



**SNDT Women's University, Mumbai**

**Undergraduate Degree / UG  
Programme (Syllabus as Per NEP) -  
Faculty of Science & Technology**

**Bachelor of Science  
(Information Technology)**

**B.Sc. (IT)**

**As Per NEP – 2020**

**Semester –V & VI**

**Syllabus  
(W.E.F. Academic Year 2026-27)**

## Terminologies

| <b>Vertical</b>     | <b>Full-Form/Definition</b>                                                                                                                                                       | <b>Remarks</b>                                                                                                                                                 | <b>Related To Major And Minor Courses</b>                                  |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <b>Major (Core)</b> | Subject Comprising Mandatory and Elective Courses, Major Specific IKS, Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects Connected to Major | Minimum 50% Of Total Credits Corresponding to Three/Four - Year UG Degree- Mandatory Courses                                                                   | Related To The Major                                                       |
| <b>Minor Course</b> | Course From Same Or Different Faculty                                                                                                                                             | Minimum 18-20 Credits to Be Completed in The First Three Years of UG Programme                                                                                 | Related To the Minor                                                       |
| <b>OEC</b>          | Open Elective Courses/ Generic Courses                                                                                                                                            | 10-12 Credits to Be Offered in I And/Or II Year. Faculty-Wise Baskets of OEC To Be Prepared                                                                    | OEC Is to Be Chosen Compulsorily from Faculty Other Than That of the Major |
| <b>VSC</b>          | Vocational Skill Courses, Including Hands On Training Corresponding To The Major And/Or Minor Subject                                                                             | 8-10 Credits, To Be Offered in First Three Years, Wherever Applicable Vocational Courses Will Include Skills Based on Advanced Laboratory Practical's of Major | Related To the Major or Minor                                              |
| <b>SEC</b>          | Skill Enhancement Courses                                                                                                                                                         | 06 Credits, To Be Offered in I And II Year, To Be Selected from The Basket of Skill Courses Approved by University                                             | Related To the Major or Minor Any Relevant Skill                           |
| <b>AEC</b>          | Ability Enhancement Courses                                                                                                                                                       | 08 Credits, To Be Offered in I And II Year, English: 04 Credits to Be Earned in Sem - I, Modern Indian Language Of 04 Credits to Be Offered in II Year         | NA                                                                         |
| <b>VEC</b>          | Value Education Courses                                                                                                                                                           | Understanding India, Environmental Science/Education, Digital and Technological                                                                                | NA                                                                         |

|            |                                               |                                                                                                                                 |                                                                                                                                         |
|------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
|            |                                               | Solutions, Health & Wellness, Yoga Education, Sports, And Fitness                                                               |                                                                                                                                         |
| <b>IKS</b> | Indian Knowledge System                       | Generic IKS Course: Basic Knowledge Of The IKS To Be Offered At First Year Level                                                | Major-Specific IKS Courses: Advanced Information About the Major, Part of the Major Credit to Be Offered at Second- Or Third-Year Level |
| <b>OJT</b> | On-Job Training (Internship / Apprenticeship) | Corresponding To the Major Subject                                                                                              | Related To The Major                                                                                                                    |
| <b>FP</b>  | Field Projects                                | Corresponding To the Major Subject                                                                                              | Related To the Major                                                                                                                    |
| <b>CC</b>  | Co-Curricular Courses                         | Health And Wellness, Yoga Education Sports, And Fitness, Cultural Activities, NSS/NCC And Fine/ Applied/Visual/ Performing Arts | NA                                                                                                                                      |
| <b>CE</b>  | Community Engagement and Service              |                                                                                                                                 | Related To Major                                                                                                                        |
| <b>RP</b>  | Research Project                              | Corresponding To the Major Subject                                                                                              | Related To Major                                                                                                                        |

## Programme Template

|                                           |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Programme</b>                          |    | <b>B.Sc.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Specialization</b>                     |    | <b>Information Technology (IT)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Programme Outcomes (POs)</b>           |    | <b>After completing this programme, Learner will</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Major</b>                              | 1. | Describes a strong foundation in computer application, including knowledge of Programming languages, Database, Mathematics, Operating system, Cyber Security and Networking.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                           | 2. | Analyze the ethical and professional responsibilities related knowledge acquisition, mastery over the implications of adhering to professional standards and practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                           | 3. | Applying programming knowledge to develop a software application to solve specific problems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                           | 4. | Evaluate software designs and architectures for efficiency, security and user experience.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                           | 5. | Design a software application to meet the requirements of the Industrial Standards.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Minor</b>                              | 6. | To Understand AI/ML working and its application.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                           | 7. | To apply the AI/ML in real time use case.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Eligibility Criteria for Programme</b> |    | <p><b>B. Sc.IT – I Year:</b><br/>A women candidate must have passed the higher secondary school certificate (std. XII) examination conducted by the different divisional boards of the Maharashtra state board of secondary and higher secondary education in any stream with 45% marks (40% for candidates belonging to reserved category). Or must have passed an examination of any other recognized board or body recognized as equivalent. Students who have not done mathematics at 12th std. Are needed to take a bridge course in mathematics and pass in university conducted test before semester 1 examination. Or must have passed any three-year government recognized diploma programme in second class.</p> <p><b>B.Sc. (IT) - II Year:</b><br/>For a student from our university - should have cleared or has ATKT as admissible in first year in the same subject. For a student from another university- studied at least two courses of four credits each in the I year in the same subject. Passed I year without ATKT.</p> <p>Passed three-year full-time Diploma in Engineering with an aggregate of not less than 60% (Open Category) and 55%</p> |

|                                                                                                                  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                  |  | <p>(Reserved Category) OR must have passed any three-year Diploma in Engineering Course.</p> <p><b>B.Sc. IT - III Year:</b></p> <p>For a student from our University- should have cleared second year in the same subject or has passed with admissible ATKT. For a student from another university- should have completed at least six courses of 4 credits each or 24 credits in the I and II year in the same subject. Passed in I and II year without ATKT.</p> |
| <p><b>Intake</b><br/><b>(For SNDTWU</b><br/><b>Departments and</b><br/><b>Conducted</b><br/><b>Colleges)</b></p> |  | <p>As Per University Affiliation Letter</p>                                                                                                                                                                                                                                                                                                                                                                                                                         |

