts for technical analysis with the help of upgraded programming skills.

T.Y.B.Sc. (Information Technology) – Cloud Computing Syllabus
Choice Based Credit System (CBCS)
With effect from
Academic year 2025-2026

Semester-V

Course Code	Course Type	Course Title	Credits	Lectures/ Week
BIT301B	Core Subject	Enterprise Java	3	3
BIT301D	Core Subject Practical	Enterprise Java - Practical	1	3
BIT302B	Core Subject	Cryptography and Information Security	3	3
BIT302D	Core Subject Practical	Cryptography and Information Security – Practical	1	3
BIT303B	Discipline Specific Elective* 1	Cloud Computing Architecture	3	3
BIT303D	Discipline Specific Elective* 1 Practical	Cloud Computing Architecture – Practical	1	3
BIT304B	Discipline Specific Elective* 2	Virtualization Technologies	3	3
BIT304D	Discipline Specific Elective* 2 Practical	Virtualization Technologies – Practical	1	3
BIT301C	Discipline Specific Course (IKS)	Integrating IKS into Sustainable Software Project Management	2	3
BIT302C	Vocational Course1	Mobile Programming	2	3
BIT303C	Vocational Course 2	Virtual Reality	2	3
	Field Project/Internship/Apprenticeship/OJT		4	120L

* *One course each from Discipline Specific Elective 1 and Discipline Specific Elective 2 should be selected by the student*

Semester-VI

Course Code	Course Type	Course Title	Credits	Lectures/ Week
BIT305B	Core Subject	Full-Stack Web Development	3	3
BIT305D	Core Subject Practical	Full-Stack Web Development – Practical	1	3
BIT306B	Core Subject	Data Mining and Business Intelligence	3	3
BIT306D	Core Subject Practical	Data Mining and Business Intelligence – Practical	1	3
BIT307B	Discipline Specific Elective* 1	AI and Computer Vision	3	3
BIT307D	Discipline Specific Elective* 1 Practical	AI and Computer Vision – Practical	1	3
BIT308B	Discipline Specific Elective* 2	Cyber security and Law	3	3
BIT308D	Discipline Specific Elective* 2 Practical	Cyber security and Law – Practical	1	3
BIT304C	Discipline Specific Course	Internet of Things Fundamentals	2	3
BIT305C	Vocational Course1	DevOps (Development & Operations)	2	3
BIT306C	Vocational Course 2	No SQLDB Integration with Cloud Services	2	3
	Field Project/Internship/Apprenticeship/OJT		4	120L

* *One course each from Discipline Specific Elective 1 and Discipline Specific Elective 2 should be selected by the student*

Semester-V
Core Subject (Major1) - Enterprise Java **4 Credits**

Course Objectives

- Understand the architecture and components of enterprise Java technologies including JDBC, Servlets, JSP, and EJB.
- Develop dynamic and data-driven web applications using Java EE technologies such as JSP, Servlets, and Spring MVC.
- Utilize Hibernate for object-relational mapping and efficient data management in enterprise applications.
- Implement enterprise features such as session tracking, transaction management, and web services using modern Java frameworks.
- Design, develop, and deploy scalable and maintainable enterprise-level Java applications using JSF, Spring, and EJB components.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the fundamentals of JDBC, Servlets, JSP, and Hibernate for database connectivity and application development.	L1:Remember L2:Understand
CO2	Develop web applications using Servlets and JSP, demonstrating a strong grasp of web technologies for handling HTTP requests and responses.	L2:Understand L3: Apply
CO3	Master the use of Spring MVC and JSF frameworks to build modern, scalable web applications.	L3: Apply L4: Analyze
CO4	Implement transaction management, session management, and exception handling in enterprise applications using EJB and JAX-WS web services.	L3: Apply L4: Analyze
CO5	Design and develop enterprise-level applications using Hibernate ORM for efficient data management and manipulation.	L2: Understand L3: Apply
CO6	Build and deploy web services using JAX-WS to integrate enterprise applications with external systems.	L3: Apply L4: Analyze
CO7	Demonstrate an understanding of enterprise architecture, including the use of EJBs for business logic, and integrate these components into scalable applications.	L1: Remember L2: Understand
CO8	Evaluate the effectiveness of different Java EE components and frameworks for enterprise application development.	L4: Analyze, L5: Evaluate

Theory Syllabus **3 Credits**

Unit	Content	Lectures
I	**1. Introduction to Java** **1.1JDBC Programming** **1.2Servlet** **1.3Introduction to JSP**	**15**
II	**2.1 Hibernate** **2.2 Java Web Frameworks** **2.3 Java Server Faces**	**15**
III	**3.1Introduction to EJB** **3.2 Defining Client Access with Interfaces** **3.3The Life Cycles of Enterprise Beans**	**15**

Reference Books:

1. "Advanced Java 2 Platform HOW TO PROGRAM" by H. M.Deitel, P. J. Deitel, S. E. Santry, Prentice Hall, 2001
2. "Beginning Java™ EE 6 Platform with GlassFish 3 from Novice to Professional" by Antonio Goncalves – Apress publication, 2009
3. "Beginning Spring" by Mert Caliskan, Kenan Sevindik, Wrox Publication, 2015

Self-Learning topic (Unit wise)

Sub Unit	Topics
1.3	Introduction on JSP, Advantage and Benefit of JSP, Need of JSP
2.3	MVC in JSP, Introduction in JSTL
3.1	Introduction on EJB, Architecture on EJB

Online Resource

Sr.No	Website Address
1.	https://docs.oracle.com/javaee/5/tutorial/doc/bnagx.html
2.	https://docs.oracle.com/javaee/7/tutorial/
3.	https://spring.io/guides

Practicals

Major1- Enterprise Java Practical 1 Credit

Sr. No	Practical
1.	Write a Java Servlet Program to implement a dynamic Html using Servlet (username and Password should be accepted using HTML and displayed using Servlet)
2.	Write a Java Servlet Program to Auto Web Page Refresh (Consider a webpage which is displaying Date and time or stock market status. For all such type of pages, you would need to refresh your webpage regularly; Java Servlet make this job easy by providing refresh automatically after a given interval)
3.	Write a Java Servlet Program using Cookie to remember user preference.
4.	Write a Java Servlet program to track Http Session by accepting username and password using HTML and display the profile page on successful login.
5.	Write a JSP program to implement all the attributes of page directive tag
6.	Write a JSP Program to get student information through a HTML and create a JAVA Bean class, populate Bean and display the same information through another JSP.
7.	Using JSF Standard Component and Facelet Tags
8.	Demonstrate an EJB application that demonstrates Session Bean (with appropriate business logic).
9.	Study and implement Hibernate.
10.	Study and Implement MVC using Spring Framework.

Core Subject (Major2) - Cryptography and Information Security 4 Credits

Course Objectives

- To introduce the core concepts of Information Security, focusing on its importance and how to protect information in a digital landscape.
- To understand and apply Risk Analysis techniques, including threat identification, assessment, and management strategies.
- To explore Cryptographic techniques and security protocols that safeguard data, focusing on encryption, decryption, and authentication methods.
- To study Network Security fundamentals, including firewalls, VPNs, and intrusion detection systems, and their role in protecting organizational networks.
- To understand and apply best practices in securing VoIP systems, PBX systems, and Internet communication protocols.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the fundamental principles of Information Security and the importance of securing information.	L1:Remember L2:Understand
CO2	Apply Risk Analysis techniques to identify, assess, and manage risks to information systems.	L2: Understand L3: Apply
CO3	Master the use of cryptographic algorithms (symmetric and asymmetric) for securing information and communication.	L2: Understand L3: Apply
CO4	Implement authentication mechanisms, including passwords, tokens, biometrics, and certificates, for secure access control.	L3: Apply
CO5	Evaluate and implement Internet security protocols (SSL/TLS, SHTTP) to secure web traffic and online transactions.	L3: Apply L4: Analyze
CO6	Understand and apply Network Security concepts such as firewalls, IPsec, and VPNs to secure communications.	L2: Understand L3: Apply
CO7	Apply the principles of Intrusion Detection and Prevention Systems (IDS/IPS) and SIEM to detect and manage security incidents.	L3: Apply L4: Analyze
CO8	Analyze and secure VoIP and PBX systems, identifying vulnerabilities and implementing countermeasures.	L3: Apply L4: Analyze

Theory Syllabus **3 Credits**

Unit	Details	Lectures
I	**Unit 1: Introduction to Information Security and Risk Analysis** **1.1 Introduction to Information Security** **1.2 Risk Analysis** **1.3 Secure Design Principles**	**15**
II	**Unit 2: Cryptography, User Authentication, and Internet Security Protocols** **2.1 Cryptography: Concepts and Techniques** **2.2 Symmetric Key Algorithms** **2.3 Asymmetric Key Algorithms and Digital Signatures** **2.4 Digital Certificates and Public Key Infrastructure (PKI** **2.5 User Authentication** **2.6 Internet Security Protocols**	**15**
III	**Unit 3: Network Security, Intrusion Detection, and VoIP Security** **3.1 Network Security** **3.2 Intrusion Detection and Prevention Systems (IDS/IPS** **3.3 Voice over IP (VoIP) and PBX Security**	**15**

Text Books and References

1. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013.
2. Behrouz A. Ferouzan, ―Cryptography & Network Security‖, Tata Mc Graw Hill.
3. Bernard Menezes, ―Cryptography & Network Security‖, Cengage Learning.
4. Network Security Bible, Eric Cole, Second Edition, Wiley.
5. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
6. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

SLE Topics

Sr. No	Topics
2.1	Steganography, key range and key size
2.3	Knapsack Algorithm, Elliptic Curve Cryptography(ECC) , ELGamal, Problems with the Public Key Exchange
3.1	PKIX Model, Public Key Cryptography Standards(PKCS),XML,PKI and Security, Creating Using Java
3.2	Key Distribution Center(KDC),Security Handshake Pitfalls, Single Sign On(SSO) Approaches.
3.3	3-D secure protocol, Electronic Money, Wireless Application Protocol (WAP) Security, Security in GSM, Security in 3G.