**Structure with Course Titles****Non-AEDP - B. Sc. In Information Technology****Semester – V (2024-25 batch and onwards) - AY 2026-27**

| <b>SN</b> | <b>Courses</b>                                            | <b>Type of Course</b> | <b>Credits</b> | <b>Marks</b> | <b>Int</b> | <b>Ext</b> |
|-----------|-----------------------------------------------------------|-----------------------|----------------|--------------|------------|------------|
| 50135211  | Computer Networks (Th+Pr) (2+2)                           | Major (Core)          | 4              | 100          | 50         | 50         |
| 50135212  | Software Engineering (Th)                                 | Major (Core)          | 4              | 100          | 50         | 50         |
| 51035211  | Indian Knowledge Systems and Ethical Practices in IT (Th) | IKS (Major Specific)  | 2              | 50           | 0          | 50         |
| 50335211  | Deep learning (Th+Pr) (2+2)                               | Minor Stream          | 4              | 100          | 50         | 50         |
| 50335212  | AI / ML Use Case (Th+Pr) (2+2)                            | Minor Stream          | 4              | 100          | 50         | 50         |
| 50635201  | Mobile Application Development using Android (Pr)         | VSC-4                 | 2              | 50           | 50         | 0          |
| 50135203  | Full Stack Development (Pr)                               | Major (Core)          | 2              | 50           | 50         | 0          |
|           |                                                           |                       | <b>22</b>      | <b>550</b>   | <b>300</b> | <b>250</b> |

## Semester – VI

| SN       | Courses                                                    | Type of Course                    | Credits   | Marks      | Int        | Ext        |
|----------|------------------------------------------------------------|-----------------------------------|-----------|------------|------------|------------|
| 60135211 | Big Data Analytics (Th+Pr) (2+2)                           | Major (Core)                      | 4         | 100        | 50         | 50         |
|          | <b>Elective-1<br/>(The Major Electives to be selected)</b> | Major (Elective) <b>(Any One)</b> | 4         | 100        | 50         | 50         |
| 60235211 | Blockchain and Web3 Fundamentals (Th)                      |                                   |           |            |            |            |
| 60235212 | Software Architectures (Th)                                |                                   |           |            |            |            |
| 60235213 | Cloud Computing and Web Services (Th)                      |                                   |           |            |            |            |
|          | <b>Elective-2<br/>(The Major Electives to be selected)</b> | Major (Elective) <b>(Any One)</b> | 4         | 100        | 50         | 50         |
| 60235214 | Software Testing and Quality Assurance (Th+Pr) (2+2)       |                                   |           |            |            |            |
| 60235215 | Cyber Security and Ethical Hacking (Th+Pr) (2+2)           |                                   |           |            |            |            |
| 60235216 | Internet of Things (IoT) (Th+Pr) (2+2)                     |                                   |           |            |            |            |
| 61535221 | Digital Literacy and Community Outreach (Pr)               | CE                                | 2         | 50         | 0          | 50         |
| 61335221 | Field Project (Pr)                                         | FP                                | 4         | 100        | 50         | 50         |
| 61235221 | On-Job Training (Pr)                                       | OJT                               | 4         | 100        | 50         | 50         |
|          |                                                            |                                   | <b>22</b> | <b>550</b> | <b>250</b> | <b>300</b> |

**Exit with Degree (3-year) The Major Electives to be selected**

**Elective Group – I:**

1. Blockchain and Web3 Fundamentals
2. Software Architectures
3. Cloud Computing and Web Services

**Elective Group – II:**

1. Software Testing and Quality Assurance
2. Cyber Security and Ethical Hacking.
3. Internet of Things (IoT)



## Course Syllabus

### Semester – V

#### .5.1 Major (Core)

|                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                                                                      | <b>Computer Networks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Credits</b>                                                                                    | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>                                                                                   | 1. Explain fundamental networking concepts and architecture.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                          | 2. Demonstrate knowledge of data communication techniques and protocols.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                          | 3. Configure and implement basic network addressing and subnetting schemes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                          | 4. Analyze network performance and identify bottlenecks and issues.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                          | 5. Evaluate network security mechanisms and propose mitigation strategies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Module 1 (Credit 1) Networking Fundamentals &amp; Models</b><br>(Builds strong conceptual foundation) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Learning Outcomes</b>                                                                                 | 1. Students understand how networks are structured and how data flows layer-by-layer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Outline</b>                                                                                    | <ul style="list-style-type: none"><li>• Introduction to Computer Networks<ul style="list-style-type: none"><li>◦ Definition, goals, and applications</li><li>◦ Network components: hosts, links, switches, routers</li></ul></li><li>• Types of Networks<ul style="list-style-type: none"><li>◦ LAN, MAN, WAN, PAN</li><li>◦ Client-Server vs Peer-to-Peer</li></ul></li><li>• Network Topologies<ul style="list-style-type: none"><li>◦ Bus, Star, Ring, Mesh, Hybrid</li></ul></li><li>• Network Models<ul style="list-style-type: none"><li>◦ OSI Model – all 7 layers with functions</li><li>◦ TCP/IP Model – layers and comparison with OSI</li></ul></li><li>• Transmission Media<ul style="list-style-type: none"><li>◦ Guided: Twisted Pair, Coaxial, Fiber Optic</li><li>◦ Unguided: Radio, Microwave, Satellite</li></ul></li><li>• Switching Techniques<ul style="list-style-type: none"><li>◦ Circuit Switching, Packet Switching, Message Switching</li></ul></li></ul> |

## Module 2 (Credit 1) Data Link & Network Layer Protocols

*(How data moves reliably and logically across networks)*

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b> | 1. Students learn IP addressing, routing basics, and error handling, which are critical for networking jobs and certifications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outline</b>    | <ul style="list-style-type: none"><li>• Data Link Layer<ul style="list-style-type: none"><li>○ Framing techniques</li><li>○ Error detection and correction<ul style="list-style-type: none"><li>▪ Parity, CRC, Hamming Code</li></ul></li><li>○ Flow control<ul style="list-style-type: none"><li>▪ Stop-and-Wait, Sliding Window</li></ul></li><li>○ Multiple Access Protocols<ul style="list-style-type: none"><li>▪ CSMA/CD, CSMA/CA</li></ul></li></ul></li><li>• Network Layer<ul style="list-style-type: none"><li>○ Logical addressing<ul style="list-style-type: none"><li>▪ IPv4 addressing, subnetting, CIDR</li><li>▪ Introduction to IPv6</li></ul></li><li>○ Routing concepts<ul style="list-style-type: none"><li>▪ Static vs Dynamic routing</li></ul></li><li>○ Routing Algorithms<ul style="list-style-type: none"><li>▪ Distance Vector (RIP)</li><li>▪ Link State (OSPF – concept)</li></ul></li></ul></li><li>• Internetworking devices<ul style="list-style-type: none"><li>○ Hub, Switch, Router, Gateway</li></ul></li></ul> |