Online Resource

https://onlinecourses.nptel.ac.in/

Major 2- Cryptography and Information Security Practical 1 Credit

Sr No.	Practical
1.	Implementation of Substitution Techniques. 1. Implement Ceaser Cipher. 2. Implement Modified Caesar Cipher.
2.	Implementation of Transposition Techniques. 1. Implement Rail Fence Cipher. 2. Implement VernamCipher.
3.	Implementing DES Algorithm.
4.	Implementing AES Algorithm.
5.	Implementing RSA Algorithm.
6.	a. Implementing RC4. b. Implementing Blowfish Algorithm
7.	Configure Routers a. OSPF MD5 authentication. b. to support SSH connections
8.	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
9.	Configure, Apply and Verify an Extended Numbered ACL.
10.	a. Configuring a Zone-Based Policy Firewall. b. Configure IOS Intrusion Prevention System (IPS) Using the CLI.

DSE1 - Cloud Computing Architecture **4 Credits**

Course Objectives

- Understand the fundamentals of cloud computing and distributed computing, including their architecture, models, and characteristics.
- Explore the role of virtualization, communication, and architectural principles in building cloud and distributed systems.
- Analyse mobile cloud computing, offloading techniques, and resource allocation strategies. Examine the design and implementation of energy-efficient and green cloud computing architectures.
- Investigate emerging trends, technologies, and research opportunities in sustainable and mobile cloud environments.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Describe the core concepts, service models, and deployment models of cloud computing.	L1:Remember L2:Understand
CO2	Compare and contrast cloud and distributed computing, including their characteristics and architectural principles.	L2: Understand L3: Apply
CO3	Analyze virtualization and communication mechanisms in distributed cloud systems.	L2: Understand L3: Apply
CO4	Demonstrate understanding of mobile cloud computing architecture, augmentation approaches, and applications.	L3: Apply
CO5	Apply various offloading strategies in cloud and mobile cloud environments to optimize performance.	L3: Apply L4: Analyze
CO6	Evaluate resource allocation techniques and identify challenges in mobile cloud computing environments.	L2: Understand L3: Apply
CO7	Design energy-efficient cloud architectures considering task scheduling, data centers, and carbon footprint.	L3: Apply L4: Analyze
CO8	Explore emerging trends such as AI, blockchain, and smart grids in green cloud computing, and identify future research opportunities.	L3: Apply L4: Analyze

Theory Syllabus **3 Credits**

Unit	Details	Lectures
I	**1.1 Overview of Cloud Computing** **1.2 Overview of Distributed Computing** **1.3 Architectural Principles**	**15**
II	**2.1 Cloud Integration** **2.2 Offloading in Cloud Computing** **2.3 Resource Allocation in cloud computing**	**15**
III	**3.1 Designing Energy-Efficient Cloud Architectures** **3.2 Emerging Trends in Green Cloud Systems** **3.3 Future Directions and Research Opportunities**	**15**

Text Books & References

- Mobile Cloud Computing: Architectures, Algorithms and Applications, by Debashis De , CRC press
- Mobile Clouds: Exploiting Distributed resources in wireless mobile and social networks, by Frank Fitzek, Marcos D. Katz Wiley
- Mobile Cloud computing: Principles and paradigms by Khanna, Sarishma.
- Architecting the cloud by Kavis Wiley publication
- Advances in Mobile cloud computing systems by F. Richard Yu. , Victor Leung, CRC press

SLE Topics

Sr. No	Topics
1.2	Advantages of Cloud Computing, Applications of Mobile Cloud computing, Research Challenges in Mobile Cloud Computing
3.2	Application of Cloud Computing Introduction, Cloud Mobile Media Application, Biometric Application, Vehicle Monitoring,

Online Resource

https://nptel.ac.in/courses/106106147
https://nptel.ac.in/courses/117104099

DSE1- Cloud Computing Architecture Practicals 1 Credit

Sr No.	Practical
1.	Introduction to Cloud Computing and Service Models.
2.	Setting Up a Virtual Machine on a Local System (Virtualization)
3.	Creating a Cloud Account and Setting Up a Virtual Machine
4.	Connecting to a Cloud Virtual Machine and Installing a Web Server
5.	Creating and Managing Cloud Storage
6.	Setting Permissions and Access Control in Cloud Storage
7.	Deploying a Static Website Using Cloud Storage
8.	Implement socket Programming using TCP/UDP

DSE2- Virtualization Technologies **4 Credits**

Course Objectives

- Understand the fundamental principles and types of virtualization, including system-level and application-level approaches.
- Explore virtualization architectures, including hypervisors, virtual machines, and cloud-based virtualization strategies.
- Analyse server and storage virtualization technologies and their applications in enterprise environments.
- Examine virtualization's role in modern data centers, blade systems, and disaster recovery strategies.
- Evaluate the integration of virtualization with automation tools and address security challenges in virtualized environments.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Explain the basic concepts and types of virtualization including system-level and application-level virtualization.	L1: Remember, L2: Understand
CO2	Describe the architecture and working principles of virtual machines and hypervisors (Type 1 and Type 2).	L2: Understand
CO3	Analyze the role of virtualization in cloud environments and identify related technologies.	L3: Apply L4: Analyze
CO4	Evaluate the planning, platform selection, and use cases for server and storage virtualization.	L4: Analyze, L5: Evaluate
CO5	Apply knowledge of SCSI, iSCSI, SAN, RAID, and SNIA models in designing storage virtualization solutions.	L3: Apply, L4: Analyze
CO6	Demonstrate understanding of virtualization in blade server architectures and its impact on data center operations.	L2: Understand, L3: Apply
CO7	Design disaster recovery strategies in virtualized environments using replication and failover techniques.	L4: Analyze, L5: Evaluate
CO8	Explore how virtualization integrates with automation and orchestration tools for efficient data center management.	L3: Apply, L6: Create

Theory Syllabus **3 Credits**

Unit	Details	Lectures
I	**1.1 Introduction to Virtualization and its Concepts** **1.2 Virtualization Architecture** **1.3 Cloud Virtualization** **1.4 Security Considerations**	**15**
II	**2.1 Server Virtualization and Storage Virtualization** **2.2 Virtualizing Storage**	**15**
III	**31. Advanced Virtualization in Data Centers and Blade Technologies** **32. Virtualization in Data Center Management** **3.3 Disaster Recovery in Virtual EnvironmentsIntegration with Automation Tools**	**15**

Text Books & References

1. Professional Xen Virtualization - William von Hagen, Wrox, Publications, January, 2008.
2. Virtualization: From the Desktop to the Enterpris, Chris Wolf, Erick M.Halter APress, 2005.
3. Network virtualization Kumar Reddy,Victor Moreno , Cisco Press,2006

SLE Topics

Sr. No	Topics
3.1	Fiber Channel –Fiber Channel Cables –Fiber Channel Hardware Devices
3.2	Needs Blade System

Online Resource

https://nptel.ac.in/courses/108106167

Virtualization Practicals 1 Credit

Sr No	Practical
1.	Implement vmwareESXi for server virtualization
2.	Implement XEN for server virtualization
3.	Implement Hyper-V server virtualization
4.	Manage vmwareESXi with vCentre server
5.	Manage xen server Xen center
6.	Understanding blade server with cisco UCS/HP eva simulator
7.	Implement vlan concept with L2/L3 switches/nexus virtual switching
8.	Simulating SAN with navisphere/netapps

Integrating IKS into Sustainable Software Project Management **2 Credits**

Course Objectives

- To introduce students to the fundamental principles of software project management.
- To explore how ancient Indian texts and philosophies offer insights into modern project Planning, execution, and leadership.
- To foster ethical, sustainable, and holistic thinking in managing IT projects.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Define the key concepts and importance of software project management.	L1: Remember
CO2	Describe the steps in project planning, including WBS and scheduling using tools like Gantt charts and PERT.	L2: Understand
CO3	Identify potential risks in software projects and apply basic risk management techniques.	L2: Understand L3: Apply
CO4	Monitor project progress using tracking tools such as Earned Value Analysis (EVA).	L3: Apply
CO5	Explain the process of project closure and how to document lessons learned.	L2: Understand