## Module 3 (Credit 1) Transport, Application Layer & Network Services

*(Real-world protocols students actually use)*

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b> | 1. Students understand how web, email, and file transfer systems work behind the scenes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Outline</b>    | <ul style="list-style-type: none"><li>• Transport Layer<ul style="list-style-type: none"><li>○ TCP vs UDP</li><li>○ TCP features: flow control, congestion control</li><li>○ Ports and sockets</li></ul></li><li>• Application Layer Protocols<ul style="list-style-type: none"><li>○ HTTP / HTTPS</li><li>○ FTP, SFTP</li><li>○ SMTP, POP3, IMAP</li><li>○ DNS – working and resolution process</li></ul></li><li>• Network Services<ul style="list-style-type: none"><li>○ DHCP</li><li>○ NAT</li><li>○ Proxy Servers</li></ul></li><li>• Performance Metrics<ul style="list-style-type: none"><li>○ Bandwidth, Throughput, Latency, Jitter</li></ul></li></ul> |

|                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Module 4 (Credit 1)</b><br><b>Modern Networking, Security &amp; Emerging Trends</b><br><i>(Latest topics + industry relevance)</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Learning Outcomes</b>                                                                                                              | 1. Students get exposure to current technologies used in cloud, wireless, and secure networks, preparing them for industry & higher studies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Course Outline</b>                                                                                                                 | <ul style="list-style-type: none"> <li>• Network Security Basics <ul style="list-style-type: none"> <li>○ Threats: sniffing, spoofing, DoS/DDoS</li> <li>○ Firewalls: packet filtering, stateful inspection</li> <li>○ VPN concepts</li> <li>○ Basics of encryption (SSL/TLS overview)</li> </ul> </li> <li>• Wireless &amp; Mobile Networks <ul style="list-style-type: none"> <li>○ Wi-Fi standards (802.11 a/b/g/n/ac/ax)</li> <li>○ Bluetooth, NFC</li> <li>○ Cellular networks overview: 4G &amp; 5G basics</li> </ul> </li> <li>• Modern Networking Concepts <ul style="list-style-type: none"> <li>○ Software Defined Networking (SDN) – concept</li> <li>○ Network Function Virtualization (NFV)</li> <li>○ Cloud Networking basics (VPC, virtual networks)</li> </ul> </li> <li>• Emerging Trends <ul style="list-style-type: none"> <li>○ IoT networking</li> <li>○ Edge Computing</li> </ul> </li> <li>• Introduction to AI in network management</li> </ul> |

#### Reference Books

1. **Computer Networking: A Top-Down Approach**  
James F. Kurose, Keith W. Ross – Pearson Education  
*(Highly recommended for application-layer to physical-layer understanding)*
2. **Data Communications and Networking**  
Behrouz A. Forouzan – McGraw-Hill  
*(Excellent for OSI, TCP/IP models, protocols, and fundamentals)*
3. **Computer Networks** – Andrew S. Tanenbaum, David J. Wetherall, Pearson
4. **Internetworking with TCP/IP (Vol. 1)** – Douglas E. Comer, Pearson
5. **Computer Networking: Principles, Protocols and Practice** – Olivier Bonaventure
6. **Network Security Essentials** – William Stallings, Pearson
7. **Wireless Communications & Networks** – William Stallings

## 8. Cloud Computing Concepts, Technology & Architecture – Thomas Erl

### Internal Assessment 50 Marks Evaluation Scheme:

#### 1. UT -25

#### 2. Project - 25

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

| The Rubric will have the following Evaluation Parameters: |                                                                                                                   |       |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------|
| Evaluation Parameters                                     | Description / Evaluation Points                                                                                   | Marks |
| Code Implementation                                       | Clear understanding of networking concepts, protocols, models, and architectures used in the project              | 5     |
| Problem Understanding                                     | Correct use of networking concepts such as IP addressing, routing, protocols, security mechanisms, or simulations | 5     |
| Output Correctness                                        | Ability to analyze networking problems, identify bottlenecks, and propose logical solutions                       | 5     |
| Code Quality & Structure                                  | Understanding of basic network security threats and suitable mitigation strategies                                | 5     |
| Debugging Skills                                          | Understanding of basic network security threats and suitable mitigation strategies                                | 5     |

**Given below are two sample projects but it is expected to work on similar sort of projects**

#### Project 1: Small Office Computer Network Design

Design a basic network for a small office using appropriate topology, devices, and IP addressing. Explain data flow using OSI and TCP/IP models.

#### Project 2: Study of Network Protocols and Security

Study common network protocols (TCP, UDP, HTTP, DNS) and basic network security threats with simple diagrams and explanations.

#### External Assessment: (Marks 50)

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

**Semester – V****.5.2 Major (Core)**

|                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                            | <b>Software Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Credits</b>                                          | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>                                         | 1. Explain basic principles, characteristics, and the need for Software Engineering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                | 2. Understand and compare different Software Development Life Cycle (SDLC) models.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                | 3. Analyze software requirements and apply appropriate design concepts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                | 4. Use UML diagrams to model software systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                | 5. Describe software testing strategies, maintenance activities, and quality assurance practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                | 6. Understand software project management fundamentals and emerging trends in software engineering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Module 1 (Credit1) Introduction to Software Engineering</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Learning Outcomes</b>                                       | <p>Students will be able to:</p> <ol style="list-style-type: none"><li>1. Explain the principles, characteristics, and need of Software Engineering.</li><li>2. Understand ethical issues in software development.</li><li>3. Describe SDLC and its importance.</li><li>4. Compare different SDLC models.</li><li>5. Identify functional and non-functional requirements.</li><li>6. Understand the purpose and structure of SRS.</li></ol>                                                                                                                                                          |
| <b>Course Outline</b>                                          | <ol style="list-style-type: none"><li>1. Introduction to Software Engineering</li><li>2. Characteristics of Software</li><li>3. Software Engineering Ethics</li><li>4. Software Development Life Cycle (SDLC)</li><li>5. SDLC Models:<ul style="list-style-type: none"><li>• Waterfall Model</li><li>• Incremental Model</li><li>• Spiral Model (Overview)</li><li>• Agile Model (Introduction)</li></ul></li><li>6. Software Requirements:<ul style="list-style-type: none"><li>• Functional and Non-functional Requirements</li><li>• Software Requirement Specification (SRS)</li></ul></li></ol> |

**Module 2 (Credit 1) Software Design, Testing and Maintenance****Learning Outcomes**

Students will be able to:

1. Explain software design concepts.
2. Differentiate architectural and detailed design.
3. Understand basic UML diagrams.
4. Describe software testing levels and approaches.
5. Explain software maintenance activities.
6. Understand Software Quality Assurance.