Detailed Syllabus

Unit	Details	Lectures
I	**Project Planning and Leadership – Ancient Wisdom for Modern Execution** • Software Projects vs. Other Projects: A dharmic perspective on project roles and purpose. • Leadership and Stakeholders: Project manager's role through Bhagavad Gita and Arthashastra lens. • Project Objectives as Sankalpa: Importance of clear intention in Vedic systems. • Work Breakdown Structure (WBS) using Panini's rule-based logic. • Time & Task Scheduling: Insights from Indian calendar systems and temple-building timelines. • Gantt and PERT charts vs. ancient Indian task sequencing models (Panchang, Yatra Nirdesh).	**15**
II	**Ethical Risk, Monitoring & Closure – Lessons from Indian Knowledge Systems** • Risk Identification & Mitigation from Arthashastra and Indian epics. • Karma Theory & Earned Value: Performance tracking and accountability models. • Change Management: Lakshman Rekha as metaphor for scope boundaries. • Team Morale & Motivation: Reflections from Panchatantra and Jataka Tales. • Project Closure as Sankalp Samapti: Rituals of completion and reflective learning (Antim Samskara). • Knowledge Documentation: From oral tradition to digital archival – continuity of knowledge.	**15**

Reference Books

- Kautilya's Arthashastra – Translations and Management Interpretations
- Bhagavad Gita for Leadership and Management – Swami Chinmayananda / Gita Press
- Panini's Ashtadhyayi (for logical structuring insights)
- Indian Ethos and Values in Management – S. Balachandran, Ghosh
- Management Insights from the Mahabharata and Ramayana – C. Rajagopalachari

Self-Learning topics

Sub- unit	Topic
1.2	Work Breakdown structure (WBS), Product Breakdown structure (PBS), Hybrid Breakdown structure (HBS), Networking and Scheduling techniques. PERT, CPM, GANTT chart
1.4	Monte Carlo Simulation, Critical Chain Concepts.

Online Resource

NPTEL :: Management - NOC:Project Management
NPTEL :: Computer Science and Engineering - NOC:Software Project Management
https://digitalguardian.com/blog/what-operational-security-five-step-process-best-practices-and-more

VoC1 - Mobile Programming **2 Credits**

Course Objectives

- Understand the fundamentals and importance of mobile application development across various platforms.
- Gain knowledge of native and cross-platform development tools, languages, and user interface design techniques.
- Learn the lifecycle of mobile apps including development, testing, deployment, and publishing to app stores.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Define the types of mobile applications, platforms, and key programming languages used in mobile development.	L1: Remember,
CO2	Describe the mobile app development lifecycle including planning, design, testing, and deployment.	L2: Understand
CO3	Develop a basic Android and iOS application using Android Studio and Xcode.	L3: Apply
CO4	Design simple user interfaces using XML (Android) and Storyboards (iOS) with key UI elements.	L3: Apply
CO5	Compare native and cross-platform mobile development frameworks like React Native and Flutter.	L2: Understand
CO6	Demonstrate basic mobile app testing techniques and explain the process of publishing apps to the Google Play Store and Apple App Store.	L3: Apply

Theory Syllabus **1 Credit =15L**

Unit	Details	Lectures
I	**1.1 Introduction to Mobile Programming** **1.2. Android Development Basics** **1.3. iOS Development Basics** **1.4 Cross-Platform Mobile Development** **1.5.Mobile App Testing and Deployment**	**15**

Reference Books

1. Android Cookbook: Problems and Solutions for Android Developers, Ian Darwin, O'Reilly Media, First 2011.
2. Android Application Development for Dummies, Donn Felker John and Wiley Sons, Second 2010.
3. Apache Cordova API Cookbook, John M. Wargo, Addison-Wesley, First,2014.
4. Professional Android™ 4 Application Development, RetoMeier, John Wiley &Sons, Third, 2012.

Self-Learning topics

Sub- unit	Topic
1.1	Installing Android studio
1.2	Kotlin basics: Layouts, navigation, Activity and fragment lifecycles.
1.3	Working with Graphics, Using the Drawable Object, Using the ShapeDrawable Objec
1.4	Basic Security Concepts for Android OS

Online Resource

Android app using Kotlin - Course (swayam2.ac.in)

VoC1 - Mobile Programming Practicals **1 Credit = 30L**

Practical List

Sr No.	Practical
1.	Develop an Android application with a login screen that validates user credentials using hardcoded values. Use EditText, Button, and Toast components.
2.	Design a simple layout using Linear and Relative Layouts.
3.	Build an Android app that uses SQLite to store and retrieve a list of student names and grades. Provide options to add, delete, and update records.
4.	Create a To-Do list app using the Ionic framework. Include functionalities to add, update, and delete tasks. Use local storage to persist data.
5.	Build an Ionic app with a multi-page structure using Ionic routing. Each page should have a unique layout and allow navigation between them using buttons or menu item
6.	Create a weather application using the Ionic framework that fetches weather data from a public API (e.g., OpenWeatherMap API) and displays it with a user-friendly interface.
7.	Create a Cordova app that fetches the user's current location using the Cordova Geolocation Plugin and displays the latitude and longitude on the screen.
8.	Develop a Cordova app that integrates with a push notification service (e.g., Firebase Cloud Messaging). Test the app to receive and display notifications on the device.
9.	Creating First Application in Cordova. • Creating Mobile Friendly CSS Layout • First AJAX page • Using a CSS Framework
10.	Create a Cordova app that uses the Device plugin to retrieve and display the device's information, such as model, platform, version, and UUID.

VoC 2 – Virtual Reality **2 Credits**

Course Objectives

- Understand the core concepts of Virtual Reality, including hardware, platforms, and design principles.
- Gain knowledge of tools and techniques used for creating VR assets, environments, and interactive experiences.
- Learn the basics of UI/UX design, 3D modelling, video editing, and animation for immersive VR applications.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Define the fundamental concepts, platforms, and hardware used in Virtual Reality.	L1: Remember,
CO2	Describe key principles of UI/UX design and the role of tools like Photoshop in designing for VR.	L2: Understand
CO3	Apply 3D modeling techniques using Maya to create and optimize assets for VR environments.	L3: Apply
CO4	Develop and edit VR-compatible video content using tools like Adobe Premiere.	L3: Apply
CO5	Use Unity and C# to assemble basic interactive VR experiences for PC and mobile devices.	L3: Apply
CO6	Create simple animations using Adobe Animate and Illustrator for use in immersive VR settings.	L3: Apply

Theory Syllabus **1 Credit- 15L**

Unit	Details	Lectures
I	**1.1.** Introduction to Virtual Reality and UI/UX Design. **1.2. 3D Asset Creation and Video Editing for VR** **1.3. Introduction to Unity and VR Interactivity** **1.4. VR Assembly for PC and Mobile VR Devices**	**15**

Reference Books

- Virtual Reality Insider, Nite Sky All About Virtual Reality: Includes 5 Amazing VR Experiences by Jack Challoner.
- Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile by Tony Parisi
- UX/UI Design Dot Grid Paper by Terri Jones
- The Complete Guide to VR & 360 Photography: Make, Enjoy, and Share & Play Virtual Reality Paperback –by Jonathan Tustain.
- Maya for Games by Michael Ingrassia, Creating Games with Unity and Maya by Adam Watkins.
- The 360° Video Handbook: A step-by-step guide to virtual reality (VR) by Michael Wohl Arnold 5: First Lessons in Autodesk Maya 2018 by Donna Betancourt.
- Virtual Reality Filmmaking: Techniques & Best Practices for VRby Celine Tricart Adobe Premiere Pro CC Classroom in a Book 1st Edition, by Jago Maxim.

1. Game Development with Unity by Michelle Menard, Unity 3D Game Development by Ryan Henson Creighton.
2. Game Programming: Developing with Unity in C# for Beginners by Ortus Publishing, Let Us C# by Yashavant P.Kanetkar.
3. Mobile Game Development with Unity by Jon Manning, Paris Buttfield addison, Working environment with Holistic Game Development with Unity by Penny de Byl.
4. Unity Virtual Reality Projects by Jonathan Linowes, Building Virtual Reality with Unity And Steam VR by Murray Jeff W.
5. Augmented Reality: Principles & Practice by Schmalstieg/Hollerer ,Complete Virtual Reality and Augmented Reality Development with Unity by Jesse, Glover, Jonathan, Linowes, Unity 2018 Augmented Realit Projects by Jesse Glover.

Self-Learning Topic

Sub Unit	Topic
1.2	Creating a 360 Image Collage
1.3	Installing Unity with required SDK,Creating environments foir VR,Assignments
1.4	Animation with Adobe Animate and Illustrator

Online Resources
https://www.pdf3d.com/photography/
https://docs.unity3d.com/560/Documentation/Manual/InstallingUnity.html

VoC 2 – Virtual Reality Practicals **1 Credit- 30L**

Practical List

Sr No.	Practical
1.	Create a User Interface using Photoshop
2.	Create A 360 Image for Virtual Reality
3.	Creating an Environment
4.	Creating Infographic Video in Virtual Reality
5.	Create a Virtual reality Walkthrough
6.	Creating an Interactive UI
7.	Creating an interactive application in Unity.
8.	Create Interactions with 3d object in a 3d Environment
9.	Create a Virtual Reality Experience for PC VR
10.	Create a Virtual Reality Experience for Mobile VR

SEM VI

Major1: Full-Stack Web Development **4 Credits**

Course Objectives

- Understand and develop dynamic, data-driven web applications using ASP.NET Web Forms and MVC.
- Explore front-end interactivity using AngularJS and integrate it with ASP.NET MVC.
- Apply client-side and server-side validation techniques and optimize applications using bundling, caching, and minification.
- Perform CRUD operations using ADO.NET and integrate database operations into ASP.NET applications.
- Build RESTful APIs using Node.js and MongoDB with the help of Express and Mongoose.
- Develop Python-based web applications using the Flask framework.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the structure and working of ASP.NET web forms, including server controls, page lifecycle, and configuration.	L1: Remember, L2: Understand
CO2	Apply MVC architecture to build modular and maintainable web applications with controller-view interaction and routing.	L2: Understand L3: Apply
CO3	Utilize AngularJS to develop dynamic, single-page applications with data binding, directives, and services.	L2: Understand L3: Apply
CO4	Implement client-side and server-side validation, and optimize web applications using bundling, caching, and minification.	L3: Apply L4: Analyze
CO5	Use ADO.NET to perform direct and disconnected data access operations and integrate SQL databases into web applications.	L2: Understand L3: Apply
CO6	Design and build RESTful APIs using Node.js and MongoDB, and apply Mongoose for schema definition and validation.	L3: Apply L4: Analyze
CO7	Develop Python-based web apps using Flask with routing, form handling, cookies, and file uploading capabilities.	L2: Understand L3: Apply
CO8	Apply AJAX and evaluate open-source frameworks/CMS for building rich internet applications with interactive UI components.	L3: Apply L4: Analyze

Detailed Syllabus **3 Credits**

Unit	Content	No. of Lectures
1	**1.1 Web Form Fundamentals**: Writing Code, Using the Code-Behind Class, Adding Event Handlers, Understanding the Anatomy of an ASP.NET Application, Introducing Server Controls, Using the Page Class, Using Application Events, Configuring an ASP.NET Application. **1.2 Form Controls / Server Side Control:** Stepping Up to Web Controls, Web Control Classes, List Controls, Table Controls, Web Control Events and AutoPostBack, Validation, Understanding Validation, Using the Validation Controls, Rich Controls, The Calendar, The AdRotator, Pages with Multiple Views, User Controls and Graphics, User Controls, Dynamic Graphics, The Chart Control, Website Navigation: Site Maps, URL Mapping and Routing, The SiteMapPath Control, The TreeView Control, The Menu Control. **1.3 Error Handling, Logging, and Tracing:** Avoiding Common Errors, Understanding Exception Handling, Handling Exceptions, Throwing Your Own Exceptions, Using Page Tracing. **1.4 MVC Architecture:** MVC Controllers, MVC Design Pattern, Working with Query Strings, MVC and API Controllers.	**15**
2	**2.1 Introduction & Routing:** Difference between ASP. Net web form and ASP.Net MVC, MVC Project structure, Create controller and view, Communication between controller and view, Routing mechanism flow. **2.2 Overview of AngularJS**: Need of AngularJS in real web sites, AngularJS modules, AngularJS built-in directives, AngularJS custom directives, AngularJS expressions, Angular JS Data Binding, AngularJS filters, AngularJS controllers, AngularJS scope, AngularJS dependency injection, Angular JS Services, Form Validation, Routing using ng-Route, ng-Repeat, ng-style, ng-view, Built-in Helper Functions, Using Angular JS with Typescript. **2.3 Validations:** Introduction, Adding Validation, Styling Validation Errors , Data Annotations, Custom Validation, Validation Summary, Client-side Validation, Anti-forgery Tokens, Caching and Bundling. MVC Caching, Bundling, Minification. **2.4 ADO.NET Fundamentals:** Understanding Databases, Configuring Database, Understanding SQL Basics, Understanding the Data Provider Model, Using Direct Data Access, Using Disconnected Data Access.	**15**

3	**3.1 MongoDB and Building REST API using MongoDB :** MongoDB: Understanding MongoDB, MongoDB Data Types, Administering User Accounts, Configuring Access Control, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Accessing and Manipulating Databases, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Using Mongoose for Structured Schema and Validation. REST API: Examining the rules of REST APIs, Evaluating API patterns, Handling typical CRUD functions (create, read, update, delete), Using Express and Mongoose to interact with MongoDB, Testing API endpoints. **3.2 Flask** Introduction, Flask Environment Setup, App Routing, URL Building, Flask HTTP Methods, Flask Request Object, Flask cookies, File Uploading in Flask. **3.1 Rich Internet Application AJAX**: Introduction and Working Developing RIA using AJAX Techniques: CSS, HTML, DOM, XML HTTP Request, JavaScript, PHP, AJAX as REST Client Introduction to Open Source Frameworks and CMS for RIA: Django, Drupal, Joomla 05 CO6 Self-learning Topics: Applications of AJAX in Blogs, Wikis and RSS Feeds.	**15**

Reference Books:

1. Beginning ASP.NET 4.5 in C# by Matthew MacDonald
2. Murach's ASP.NET 4.6 Web Programming in C# by Mary Dealmater, 2015
3. C# The Basics by Vijay Mukhi, BPB Publications
4. Asp.Net Visual C#.Net by Vijay Nicoel, TMH
5. Programming ASP.NET MVC 5, 2013

Self-Learning topics (Unit wise)

Unit	Topics
1.2	**The C# Language:** C# Language Basics, Variables and Data Types, Variable Operations, Object-Based Manipulation, Conditional Logic, Loops, Methods
1.3	**Types, Objects, and Namespaces** The Basics About Classes, building a Basic Class, Value Types and Reference Types, Understanding Namespaces and Assemblies, Advanced Class Programming.
3.3	**XML**: XML Explained, The XML Classes, XML Validation, XML Display and Transforms

Online Resources

1. VB.NET Tutorial 15 - For Loop (Visual Basic 2008/2010) - Visual Basic .Net Videos (nptelvideos.com)
2. VB.NET Tutorial 3 - Variables (Visual Basic 2008/2010) - Visual Basic .Net Videos (nptelvideos.com)
3. NPTEL :: Computer Science and Engineering - Internet Technology

Major1- Full-Stack Web Development Practical 1 Credit

Sr No.	Practical
1.	Create an application that obtains four int values from the user and displays the product.
2.	a. C# Program to implement Phone Book b. C# Program to find a number using Pythagoras Theorem
3.	a. Create an application to demonstrate following operations i. Generate Fibonacci series. ii. Test for prime numbers. iii. Test for vowels. iv. Use of for each loop with arrays v. Reverse a number and find sum of digits of a number. b. Create simple application to perform following operations i. Finding factorial Value ii. Money Conversion iii. Quadratic Equation iv. Temperature Conversion
4.	Create a simple web page with various sever controls to demonstrate setting and use of their properties. (Example: AutoPostBack)
5.	Working with Basic and Form Controls with Master Page and storing into database
6.	Create a simple login form in MVC ASP.NET
7.	Handle Routing in Angular Single Page Applications (SPAs) with JavaScript and Node.js
8.	Working with data controls
9.	Working with AJAX and XML
10.	Programs to create and use DLL

Major2: Data Mining and Business Intelligence **4 Credits**

Course Objectives

- Understand the core concepts of Data Mining and the Knowledge Discovery in Databases (KDD) process, including system architectures and real-world applications.
- Explore and preprocess diverse data types using techniques such as cleaning, transformation, normalization, and feature selection to prepare data for mining tasks.
- Learn and apply key data mining techniques including classification, clustering, outlier detection, and frequent pattern mining to uncover hidden patterns in large datasets.
- Evaluate data mining models and results using various performance metrics to ensure reliability, accuracy, and scalability.
- Understand the fundamentals of Business Intelligence (BI), its architecture, importance, and ethical implications in organizational decision-making.
- Explore Decision Support Systems (DSS) and their role in strategic and tactical decision-making across business functions.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Understand the fundamental concepts, scope, and process of Data Mining and Knowledge Discovery in Databases (KDD), and explore different data types and pre-processing techniques.	L1: Remember, L2: Understand
CO2	Apply classification algorithms such as Decision Trees, Naive Bayes, K-NN, and SVM; and evaluate models using performance metrics like precision, recall, and F1-score.	L2: Understand L3: Apply
CO3	Analyze clustering techniques (e.g., K-Means) and interpret clustering results using internal and external evaluation metrics.	L2: Understand L3: Apply
CO4	Evaluate and implement outlier detection techniques and identify different types of outliers in real-world data.	L3: Apply L4: Analyze
CO5	Apply frequent pattern mining techniques such as association rules for Market Basket Analysis and mine multidimensional association patterns.	L2: Understand L3: Apply
CO6	Understand the principles and architecture of Business Intelligence (BI) and evaluate its role in transforming data into actionable insights.	L3: Apply L4: Analyze
CO7	Understand the structure and purpose of Decision Support Systems (DSS) and their application in decision-making across various business functions.	L2: Understand L3: Apply
CO8	Analyze real-life BI applications across domains such as CRM, marketing, logistics, finance, and fraud detection.	L3: Apply L4: Analyze