**Course Outline**

1. Software Design Concepts
2. Types of Design:
  - Architectural Design
  - Detailed Design
3. UML Diagrams (Introduction):
  - Use Case Diagram
  - Class Diagram (Basic)
4. Software Testing:
  - Levels of Testing
  - Black Box and White Box Testing
5. Software Maintenance
6. Software Quality Assurance (SQA)

**Module 3 (Credit1) Advanced Software Engineering & Project Management****Learning Outcomes**

**Students will be able to:**

1. Understand software project planning and estimation.
2. Apply basic project management concepts.
3. Identify software risks and mitigation strategies.
4. Understand configuration and version management.

|                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outline</b>                                                                  | <ol style="list-style-type: none"> <li>1. Software Project Management <ul style="list-style-type: none"> <li>• Software project characteristics</li> <li>• Project planning and scheduling</li> </ul> </li> <li>2. Software Cost Estimation <ul style="list-style-type: none"> <li>• LOC and Function Point (Conceptual)</li> </ul> </li> <li>3. Risk Management <ul style="list-style-type: none"> <li>• Types of risks</li> <li>• Risk identification and mitigation</li> <li>• </li> </ul> </li> <li>4. Software Configuration Management <ul style="list-style-type: none"> <li>• Version control concepts</li> <li>• Change management</li> </ul> </li> <li>5. Introduction to CASE Tools</li> </ol> |
| <b>Module 4 (Credit 1) Modern Software Engineering Practices &amp; Emerging Trends</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Learning Outcomes</b>                                                               | <b>Students will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand modern development practices.</li> <li>2. Describe DevOps and continuous integration concepts.</li> <li>3. Analyze quality and reliability of software systems.</li> <li>4. Understand current trends and future directions in Software Engineering.</li> </ol>                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outline</b>                                                                  | <ol style="list-style-type: none"> <li>1. Agile Software Development (Scrum overview)</li> <li>2. DevOps Concepts <ul style="list-style-type: none"> <li>• Continuous Integration</li> <li>• Continuous Deployment (CI/CD – overview)</li> </ul> </li> <li>3. Software Reliability and Metrics</li> <li>4. Software Reusability and Component-Based Development</li> <li>5. Emerging Trends: <ul style="list-style-type: none"> <li>• Cloud-based software development</li> <li>• Microservices architecture (conceptual)</li> <li>• AI-assisted software development</li> </ul> </li> <li>6. Ethical, Legal, and Social Issues in Software Engineering</li> </ol>                                        |

### Reference Books

1. **Ian Sommerville** — *Software Engineering*, Pearson Education.  
(Widely used, clear explanation of fundamentals and practices.)
2. **Roger S. Pressman & Bruce R. Maxim** — *Software Engineering: A Practitioner's Approach*, McGraw-Hill.  
(Classic comprehensive text with examples and case studies.)

3. **Pankaj Jalote** — *An Integrated Approach to Software Engineering*, Springer.
4. **K.K. Aggarwal & Yogesh Singh** — *Software Engineering*, New Age International.
5. **Ali Behforooz & Frederick J. Hudson** — *Software Engineering Fundamentals*, Oxford University Press.
6. **Bernd Bruegge & Allen H. Dutoit** — *Object-Oriented Software Engineering*, Pearson.
7. **R. Mall** — *Fundamentals of Software Engineering*, PHI Learning.

#### **Internal Assessment 50 Marks Evaluation Scheme:**

##### **1. UT -25**

##### **2. Project - 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

| <b>The Rubric will have the following Evaluation Parameters:</b> |                                                                                                                                  |              |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Evaluation Parameters</b>                                     | <b>Description / Evaluation Points</b>                                                                                           | <b>Marks</b> |
| <b>Conceptual Understanding</b>                                  | Clear understanding of Software Engineering principles, SDLC, design concepts, testing, and maintenance.                         | 5            |
| <b>Technical Implementation &amp; Accuracy</b>                   | Correct application of concepts (e.g., SRS, UML, test plan, design diagrams) and logical structure of deliverables.              | 5            |
| <b>Problem Analysis &amp; Solution Design</b>                    | Ability to analyze requirements, propose suitable design and methodologies, identify constraints and justify decisions.          | 5            |
| <b>Software Quality Awareness</b>                                | Demonstrates understanding of testing strategies, maintenance implications, and quality assurance considerations.                | 5            |
| <b>Communication &amp; Documentation</b>                         | Report and presentation clarity; including diagrams, tables, proper formatting, screenshots (if any), and professional delivery. | 5            |

**Given below are two sample projects but it is expected to work on similar sort of projects**

#### **Project 1: Library Management System (SRS + Design + Test Plan)**

Description:

Create a Software Requirement Specification (SRS), UML diagrams, and a basic test plan for a Library Management System. This project focuses on requirement analysis, design,



and testing documentation rather than coding.

**Project 2: Online Examination System – Design & Quality Plan Description:**

Develop a design documentation and quality assurance plan for an online examination application. Focus is on design decisions and quality/testing strategies.

**External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – V

### .5.3 Indian Knowledge Systems (IKS)

|                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course Title                                                                                                                              | Indian Knowledge Systems and Ethical Practices in IT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Course Credits                                                                                                                            | 2 Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Course Outcomes                                                                                                                           | <ol style="list-style-type: none"><li>1. Explain the foundational principles of Indian Knowledge Systems (IKS) <b>such as <i>Dharma</i> (duty), <i>Karma</i> (action), and <i>Pramana</i> (means of valid knowledge), and relate these to ethical reasoning in computing and technology.</b></li><li>2. Analyze ethical challenges in IT and computing (e.g., data privacy, algorithmic bias, and digital governance) using traditional Indian ethical concepts such as <b><i>Lokasangraha</i></b> (welfare of society) and <b><i>Ahimsa</i></b> (non-violence).</li><li>3. Apply Indian moral values and ethical frameworks to formulate responsible technology practices <b>that promote societal well-being, fairness, and accountability in IT projects.</b></li><li>4. Evaluate contemporary technology issues (e.g., AI ethics, cybersecurity policies, user privacy) in light of constitutional, cultural, and moral values emphasized by Indian ethical traditions.</li><li>5. Design guidelines and strategies for ethical decision-making in IT organizations that reflect both global standards (e.g., fairness, transparency) and Indian philosophical insights about duty and societal harmony.</li></ol> |
| <b>Module 1 (Credit 1) Foundations of Indian Knowledge Systems (IKS)</b><br><i>(Philosophical and cultural roots of Indian knowledge)</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Learning Outcomes                                                                                                                         | <ol style="list-style-type: none"><li>1. Students understand Indian philosophical values and their relevance to ethical thinking in IT.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| <b>Module 2 (Credit 1) Indian Contributions to Science, Mathematics &amp; Computing</b><br><i>(India's legacy in scientific and logical thinking)</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                                                                                                                              | 1. Students appreciate India's intellectual heritage and its influence on modern computing concepts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Outline</b>                                                                                                                                 | <ul style="list-style-type: none"> <li>• <b>Ancient Indian Mathematics</b></li> <li>• <b>Zero, decimal system, place value</b></li> <li>• <b>Contributions of Aryabhata, Brahmagupta, Bhaskaracharya</b></li> <li>• <b>Indian Logic and Algorithms</b></li> <li>• <b>Nyaya and Vaisheshika schools</b></li> <li>• <b>Algorithmic thinking in ancient texts</b></li> <li>• <b>Astronomy &amp; Timekeeping</b></li> <li>• <b>Indian calendars, eclipses, planetary motion</b></li> <li>• <b>Linguistics &amp; Computing</b></li> <li>• <b>Panini's grammar as a precursor to formal Languages</b></li> <li>• <b>Sanskrit and structured programming logic</b></li> <li>• <b>Traditional Engineering &amp; Technology</b></li> <li>• <b>Metallurgy (Iron Pillar of Delhi)</b></li> <li>• <b>Water management systems</b></li> </ul> |