Detailed Syllabus **3 Credits**

Unit	Details	Lectures
I	**Unit 1: Introduction to Data Mining**- Definition, Scope, and Process of Knowledge Discovery in Databases (KDD), Architecture of Data Mining Systems, Data Mining Tasks: Classification, Clustering, Association, Prediction, Applications and Ethical Considerations. **Data Types and Data Exploration** -Types of Data (Structured, Unstructured, Semi-structured), Visualization Techniques for Exploratory Data Analysis. **Data Pre-processing**- Importance of Data Pre-processing, Data Cleaning: Missing Values, Noise Handling, Data Integration and Transformation, Normalization and Aggregation, Data Reduction and Feature Selection.	**15**
II	**Unit 2: Data Mining Techniques** **2.1 Classification:** Basic Concepts of Classification, Classification Methods: Decision Trees, Naive Bayes, K-NN, SVM. Prediction vs. Classification, Model Evaluation and Selection: Accuracy, Precision, Recall, F1-Score. **2.2 Clustering:** Introduction to Clustering and Cluster Analysis, Clustering Methodologies: K-Means Clustering, Evaluation of Clustering Results: Internal and External Metrics. **2.3 Outlier Analysis:** Real-World Applications of Outlier Analysis, Types of Outliers: Global vs. Local Outliers, Outlier Challenges and Detection Approaches, Outlier Detection Methods: Supervised, Semi-Supervised, Unsupervised, Proximity-Based and Clustering-Based Outlier Analysis. **2.4 Frequent Pattern Mining:** Market Basket Analysis: Concept and Applications, Efficient and Scalable Frequent Itemset Mining Methods, Mining Multilevel and Multidimensional Association Rules.	**15**
III	**Unit 3: Business Intelligence and Decision Support Systems** **3.1 Introduction to Business Intelligence (BI):** Data, Information, and Knowledge, Defining Business Intelligence and its Importance, Key Factors in Business Intelligence, BI Architecture and Framework, Role of Mathematical Models in BI, Challenges and Obstacles to Successful BI Projects, Ethics in Business Intelligence. **3.2 Decision Support Systems (DSS):** Concept of Decision Making and Techniques, Understanding Decision Support Systems (DSS), Evolution of Information Systems and DSS, Development of DSS and their Applications, Role of BI in Decision Making. **3.3 BI and Data Mining Applications:** ERP and Business Intelligence, BI Applications in Customer Relationship Management (CRM), BI in Marketing, Logistics, and Production, Role of BI in Finance, Banking, and Telecommunications, BI Applications in Fraud Detection and Clickstream Mining, BI Applications in the Retail Industry.	**15**

Text Books and References:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
3. Paulraj Ponniah “Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals” Wiley Publications
4. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis, Wiley India Publications.
5. Decision support and Business Intelligence Systems, Efraim Turban, RameshSharda,
6. Dursun Delen, Pearson Edition, 9th Edition, 2011.
7. Fundamental of Business Intelligence Grossmann W,Rinderle-Ma, Springer, First Edition, 2015.

SLE Topics

Sr. No	Topics
1.1	Overview and concepts Data Warehousing
2.3	Data Pre-processing
3.3	Association Rule Mining

Online Resource

https://onlinecourses.nptel.ac.in/
Data Mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview
Business Intelligence & Data Mining Course - Online Video Lessons | Study.com

Major 2- Data Mining and Business Intelligence Practicals 1 Credit

Sr No.	Practical
1.	Import the legacy data from different sources such as (Excel, SqlServer, and Oracle etc.) and load in the target system. (You can download sample database such as Adventureworks, Northwind, foodmart etc.)
2.	Design Star and Snowflake Schema
1.	Implement using tools or languages like JAVA/ python/R a) Data Exploration b) Data preprocessing
4.	a. Create the Data staging area for the selected database. b. Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP And HOLAP model.
5.	a. Import the data warehouse data in Microsoft Excel and create the Pivot table and Pivot Chart. b. Import the cube in Microsoft Excel and create the Pivot table and Pivot Chart to Perform data analysis.
6.	Implement and evaluate using languages like JAVA/ python/R for Classification Algorithm.
7.	Implement and evaluate using languages like JAVA/ python/R for Clustering Algorithm.
8.	Implement and evaluate using languages like JAVA/ python/R for Frequent Pattern Mining Algorithm.
9.	Detailed case study of any one BI tool such as Pentaho, Tableau and QlikView
10.	Business Intelligence Mini Project: Each group assigned one new case study for this A BI report must be prepared outlining the following steps: a) Problem definition, identifying which data mining task is needed b) Identify and use a standard data mining dataset available for the problem. Some links for data mining datasets are: WEKA, Kaggle, KDD cup, Data Mining Cup, UCI Machine Learning Repository etc. c) Implement appropriate data mining algorithm d) Interpret and visualize the results Provide clearly the BI decision that is to be taken as a result of mining

DSE3 – AI and Computer Vision **4 Credits**

Course Objectives

- Understand the foundational concepts of Artificial Intelligence (AI), including Machine Learning (ML) paradigms and neural networks.
- Explore the fundamentals of image processing and computer vision techniques for real-world image understanding tasks.
- Gain hands-on experience with popular ML and CV libraries such as Scikit-learn and OpenCV to build basic AI models.
- Learn and apply deep learning architectures like CNNs, U-Net, and GANs for object detection, segmentation, and image generation.
- Evaluate and compare AI models using performance metrics and understand ethical considerations in AI development.
- Implement advanced computer vision systems using deep learning frameworks like TensorFlow and PyTorch.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Describe the fundamentals of Artificial Intelligence, its types, and evolution, and explain the differences between weak and strong AI.	L1: Remember, L2: Understand
CO2	Apply basic machine learning algorithms and evaluate models using metrics like accuracy, precision, recall, and F1-score.	L2: Understand L3: Apply
CO3	Understand the structure of neural networks and implement simple models using Scikit-learn for classification, regression, and clustering tasks.	L2: Understand L3: Apply
CO4	Explain computer vision principles, image processing operations, and implement basic feature detection using OpenCV.	L2: Understand L3: Apply
CO5	Implement object detection and segmentation techniques using classical and ML-based approaches such as Haar cascades, HOG, and k-means.	L3: Apply L4: Analyze
CO6	Analyze and build convolutional neural network (CNN) architectures for tasks like object classification and localization.	L3: Apply L4: Analyze
CO7	Develop deep learning-based object detection models using YOLO, SSD, and Faster R-CNN for real-time applications.	L3: Apply L5: Evaluate
CO8	Design and implement segmentation and generative models (e.g., U-Net, GANs) for tasks like semantic segmentation and image generation using TensorFlow/PyTorch.	L4: Analyze L5: Evaluate L6: Create

Detailed Syllabus **3 Credits**

Unit	Details	Lectures
I	**1.1 Introduction to AI**: What is AI? History and evolution of AI Types of AI: Weak AI vs. Strong AI Key components of AI systems. **1.2 Overview of Machine Learning**: Supervised vs Unsupervised Learning, Basic ML algorithms: Linear Regression, Logistic Regression, Decision Trees, and k-Nearest Neighbors (k-NN). Introduction to Clustering (e.g., k-means), Model Evaluation: Cross-validation, Accuracy, Precision, Recall, and F1-score. **1.3 Neural Networks and Deep Learning**: Fundamentals of Neural Networks, Back propagation and Gradient Descent, Introduction to Deep Learning: Multi-layer neural networks and activation functions **1.4 Hands-on with Scikit-learn**: Implementing ML models using Scikit-learn, Simple projects on classification, regression, and clustering. **1.5 Ethics in AI**: Ethical issues in AI and ML, Data privacy and bias in algorithms.	**15**
II	**1.1 Introduction to Computer Vision:** What is Computer Vision? Key Challenges: Lighting, Occlusion, Scale, and Rotation, Image Processing Basics: Pixel operations, histograms, and color spaces (RGB, Grayscale, HSV). **1.2 Feature Detection and Matching**: Techniques for detecting and Describing image features: SIFT, SURF, and ORB,Feature Matching: Using descriptors for image alignment and recognition. **1.3 Image Transformation**: Geometric transformations: Scaling, Rotation, Translation, Image registration and stitching **1.4 Object Detection and Segmentation**: Basic techniques: Thresholding, Edge Detection, Contour Detection Object Detection Algorithms: Haar Cascade Classifiers, HOG (Histogram of Oriented Gradients) Segmentation: Region-growing, Watershed Algorithm, K-means clustering for image segmentation **1.5 Hands-on with OpenCV**: Implementing feature detection, edge detection, and object tracking Building simple object detection systems	**15**
III	**Deep Learning for Computer Vision** **3.1 Convolutional Neural Networks (CNNs):** Introduction to CNNs: Layers, Convolution, Pooling, Architectures of CNNs: LeNet, AlexNet, VGG16, ResNet, Transfer Learning: Using pre-trained models for fine-tuning. **3.2 Object Detection and Localization with Deep Learning:** Understanding Object Detection: Bounding box regression, Intersection over Union (IoU), Advanced techniques: YOLO (You Only Look Once), Faster R-CNN, Single Shot Multibox Detector (SSD), Hands-on	