### **Suggested Pedagogy**

- Case-study based learning
- Group discussions & debates
- Reflection essays
- Guest lectures from ethics / IKS experts

### **External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – V

### .5.4 Minor (Stream)

|                            |                                                                                                                                                                           |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>        | <b>Deep Learning</b>                                                                                                                                                      |
| <b>Course Credits</b>      | <b>4 Credits</b>                                                                                                                                                          |
| <b>Course Outcomes</b>     | 1. Understand the core principles of deep learning and artificial neural networks.                                                                                        |
|                            | 2. Build and optimize deep learning models for various applications.                                                                                                      |
|                            | 3. Implement convolutional and recurrent architectures for structured and unstructured data.                                                                              |
|                            | 4. Train and fine-tune deep generative models for feature extraction and synthesis.                                                                                       |
|                            | 5. Apply deep learning techniques to solve real-world problems in vision, NLP, and generative AI.                                                                         |
|                            | 6. Evaluate model performance using metrics such as accuracy, precision, recall, and loss functions.                                                                      |
|                            | 7. Deploy deep learning models efficiently on cloud or edge devices.                                                                                                      |
|                            | 8. Understand the ethical implications of AI and deep learning applications.                                                                                              |
| <b>Module 1 (Credit 1)</b> |                                                                                                                                                                           |
| <b>Learning Outcomes</b>   | <b>After learning the module, learners will be able to</b>                                                                                                                |
|                            | 1. Explain the evolution, significance, and key applications of deep learning across various industries.                                                                  |
|                            | 2. Apply fundamental mathematical concepts from linear algebra, including vectors, matrices, tensors, eigenvalues, norms, and matrix operations, in deep learning models. |
|                            | 3. Understand numerical computation issues, such as overflow, underflow, conditioning, and algorithmic stability.                                                         |
|                            | 4. Describe the structure and working of neural networks, including neurons, activation functions, and loss functions.                                                    |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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|                            | 5. Explain the training process of neural networks, including forward and backward propagation and gradient descent methods.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                            | 6. Analyze overfitting and underfitting and apply regularization techniques such as L1, L2, and dropout to improve model performance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Content Outline</b>     | <ul style="list-style-type: none"> <li>• <b>Foundations of Deep Learning Introduction:</b><br/>Evolution and significance of deep learning, Key applications across industries</li> <li>• <b>Mathematical Foundations: Linear Algebra:</b><br/>Scalars, Vectors, Matrices, and Tensors, Matrix operations: Multiplication, Identity, and Inverses, Eigenvalues and Eigenvectors, Norms and special matrices</li> <li>• <b>Numerical Computation:</b><br/>Issues of overflow and underflow, Conditioning and stability in algorithms</li> <li>• <b>Neural Networks Basics:</b><br/>Structure and function of neurons, Activation functions: Sigmoid, Tanh, ReLU, and variants, Loss functions: MSE, Cross- Entropy</li> <li>• <b>Training Neural Networks:</b><br/>Forward and backward propagation, Gradient Descent and its variants, Overfitting and underfitting, Regularization techniques: L1, L2, Dropout</li> </ul> |
| <b>Module 2 (Credit 1)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Learning Outcomes</b>   | <b>After learning the module, learners will be able to</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                            | 1. Explain deep feedforward network architectures, training challenges, and weight initialization strategies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                            | 2. Apply regularization techniques such as batch normalization and dropout to improve deep network training and generalization.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                            | 3. Understand optimization techniques for deep networks, including advanced optimizers (RMSprop, Adam), learning rate scheduling, and methods to handle vanishing and exploding gradients.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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|                            | <p>4. Describe the working principles of Convolutional Neural Networks (CNNs), including convolution, feature maps, pooling, and popular architectures like LeNet, AlexNet, VGG, and ResNet.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                            | <p>5. Explain sequence modeling using Recurrent Neural Networks (RNNs) and advanced variants such as LSTM, GRU, and bidirectional RNNs.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                            | <p>6. Understand attention mechanisms and their role in improving performance for sequence-based deep learning applications.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Content Outline</b>     | <ul style="list-style-type: none"> <li>• <b>Advanced Neural Network Architectures</b></li> <li>• <b>Deep Feedforward Networks:</b><br/>Architecture and training challenges, Weight initialization strategies</li> <li>• <b>Regularization Techniques:</b><br/>Batch Normalization, Dropout and its impact on training</li> <li>• <b>Optimization for Deep Networks:</b><br/>Advanced optimizers: RMSprop, Adam, Learning rate scheduling, Handling vanishing and exploding gradients</li> <li>• <b>Convolutional Neural Networks (CNNs):</b><br/>Convolution operations and feature maps Pooling mechanisms, Popular CNN architectures: LeNet, AlexNet, VGG, ResNet</li> <li>• <b>Recurrent Neural Networks (RNNs):</b><br/>Sequence modeling and applications, Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRUs), Bidirectional RNNs and attention mechanisms</li> </ul> |
| <b>Module 3 (Credit 1)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Learning Outcomes</b>   | <b>After learning the module, learners will be able to</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                            | <p>1. Explain autoencoders and representation learning techniques, including undercomplete, sparse, denoising, and variational autoencoders.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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|                            | 2. Understand generative modeling concepts, including Generative Adversarial Networks (GANs), conditional GANs, and their practical applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                            | 3. Describe advanced sequence modeling techniques, including advanced RNN architectures, transformer models, and attention mechanisms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                            | 4. Explain the fundamentals of deep reinforcement learning, including Deep Q-Networks and policy gradient methods.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                            | 5. Apply deep learning models to real-world applications in natural language processing, computer vision, and speech processing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                            | 6. Analyze the suitability of specialized deep learning models for different problem domains and applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Content Outline</b>     | <ul style="list-style-type: none"> <li>• <b>Specialized Deep Learning Models and Applications</b></li> <li>• <b>Autoencoders and Representation Learning:</b> Undercomplete and sparse autoencoders, Denoising and variational autoencoders</li> <li>• <b>Generative Models:</b> Generative Adversarial Networks (GANs), Conditional GANs and applications</li> <li>• <b>Sequence Modeling:</b> Advanced RNN architectures, Transformer models and attention mechanisms</li> <li>• <b>Deep Reinforcement Learning:</b> Fundamentals of reinforcement learning, Deep Q-Networks and policy gradients</li> <li>• <b>Applications of Deep Learning:</b> Natural Language Processing: Text generation, translation, Computer Vision: Image classification, object detection, Speech Recognition and synthesis</li> </ul> |
| <b>Module 4 (Credit 1)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Learning Outcomes</b>   | <b>After learning the module, learners will be able to</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                            | 1. Explain ethical issues in deep learning, including bias, fairness, interpretability, and explainability of AI models.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | 2. Analyze the societal and technical impact of ethical challenges in the design and deployment of deep learning systems..                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                        | 3. Understand scalability and deployment considerations, including model optimization and hardware requirements such as GPUs and TPUs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                        | 4. Evaluate real-world deep learning case studies to identify best practices and lessons learned from industry applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                        | 5. Discuss emerging trends and future directions in deep learning, including new architectures, quantum computing, and neuromorphic computing                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Content Outline</b> | <ul style="list-style-type: none"> <li>• <b>Ethics and Practical Considerations in Deep Learning</b></li> <li>• <b>Ethical Considerations:</b> Bias and fairness in AI models, Interpretability and explainability</li> <li>• <b>Scalability and Deployment:</b> Model optimization for deployment, Hardware considerations: GPUs, TPUs</li> <li>• <b>Case Studies:</b> Analysis of real-world deep learning applications, Lessons learned from industry implementations</li> <li>• <b>Future Directions:</b> Emerging Architectures, Quantum computing and deep learning, Neuromorphic computing</li> </ul> |

### Reference Books

1. Goodfellow, Ian, et al. Deep Learning. MIT Press, 2016.
2. Chollet, François. Deep Learning with Python. Manning Publications, 2018.
3. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media, 2019.
4. Nielsen, Michael A. Neural Networks and Deep Learning. Determination Press, 2015.
5. Aggarwal, Charu C. Neural Networks and Deep Learning: A Textbook. Springer, 2018

### Internal Assessment 50 Marks Evaluation Scheme:

1. **UT -25**
2. **Project - 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.



| The Rubric will have the following Evaluation Parameters: |                                                                                                                                                     |       |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Evaluation Parameters                                     | Description / Evaluation Points                                                                                                                     | Marks |
| <b>Problem Understanding</b>                              | Clarity in understanding the problem statement, correct identification of objectives, dataset selection, and suitability of deep learning approach  | 5     |
| <b>Model Implementation</b>                               | Correct implementation of deep learning model (CNN / RNN / Autoencoder / GAN / Transformer), appropriate architecture, and correct use of libraries | 5     |
| <b>Training &amp; Output Correctness</b>                  | Proper training of the model, correct execution without errors, valid outputs, and meaningful results                                               | 5     |
| <b>Model Evaluation &amp; Analysis</b>                    | Use of appropriate evaluation metrics (accuracy, loss, precision, recall, etc.), interpretation of results, and comparison of outcomes              | 5     |
| <b>Code Quality &amp; Documentation</b>                   | Clean, well-structured code with proper indentation, comments, modularity, and reproducibility                                                      | 3     |
| <b>Project Report / Lab Record</b>                        | Completeness of report, clarity of explanation, formatting, screenshots/outputs, and timely submission                                              | 2     |

**Given below are two sample projects but it is expected to work on similar sort of projects**

### **Project 1: Image Classification Using Convolutional Neural Networks**

#### **Description:**

This project focuses on building and training a Convolutional Neural Network (CNN) for image classification tasks using standard datasets such as CIFAR-10 or MNIST. Students analyse the impact of different CNN architectures and regularization techniques on model performance.

#### **Techniques Used:**

CNN, Convolution and Pooling Layers, Dropout, Batch Normalization, Performance Metrics.

### **Project 2: Sentiment Analysis Using Recurrent Neural Networks Description:**

Students develop a deep learning model to perform sentiment analysis on text data such as movie reviews or social media posts. The project uses Recurrent Neural Networks (RNNs) and LSTM/GRU architectures to capture sequential patterns in text.

**Techniques Used:**

RNN, LSTM / GRU, Text Preprocessing, Accuracy and Loss Evaluation

**External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

**Semester – V****.5.5 Minor (Stream)**

|                                                                    |                                                                                                       |
|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                                | <b>AI / ML Use Cases</b>                                                                              |
| <b>Course Credits</b>                                              | <b>4 Credits</b>                                                                                      |
| <b>Course Outcomes</b>                                             | <b>After Completion of this Course, students will be able</b>                                         |
|                                                                    | 1. Understand real-world applications of Artificial Intelligence and Machine Learning.                |
|                                                                    | 2. Identify appropriate ML techniques for different problem domains.                                  |
|                                                                    | 3. Analyze datasets and problem statements to select suitable AI/ML models.                           |
|                                                                    | 4. Build, evaluate, and interpret ML solutions for practical use cases.                               |
|                                                                    | 5. Apply AI/ML concepts in domains such as healthcare, finance, education, retail, and smart systems. |
|                                                                    | 6. Understand ethical, social, and deployment challenges in AI/ML systems.                            |
| <b>Module 1(Credit 1) Introduction to AI &amp; ML Applications</b> |                                                                                                       |
| <b>Learning Outcomes</b>                                           | <b>After learning the module, learners will be able to:</b>                                           |
|                                                                    | 1. Explain the scope and evolution of AI and ML.                                                      |
|                                                                    | 2. Differentiate between AI, ML, and Deep Learning.                                                   |
|                                                                    | 3. Identify real-world AI/ML use cases across industries.                                             |