	with YOLO for real-time object detection **3.3 Image Segmentation:** Semantic Segmentation: Understanding the role of segmentation in image understanding, Architectures: U-Net, FCN (Fully Convolutional Networks), Hands-on with TensorFlow/ Keras for semantic segmentation **3.2 Generative Models:** Generative Adversarial Networks (GANs) for image generation, Autoencoders: Basics and applications in image denoising and compression. **3.3 Hands-on with TensorFlow/PyTorch:** Building and training CNNs with TensorFlow or PyTorch, Implementing YOLO for object detection, Hands-on projects with segmentation models using U-Net.	

Resources:

- **Books**:
  - "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani
  - "Computer Vision: Algorithms and Applications" by Richard Szeliski
  - "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
- **Libraries and Frameworks**:
  - **OpenCV** for image processing
  - **TensorFlow** / **Keras** / **PyTorch** for deep learning
  - **Scikit-learn** for machine learning

SLE Topics

Sr. No	Topics
1.1	Linear Algebrs
2.1	Basics of Computer Graphics
3.3	Basic knowledge of datasets

Online Resource

Deep Learning | Coursera
GitHub - ultralytics/yolov5: YOLOv5 🚀 in PyTorch > ONNX > CoreML > TFLite
PyImageSearch - You can master Computer Vision, Deep Learning, and OpenCV.
Kaggle: Your Machine Learning and Data Science Community

DSE 3 – AI and Computer Vision Practicals 1 Credit

Sr No.	Practical
1.	Implement basic ML models using Scikit-learn (Linear Regression, Logistic Regression, Decision Trees, k-NN).
2.	Implement both supervised and unsupervised learning techniques using Scikit-learn.
3.	Build a simple neural network using Scikit-learn or Keras.
4.	Implement basic image processing tasks using OpenCV.
5.	Detect and match image features using OpenCV.
6.	Implement an object detection system using Haar cascades.
7.	Implement real-time object detection using the YOLO algorithm.
8.	Build a semantic segmentation model using U-Net.
9.	Implement a simple Generative Adversarial Network (GAN) to generate image.
10.	Implement an image stitching technique using feature matching and geometric transformations.

DSE4 – Cyber security and Law **4 Credits**

Course Objectives

- Understand the nature, evolution, and classifications of cybercrime, and the legal frameworks addressing it at national and international levels.
- Analyse the Indian IT Act, 2000 and its role in regulating cyber offences, including judicial processes and legal implications of specific cybercrimes.
- Examine the challenges posed by cybercrime to criminal justice systems, including jurisdiction issues and the role of network service providers.
- Explore tools, techniques, and methods used in cybercrimes, along with security tools, prevention strategies, and technological solutions.
- Understand consumer protection in cyberspace and the legal relevance of digital evidence under the Indian Evidence Act and IT Act.
- Evaluate amendments in cyber laws and international legal compliance frameworks to effectively respond to evolving cyber threats.

Course Outcomes

SNo.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Describe the historical evolution and definitions of cybercrime, and explain its relationship with information security.	L1: Remember, L2: Understand
CO2	Classify different types of cybercrimes and assess their societal and legal implications.	L2: Understand L3: Apply
CO3	Analyze the Indian Information Technology Act (ITA) 2000 and its effectiveness in dealing with cybercrime.	L2: Understand L4: Analyze
CO4	Evaluate global legal frameworks and international cooperation in combating cybercrime.	L3: Apply L4: Analyze
CO5	Explain judicial processes, penalties, and adjudication procedures under the ITA 2000 and their role in the Indian cyber justice system.	L2: Understand L3: Apply
CO6	Identify various cyber threats, tools, and methods of attack, and analyze legal and technical responses.	L3: Apply L4: Analyze
CO7	Interpret digital evidence in light of cyber law, understand consumer protection under cyber laws, and assess the applicability of the Indian Evidence Act in cybercrime cases.	L2: Understand L4: Analyze
CO8	Evaluate amendments to the IT Act and analyze legal compliance frameworks like SOX, HIPAA, and ISO in the context of cyber security.	L4: Analyze L5: Evaluate

Detailed Syllabus **3 Credits**

Unit	Details	Lectures
I	**1.1 Introduction to Cybercrime and the Legal Framework** - Cybercrime Definition and Origins, Understanding Cybercrime: Definition, Historical Background, and Evolution, Cybercrime and Information Security: Overview of the relationship between cybercrime and information security. **1.2 Classifications of Cybercrime**- Types of Cybercrime (Hacking, Identity Theft, Phishing, Cyber Stalking, etc.) Overview of Cybercrime Categories: Cyber fraud, Cyber cheating, Cyber bullying, Cyber pornography, Data breaches. **1.3 Cybercrime and the Indian ITA 2000** -The Information Technology Act 2000 (ITA 2000) and its role in combating cybercrime in India. Importance of ITA 2000 in the Indian legal system: Legal provisions, IT regulations, and their impact on cybersecurity. **1.4 Global Perspective on Cybercrime**-Comparative analysis of cybercrime laws across the globe. International efforts to combat cybercrime: Role of the United Nations, INTERPOL, and regional legal frameworks. Trends in global cybercrime and the need for global cybersecurity cooperation.	**15**
II	**2.1Cybercrime and Criminal Justice Framework**- Penalties, Adjudication, and Appeals under the IT Act, 2000, Overview of the IT Act, 2000: Cybercrime under the Act and relevant penalties. Types of Cybercrimes covered under IT Act 2000: Hacking, Cyber Fraud, Cyber Cheating, etc. Process of adjudication and appeals: Judicial processes and the role of cyber courts. **2.2Key Concepts in Cybercrime under the IT Act** -Concept of Cyber Crime: Criminal activities under the IT Act. Cyber stalking, defamation, email abuse, and harassment. Cyber pornography and the legal implications of digital media. Other offences under the IT Act, 2000: Virus and malicious software, illegal data access. **2.3 Jurisdiction and Network Service Providers** -Jurisdictional challenges in cybercrime: Issues of legal authority, cross-border crimes, and international cybercrime law enforcement. Role of Network Service Providers in managing cybercrime. Criminal Justice in India and its implications for cybercrime: Investigation, prosecution, and punishment for cybercrime offenders. **2.4Strategies to Tackle Cybercrime**-Prevention strategies: Awareness campaigns, cybersecurity practices, and risk mitigation. Technology-based solutions: AI, machine learning, and data analytics in combatting cybercrime. Emerging trends and tactics for addressing evolving cyber threats.	**15**

III	**3.1 Cyber Offenses, Security Tools, and Legal Protection**- Tools **a**nd Methods Used in Cybercrime, Methods of Attack: Phishing, password cracking, key loggers, and spyware. Malware: Virus, worms, Trojans, and other forms of malicious software. Denial of Service (DoS), Distributed Denial of Service (DDoS) attacks.SQL Injection, Buffer Overflow, and Wireless Network Attacks. Social Engineering and Cyber stalking techniques. **3.2 The Security Aspect of Cyber Law -**Intellectual Property in Cyber Law: Protection of digital assets and copyright. Evidence in Cybercrime: Digital evidence, electronic signatures, and proof of electronic transactions. Criminal Aspect: How cybercrimes are prosecuted in the Indian context. **3.3 Protection of Cyber Consumers in India -**Consumer Protection under Cyber Laws: Are cyber consumers overed under the Consumer Protection Act (CPA)? Jurisdiction and Legal Protections for Cyber Consumers in India. Relief for consumers under CPA, unfair trade practices in cyber services. The applicability of CPA to foreign manufacturers or service providers. **3.4 Cyber Laws and Indian Evidence Act, 1872-** Role of the Indian Evidence Act in digital contexts: Admissibility of electronic records, e-signatures, and digital agreements. Amendments brought by the IT Act, 2000, and their impact on evidence in cybercrime cases. Case studies on proving electronic evidence: Proof of emails, digital contracts, and electronic banking records. **3.5 Cybercrime, Criminal Justice, and IT Act Amendments -**Overview of amendments in the IT Act, 2008 and 2011: Impact on cybercrime penalties and adjudication. Criminal Justice implications: Penalties, adjudication procedures, and appeals. Information Security Compliance and Legal Standards: SOX, GLBA, HIPAA, ISO, FISMA, PCI compliance.	