|                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Content Outline</b>                                                      | <p><b>Introduction to Artificial Intelligence</b></p> <ul style="list-style-type: none"> <li>• Definition and scope of AI</li> <li>• Strong AI vs Weak AI</li> </ul> <p><b>Machine Learning Overview</b></p> <ul style="list-style-type: none"> <li>• Supervised, Unsupervised, Reinforcement Learning</li> <li>• ML workflow (data → model → evaluation → deployment)</li> </ul> <p><b>AI/ML vs Traditional Programming</b></p> <p><b>Applications of AI/ML</b></p> <ul style="list-style-type: none"> <li>• Healthcare</li> <li>• Finance</li> <li>• Retail &amp; E-commerce</li> <li>• Education</li> <li>• Smart Cities</li> </ul> <p><b>Challenges in AI/ML</b></p> <ul style="list-style-type: none"> <li>• Data quality</li> <li>• Bias and fairness</li> <li>• Interpretability</li> </ul> |
| <b>Module 2 (Credit 1) Machine Learning Use Cases – Supervised Learning</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Learning Outcomes</b>                                                    | <p><b>After learning the module, learners will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Analyze supervised learning problems.</li> <li>2. Apply classification and regression techniques to real-world use cases.</li> <li>3. Interpret model outputs for decision-making.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Content Outline</b>                                                                         | <p><b>Classification Use Cases</b></p> <ul style="list-style-type: none"> <li>• Spam detection</li> <li>• Credit risk assessment</li> <li>• Disease diagnosis</li> <li>• Customer churn prediction</li> </ul> <p><b>Regression Use Cases</b></p> <ul style="list-style-type: none"> <li>• House price prediction</li> <li>• Sales forecasting</li> <li>• Demand prediction</li> </ul> <p><b>Common Algorithms (Conceptual)</b></p> <ul style="list-style-type: none"> <li>• Linear &amp; Logistic Regression</li> <li>• Decision Trees</li> <li>• k-Nearest Neighbors</li> <li>• Naïve Bayes</li> </ul> <p><b>Model Evaluation</b></p> <ul style="list-style-type: none"> <li>• Accuracy, Precision, Recall, F1-Score</li> <li>• Confusion Matrix</li> </ul> |
| <b>Module 3 (credit 1) Machine Learning Use Cases – Unsupervised &amp; Intelligent Systems</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Learning Outcomes</b>                                                                       | <p><b>After learning the module, learners will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Apply unsupervised learning techniques for pattern discovery.</li> <li>2. Understand recommendation and anomaly detection systems.</li> <li>3. Analyze intelligent system behavior.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Content Outline</b>                                                      | <p><b>Clustering Use Cases</b></p> <ul style="list-style-type: none"> <li>• Customer segmentation</li> <li>• Market basket analysis</li> <li>• Student performance grouping</li> </ul> <p><b>Anomaly Detection</b></p> <ul style="list-style-type: none"> <li>• Fraud detection</li> <li>• Network intrusion detection</li> </ul> <p><b>Recommendation Systems</b></p> <ul style="list-style-type: none"> <li>• Content-based recommendation</li> <li>• Collaborative filtering (conceptual)</li> </ul> <p><b>Intelligent Systems</b></p> <ul style="list-style-type: none"> <li>• Chatbots (conceptual)</li> <li>• Virtual assistants</li> <li>• Smart recommendation engines</li> </ul>                                                                                                              |
| <b>Module 4 (Credit 1)Advanced AI/ML Use Cases, Ethics &amp; Deployment</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Learning Outcomes</b>                                                    | <ol style="list-style-type: none"> <li>1. Understand advanced AI/ML applications.</li> <li>2. Evaluate ethical and societal impacts of AI.</li> <li>3. Analyze challenges in deploying AI/ML systems.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Content Outline</b>                                                      | <ol style="list-style-type: none"> <li>1. <b>Advanced AI/ML Use Cases</b> <ul style="list-style-type: none"> <li>• Autonomous vehicles (overview)</li> <li>• Facial recognition systems</li> <li>• Predictive maintenance</li> <li>• Smart healthcare systems</li> </ul> </li> <li>2. <b>Model Deployment Concepts</b> <ul style="list-style-type: none"> <li>• ML lifecycle</li> <li>• Model monitoring and updates</li> </ul> </li> <li>3. <b>Ethical and Social Issues</b> <ul style="list-style-type: none"> <li>• Bias and fairness</li> <li>• Privacy and data security</li> <li>• Responsible AI</li> </ul> </li> <li>4. <b>Future Trends</b> <ul style="list-style-type: none"> <li>• Explainable AI (XAI)</li> <li>• Generative AI (overview)</li> <li>• AI governance</li> </ul> </li> </ol> |

### **Text Books/Reference Books**

1. **Tom M. Mitchell** – *Machine Learning* McGraw-Hill Education  
(A classic foundational text covering ML concepts and algorithms.)
2. **Christopher M. Bishop** – *Pattern Recognition and Machine Learning* Springer  
(Statistical view of machine learning algorithms with real use case discussions.)
3. **Aurélien Géron** – *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow* O'Reilly Media  
(Practical approach to ML with Python — excellent for case studies.)
4. **Charu C. Aggarwal** – *Machine Learning for Text* Springer  
(Covers ML techniques with applications; useful for real-world use cases.)
5. **Russell & Norvig** – *Artificial Intelligence: A Modern Approach* Pearson Education  
(AI concepts and applications across domains.)

### **Assessment**

#### **Internal Assessment 50 Marks Evaluation Scheme:**

1. **UT -25**
2. **Project - 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

| <b>The Rubric will have the following Evaluation Parameters:</b> |                                                             |              |
|------------------------------------------------------------------|-------------------------------------------------------------|--------------|
| <b>Evaluation Criteria</b>                                       | <b>Description</b>                                          | <b>Marks</b> |
| Core Functional Implementation                                   | Correct identification and implementation of AI/ML use case | 5            |
| Problem Understanding & Model Selection                          | Appropriate ML technique selection                          | 5            |
| Solution Design & Interpretation                                 | Result analysis and interpretation                          | 5            |
| Input Handling & Error Management                                | Data validation and robustness                              | 5            |
| Project Report & Documentation                                   | Proper documentation and presentation                       | 5            |

**Given below are sample projects but it is expected to work on similar sort of projects:**

**Project 1: Disease Prediction System**

- Predict disease based on patient data
- Techniques: Classification models

**Project 2: Customer Churn Prediction**

- Identify customers likely to leave a service
- Techniques: Logistic Regression, Decision Tree

**External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.



## Semester – V

### .5.6 (VSC-S4)

|                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                                                                                                 | <b>Mobile Application Development using Android</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Credits</b>                                                                                                               | <b>2 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Outcomes</b>                                                                                                              | 1. Understand the fundamentals of Dart programming and Flutter framework for mobile app development.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                     | 2. Design and develop responsive and interactive mobile applications using Flutter widgets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                     | 3. Integrate APIs, databases, and external services into mobile applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                     | 4. Debug, test, and deploy mobile applications for Android platforms efficiently.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                                                     | 5. Apply best practices in UI/UX design, state management, and performance optimization for mobile apps.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Module 1 (Credit 1) Introduction to Mobile App Development &amp; Dart Basics<br/>(Strong foundation for Flutter development)</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Learning Outcomes</b>                                                                                                            | 1. Students understand Flutter fundamentals and can write basic Dart programs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Outline</b>                                                                                                               | <ul style="list-style-type: none"><li>• Introduction to Mobile Application Development<ul style="list-style-type: none"><li>◦ Native vs Hybrid vs Cross-platform apps</li><li>◦ Overview of Android ecosystem</li></ul></li><li>• Introduction to Flutter<ul style="list-style-type: none"><li>◦ Flutter architecture</li><li>◦ Advantages of Flutter</li></ul></li><li>• Development Environment Setup<ul style="list-style-type: none"><li>◦ Flutter SDK</li><li>◦ Android Studio / VS Code</li></ul></li><li>• Dart Programming Fundamentals<ul style="list-style-type: none"><li>◦ Variables, data types</li><li>◦ Functions &amp; arrow functions</li><li>◦ Control statements</li><li>◦ OOP concepts in Dart</li><li>◦ Null safety</li></ul></li></ul> |
| <b>Module 2 (Credit 1) Flutter UI Design &amp; Navigation (Building beautiful and responsive interfaces)</b>                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Learning Outcomes</b>                                                                                                            | 1. Students can design interactive, responsive Android UIs using Flutter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outline</b> | <ul style="list-style-type: none"> <li>• Flutter Widgets</li> <li>• Stateless vs Stateful widgets</li> <li>• Widget tree &amp; build method</li> <li>• Layouts &amp; UI Design</li> <li>• Row, Column, Stack</li> <li>• Container, Padding, Expanded</li> <li>• Material Design in Flutter</li> <li>• Scaffold, AppBar, Themes</li> <li>• User Interaction</li> <li>• Buttons, forms, input fields</li> <li>• Gesture detection</li> <li>• Navigation</li> <li>• Named routes</li> <li>• Bottom navigation &amp; drawer</li> </ul> |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Reference Books