Textbooks and References-

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. Cyber Law Simplified- Vivek Sood TMH Education 2001
3. Cybersecurity Law- Jeff Kosseff, Wiley, 2017.
4. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
5. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
6. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
7. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
8. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.

SLE Topics

Sr. No	Topics
1.1	Power of Arrest Without Warrant Under the IT Act, 2000:
2.3	Jurisdiction in the Cyber World
3.2	E-Commerce Taxation: Real Problems in the Virtual World:
3.3	Protection of Cyber Consumers in India:

Online Resource

https://onlinecourses.nptel.ac.in/

The Information Technology ACT, 2008- TIFR :
https://www.tifrh.res.in

A Compliance Primer for IT professional :
https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

DSE4 - Cyber security and Law Practicals 1 Credit

Sr No.	Practical
1.	TCP Scanning using NMAP.
2.	Port Scanning using NMAP
3.	TCP/UDP Connectivity using Netcat
4.	Network Vulnerability using OpenVAS
5.	Web Application Testing using DVWA
6.	Manual SQL Injection using DVWA
7.	XSS using DVWA
8.	Automated SQL Injection with SQLMAP
9.	Demonstrate Sniffing using packet tool i.e. snort
10.	Configure your e-mail account against various threats. I.e. spam attack, phishing, spoofing et**c.**

2P – IoT Fundamentals **2 Credits**

Course Objectives

- Understand the fundamental concepts and architecture of the Internet of Things (IoT).
- Identify the key hardware components of IoT systems including sensors, actuators, and microcontrollers.
- Explore communication protocols and data flow mechanisms used in IoT environments.
- Recognize security, privacy, and scalability challenges associated with IoT systems.
- Analyse real-world IoT applications and current trends impacting various industries.

Course Outcomes

Sr No.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Define IoT, its architecture, and components such as sensors, actuators, microcontrollers, and cloud services.	L1: Remember, L2: Understand
CO2	Identify and demonstrate the role of IoT hardware (e.g., Arduino, Raspberry Pi) and basic interfacing with sensors and actuators.	L2: Understand L3: Apply
CO3	Explain communication protocols (e.g., MQTT, HTTP, Wi-Fi, Bluetooth) and describe how data flows between IoT devices and the cloud.	L2: Understand
CO4	Describe IoT data management concepts and discuss privacy and security considerations in IoT systems.	L2: Understand L3: Apply
CO5	Analyze practical IoT applications and recent trends such as AI integration, 5G, and Industry 4.0.	L3: Apply L4: Analyze

Detailed Syllabus **1 Credit**

Unit	Details	Lectures
I	**1. Introduction to IoT** -What is IoT? Definition, importance, and evolution of IoT ,Key components of an IoT system (sensors, actuators, devices, network, cloud), IoT use cases and applications across different industries (smart homes, healthcare, agriculture, transportation), IoT Architecture, Layers of IoT architecture: Perception, Network, and Application, Overview of IoT devices, communication protocols, and cloud integration, IoT Trends and Challenges, Market trends in IoT, Security, privacy, and scalability challenges in IoT. **2. IoT Components and Sensors**- IoT Devices and Hardware Components, Overview of IoT hardware: Microcontrollers (e.g., Arduino, Raspberry Pi), Role of sensors and actuators in IoT systems, Types of sensors (temperature, humidity, motion, light, etc.) Working with Sensors ,How sensors collect data in IoT systems ,Basic interfacing of sensors with microcontrollers (Arduino/Raspberry Pi), Hands-on examples of sensor readings and data transmission, Actuators and IoT Devices, Overview of actuators (motors, relays, lights) and their role in IoT, Control of actuators based on sensor data. **3. Communication Protocols for IoT** -Overview of IoT Communication Protocols, Introduction to wireless communication protocols for IoT (Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoT), Low Power Wide Area Network (LPWAN) technologies, Data Transmission in IoT, Communication between IoT devices and cloud/servers, Protocols for data exchange: MQTT, HTTP, CoAP, Introduction to IoT gateways and edge computing, IoT Cloud Integration, Overview of cloud platforms for IoT (AWS IoT, Microsoft Azure IoT, Google Cloud IoT), Role of cloud in IoT data storage, processing, and visualization, Data flow from IoT devices to the cloud. **4. IoT Data Management and Applications-** Data Management in IoT Systems, Data collection, processing, and analytics in IoT, Introduction to Big Data and IoT data storage, Edge computing vs. cloud computing in IoT, IoT Security and Privacy, Security challenges in IoT networks, Best practices for securing IoT devices and data, Real-World IoT Applications, Case studies of IoT applications in various fields (Smart homes, healthcare, agriculture, transportation) ,Future trends in IoT and emerging technologies (AI, 5G, IoT in Industry 4.0).	**15**

Text Books and References:

1. "Internet of Things: A Hands-On Approach" -Author(s)**:** Arshdeep Bahga, Vijay Madisetti Publisher: VPT (Vishal Publishing), Year: 2014.
2. "Internet of Things: Principles and Paradigms" -Author(s)**:** Rajkumar Buyya, Amir Vahid Dastjerdi**,** Publisher**:** Morgan Kaufmann**,** Year**:** 2016.
3. "The Internet of Things: Connecting Objects to the Web", Author(s)**:** Hakima Chaouchi**,** Publisher**:** Wiley**,** Year**: 2017**
4. "Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud", Author(s)**:** Cuno Pfister **,**Publisher**: O'Reilly Media,** Year**: 2011**
5. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Author(s)**:** David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton**,** Publisher**:** Cisco Press, Year: 2017**.**

Self-Learning Topic

Sub Unit	Topic
1.1	Case studies: Washing Machine, Microwave Owen CISC-8051, RISC- DSP , Displays- Light emitting diode ,7-Segment LED Display ,Dot Matrix LED Display, Liquid Crystal Display ,Electroluminescent Display Technology Keyboard-4x4 Matrix Keypad
1.2	Software Programming in Assembly Language.
1.3	Case studies: IoT in Soap Dispensers, Retail Uses RFID to Enable Cold Chain Monitoring
1.4	Case studies: Smart Home, Smart Industry, Internet of Things in Smart Ambulance and Emergency Medicine, Implementing the Internet of Things for Renewable Energy

Online Resource

Coursera – Internet of Things Specialization
edX – Internet of Things (IoT) for Beginners
IoT For All (Website) **– https://www.iotforall.com/**
The Things Network (Website) **– https://www.thethingsnetwork.org/**
Hackster.io (IoT Projects) **– https://www.hackster.io/**

VoC2- IoT Fundamentals **1 Credit**

Sr No.	Practical
1.	Basic programs using LEDs 1. Blink Single LED 2. Toggle two LEDs 3. Generate different LED patterns 4. Turn the LED ON/OFF using Push button
2.	Programs based on 7-segment LED. 1. Display digits 0 to 9. 2. Display numbers 00 to 99. 3. Display Hours and Minutes.
3.	Stepper motor/ Servo motor programs 1. Rotate motor in clockwise direction 2. Rotate motor in anti-clockwise direction
4.	Programs based on LCD display and Keypad 2. Display Roll number and Name 3. Display digits entered through Keypad
5.	Write a program to simulate oscilloscope using Raspberry Pi.
6.	Visitor monitoring system using Pi Camera.
7.	User Authentication using RFID cards or tags.
8.	Biometric attendance system using Fingerprint module.
9.	Tracking location using GPS module.
10.	Home Automation using Telegram.

VoC3- DevOPs **2 Credits**

Course Objective

- Understand the core principles, architecture, and evolution of DevOps in the context of modern software development.
- Gain hands-on experience with essential DevOps tools such as Git, Jenkins, Docker, and Kubernetes.
- Learn the basics of Continuous Integration/Continuous Delivery (CI/CD) pipelines and containerization.
- Understand the role of collaboration, automation, and monitoring in the DevOps lifecycle.
- Apply version control and team collaboration practices using Git and GitHub/GitLab.

Course Outcomes

Sr No.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Define the concept of DevOps, its lifecycle, and compare it with traditional software development models.	L1: Remember, L2: Understand
CO2	Use Git for version control, including branching, merging, and collaboration in a team environment.	L2: Understand L3: Apply
CO3	Implement basic CI/CD pipelines using Jenkins integrated with Git.	L3: Apply
CO4	Build and deploy containerized applications using Docker and understand the basics of Dockerfile and Docker Hub.	L3: Apply
CO5	Describe the fundamentals of Kubernetes and its role in container orchestration.	L2: Understand

Detailed Syllabus **1 Credit – 15L**

Unit	Details	Lectures
I	**1. Introduction to DevOps** - What is DevOps? Definition, Importance, and Evolution of DevOps, DevOps and the Software Development Life Cycle (SDLC), Comparison: Waterfall vs. Agile vs. DevOps,Key principles: Collaboration, Automation, Continuous Improvement, DevOps Architecture and Workflow, The DevOps Lifecycle (Plan, Code, Build, Test, Release, Deploy, Operate, Monitor),Overview of essential DevOps tools (Jenkins, Docker, Kubernetes, Git) **2. Continuous Integration and Continuous Delivery (CI/CD) -**Version Control with Git, Introduction to Git and its role in DevOps, Basic Git commands: Clone, Commit, Push, Pull, Branching and Merging (Git Flow),Automated Build and Deployment, Introduction to Jenkins for CI, Setting up a simple Jenkins pipeline for automated build and testing, Integration with version control (Git), CI/CD Best Practices, Building a basic Continuous Integration pipeline, Introduction to Jenkins Pipelines for Continuous Delivery. **3. Docker and Containerization-** Introduction to Docker, What is Docker and why use it? Difference between containers and virtual machines, Working with Docker, Installing Docker on Windows/Linux, Building and running Docker containers, Understanding Docker images and Docker Hub, Docker Configuration and Dockerfile, Creating a Dockerfile, Managing Docker containers (start, stop, logs), Docker Networking and Volumes, Docker Networking basics, Persistent data using Docker Volumes, Working with Docker for application deployment (Node.js, MongoDB, ASP.NET) **4. Kubernetes for Container Orchestration-** Introduction to Kubernetes, What is Kubernetes? Why is it important for container orchestration?, Kubernetes architecture: Nodes, Pods, Deployments, Services, Setting up Kubernetes, Installing Kubernetes on a local machine or using a cloud provider,Creating and managing a Kubernetes cluster,Managing Applications with Kubernetes, Deploying microservices applications on Kubernetes, Scaling applications and managing deployments, Basics of Kubernetes Networking and Persistent Storage. **5. Git Version Control and Collaboration-** Git Commands, Key Git operations (Clone, Commit, Push, Pull), Handling merges and resolving conflicts, Collaboration in Git, Using Git in teams (Branching strategies, Pull Requests, Code Review), Collaborative workflows in DevOps, Introduction to GitHub/GitLab	**15**

Textbooks & References

1. DevOps Bootcamp, Sybgen Learning
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
3. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", Addison Wesley Pearson Publication.
4. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication.
5. Optimize enterprise-grade environment performance with Puppet, by Ryan Russell- Yates Packt Publishing (September 29, 2018)
6. Sanjeev Sharma and Bernie Coyne," DevOps for Dummies", Wiley Publication
7. Httermann, Michael, "DevOps for Developers", Apress Publication.
8. Joakim Verona, "Practical DevOps", Pack publication

SLE Topics

Sr. No	Topics
1.2	Scrum, Kanban, Agile
1.3	Docker Compose, Docker Swarm.

Online Resource

https://www.ibm.com/in-en/cloud/devops
https://www.udemy.com/course/learn-devops

VoC3- DevOPs Practicals **1 Credit – 30L**

Sr No.	Practical
1.	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2.	To understand Version Control System / Source Code Management, install git and create a GitHub account
3.	To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet
4.	To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
5.	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
6.	To learn Docker file instructions, build an image for a sample web application using Docker file.
7.	Create a new bridge network and connect with container using Docker
8.	Docker Swarm: Create and Scale a Services
9.	Create an application with an API and deploy it to Kubernetes
10.	Create a Kubernetes Cluster on AWS

VoC4- No SQLDB Integration with Cloud Services **2 Credits**

Course Objective

- Understand the fundamental concepts of NoSQL databases and distinguish them from traditional relational databases.
- Explore MongoDB architecture, installation, and core components including collections and documents.
- Learn basic and advanced querying, indexing, and aggregation operations in MongoDB.
- Work with MongoDB tools for importing, exporting, and managing data.
- Understand how to store large files using GridFS and perform database operations using command-line tools.

Course Outcomes

Sr No.	Course Outcomes (CO)	Blooms Level
After completing this course the student must demonstrate the knowledge and ability to:		
CO1	Describe NoSQL database types and explain the key differences between NoSQL and relational databases.	L1: Remember, L2: Understand
CO2	Set up and configure MongoDB, and use the MongoDB shell to perform basic operations on collections and documents.	L2: Understand L3: Apply
CO3	Model data using document-based structures and perform CRUD operations with query filters in MongoDB.	L2: Understand L3: Apply
CO4	Use indexing and aggregation pipelines to enhance performance and generate insights from data.	L3: Apply L4: Analyze
CO5	Store and retrieve large files using GridFS and utilize MongoDB command-line tools for database administration.	L3: Apply

Detailed Syllabus **1 Credit – 15L**

Unit	Details	Lectures
I	**1. Introduction to NoSQL and MongoDB** - What is NoSQL?Definition and history of NoSQL databases, Overview of NoSQL database types: Key-value, Document, Column-family, and Graph databases, Differences between NoSQL and relational databases, Introduction to MongoDB and its components, MongoDB Installation and Setup, Installing MongoDB, Overview of MongoDB shell and basic MongoDB commands, NoSQL Data Models, NoSQL data models vs. relational data models, Document-based data modeling (collections and documents), ACID properties in NoSQL vs. relational databases, Sharding and replication in distributed NoSQL databases. **2. Data Modeling and Querying in MongoDB** -MongoDB Data Types and Modeling, Data types in MongoDB: String, Number, Date, Boolean, Arrays, and Embedded Documents, Designing a database: Collections and documents, Using the _id field for document identification, Inserting and Querying Data, Inserting documents into collections, Basic query operations: find(), insert(), update(), delete(), Using the dot notation to access embedded document fields, Querying for data and filtering results, Working with sort(), limit(), and skip() functions, Indexing in MongoDB, Creating and using indexes for improving performance, Types of indexes in MongoDB (single-field, compound, geospatial), **3. Advanced MongoDB Operations** -Aggregation in MongoDB, Introduction to the aggregation framework, Using aggregation operators (e.g., $match, $group, $project), Complex data transformations using the aggregation pipeline, Working with Capped Collections, Understanding capped collections and their use cases, Retrieving data from capped collections, Update Operations and Conditional Queries, Updating documents with $set, $push, and $inc, Conditional queries and using regular expressions in queries, Automatically updating data with MongoDB triggers and time-based operations **4. Working with GridFS and MongoDB Command Line** - Introduction to GridFS, Storing and retrieving large files (e.g., images, videos) in MongoDB using GridFS, Working with GridFS API in MongoDB, Uploading, retrieving, and deleting files with MongoDB, Working with the _id key and file metadata (filename, length, chunk size), Using MongoDB Command Line Tools, Command-line tools for interacting with MongoDB, Exporting and importing data using MongoDB shell, Monitoring and managing MongoDB instances.	**15**

Text Books and References:

1. NoSQL For Dummiesby Adam FowlerA Wiely brand
2. David Hows, “The definitive guide to MongoDB”, 2nd edition, Apress Publication, 2009, 8132230485.
3. Shakuntala Gupta Edward, “Practical Mongo DB”, Second edition, Apress Publications, 2016, ISBN 1484206487
4. Daniel Perkins, “Mongo DB, Third Edition, CreateSpace Independent Publishing Platform, 2016, ISBN 152396300.
5. Steve Hoberman, “Data Modelling for Mongo DB”, First Edition, Technics Publication, 2014, ISBN 9781935504702

Self-Learning Topic (Unit wise)

Sub Unit	Topics
1.1	NoSql database classification-key value stores, column family stores, document stores, XML Database, Graph Database, Introduction to MongoDB installation.
1.2	Data Types, Data Modelling: Designing the database, Drilling down on collection
1.3	Working with Conditional Operator, Leveraging Regular Expression, Update Data, and Update Information Automatically.

Online Resource

Sr.No	**Website Address**
1.	https://www.nosqldbm.ru
2.	https://www.mongodb.com

VoC4- No SQLDB Integration with Cloud Services **1 Credit – 30 L**

Sr. No	Practical
1.	Write a MongoDB query to display all the documents in the collection restaurants
2.	Write a MongoDB query to display the fields' restaurant_id, name, borough and cuisine for all the documents in the collection restaurant.
3.	Write a MongoDB query to display the fields' restaurant_id, name, borough and cuisine, but exclude the field _id for all the documents in the collection restaurant.
4.	Write a MongoDB query to display the fields' restaurant_id, name, borough and zip code, but exclude the field _id for all the documents in the collection restaurant.
5.	Write a MongoDB query to display the entire restaurant which is in the borough Bronx.
6.	Write a MongoDB query to display the first 5 restaurant which is in the borough Bronx
7.	Write a MongoDB query to display the next 5 restaurants after skipping first 5 which are in the borough Bronx.
8.	Write a MongoDB query to find the restaurants who achieved a score more than 9
9.	Write a MongoDB query to find the restaurants that achieved a score, more than 80 but less than 100.
10.	Write a MongoDB query to find the restaurants which locate in latitude value less than -95.754168