1. Eric Windmill – *Flutter in Action* Manning Publications  
(Excellent practical guide for Flutter fundamentals and UI development)
2. Alessandro Biessek – *Beginning Flutter: A Hands-On Guide to App Development* Apress  
(Good for beginners with Dart + Flutter concepts)
3. Marco L. Napoli – *Flutter Cookbook* O'Reilly Media  
(Widget-based solutions and UI patterns)

### Assessment:

#### Internal Assessment – 50 Marks

Internal assessment will be conducted through Mini Project Development, Project Presentation, and Report Submission.

| The Rubric will have the following Evaluation Parameters: |                                                    |       |
|-----------------------------------------------------------|----------------------------------------------------|-------|
| Evaluation Criteria                                       | Description                                        | Marks |
| Core Functionality                                        | Implementation of main features, logic correctness | 20    |
| UI Design & Responsiveness                                | Proper widget usage, layout design, navigation     | 10    |
| Code Quality & Structure                                  | Readability, modularity, naming conventions        | 10    |
| Debugging & Error Handling                                | Handling invalid inputs, crash-free execution      | 5     |
| Project Report & Documentation                            | Proper documentation and presentation              | 5     |

**Given below are sample projects but it is expected to work on similar sort of projects:**

**Project 1: Student Notes App**

Description:

Develop a simple notes application to add, edit, and delete notes. Features:

- Text input
- List view of notes
- Navigation between screens

Concepts Used:  
Flutter widgets, Stateful widgets, Navigation, Forms

**Project 2: To-Do List Application**

Description:

Create a task management app to track daily activities. Features:

- Add / delete tasks
- Mark tasks as completed
- Responsive UI

Concepts Used:  
ListView, Checkbox, State management, UI design

## Semester – V

### .5.7 Major (Core)

|                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                                                                               | <b>Full Stack Development</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Credits</b>                                                                                             | <b>2 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                                                                            | 1. Understand core web and mobile application fundamentals including client-server architecture, HTTP/HTTPS, and responsive design.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                   | 2. Develop interactive and responsive user interfaces using modern front-end technologies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                   | 3. Implement server-side logic and database operations to support dynamic application behavior.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                   | 4. Analyze and resolve full stack development challenges, including state management, asynchronous communication, and security considerations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                   | 5. Evaluate and apply best practices for deployment, testing, performance optimization, and security in full stack development projects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Module 1 (Credit 1) Frontend Fundamentals &amp; Modern UI Development &amp; Backend Development &amp; APIs</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Learning Outcomes</b>                                                                                          | 1. Students can build responsive, interactive user interfaces using modern frontend tools                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outline</b>                                                                                             | <ul style="list-style-type: none"><li>• Introduction to Full Stack Development<ul style="list-style-type: none"><li>◦ Frontend vs Backend vs Database</li><li>◦ Web &amp; App development workflow</li></ul></li><li>• HTML5 &amp; CSS3<ul style="list-style-type: none"><li>◦ Semantic HTML</li><li>◦ Flexbox &amp; Grid</li><li>◦ Responsive design &amp; mobile-first approach</li></ul></li><li>• JavaScript (ES6+)<ul style="list-style-type: none"><li>◦ Variables, functions, arrays, objects</li><li>◦ Arrow functions, promises, async/await</li></ul></li><li>• Modern Frontend Framework – React<ul style="list-style-type: none"><li>◦ Component-based architecture</li><li>◦ JSX</li><li>◦ Props &amp; state</li><li>◦ Hooks (useState, useEffect)</li></ul></li><li>• UI Libraries<ul style="list-style-type: none"><li>◦ Tailwind CSS / Material UI (overview)</li></ul></li></ul> |

|                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                | <ul style="list-style-type: none"> <li>• Backend basics <ul style="list-style-type: none"> <li>◦ Client–Server architecture</li> <li>◦ RESTful API concepts</li> </ul> </li> <li>• Node.js <ul style="list-style-type: none"> <li>◦ Event-driven architecture</li> <li>◦ npm &amp; package management</li> </ul> </li> <li>• Express.js <ul style="list-style-type: none"> <li>◦ Routing</li> <li>◦ Middleware</li> <li>◦ Request &amp; response handling</li> </ul> </li> <li>• API Development <ul style="list-style-type: none"> <li>◦ CRUD operations</li> <li>◦ JSON data handling</li> </ul> </li> <li>• Authentication Basics <ul style="list-style-type: none"> <li>◦ JWT authentication</li> <li>◦ Password hashing (bcrypt – concept)</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                          |
| <b>Module 2 (Credit 1) Database, State Management &amp; Full Stack Integration &amp; App Development, Cloud Deployment &amp; Latest Trends</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Learning Outcomes</b>                                                                                                                       | 1. Students can build complete full-stack applications with real databases.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outline</b>                                                                                                                          | <ul style="list-style-type: none"> <li>• Database Concepts <ul style="list-style-type: none"> <li>◦ SQL vs NoSQL</li> </ul> </li> <li>• MongoDB <ul style="list-style-type: none"> <li>◦ Collections &amp; documents</li> <li>◦ CRUD operations</li> <li>◦ Mongoose ORM</li> </ul> </li> <li>• Full Stack Integration <ul style="list-style-type: none"> <li>◦ Connecting React frontend with Node backend</li> <li>◦ API consumption using Axios / Fetch</li> </ul> </li> <li>• State Management <ul style="list-style-type: none"> <li>◦ Lifting state</li> <li>◦ Context API</li> <li>◦ Introduction to Redux</li> </ul> </li> <li>• File Uploads &amp; Media Handling <ul style="list-style-type: none"> <li>◦ Image upload concepts</li> <li>◦ Cloud storage overview</li> </ul> </li> <li>• App Development using React Native <ul style="list-style-type: none"> <li>◦ Cross-platform mobile apps (Android &amp; iOS)</li> <li>◦ Components, navigation, APIs</li> </ul> </li> <li>• TypeScript <ul style="list-style-type: none"> <li>◦ Benefits over JavaScript</li> </ul> </li> </ul> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>○ Typing props, functions, and APIs</li> <li>• Deployment &amp; DevOps Basics <ul style="list-style-type: none"> <li>○ Hosting frontend (Vercel / Netlify)</li> <li>○ Hosting backend (Render / Railway)</li> <li>○ Environment variables</li> </ul> </li> <li>• Security &amp; Performance <ul style="list-style-type: none"> <li>○ OWASP Top 10 (overview)</li> <li>○ CORS</li> <li>○ Rate limiting</li> </ul> </li> <li>• Latest Trends <ul style="list-style-type: none"> <li>○ Serverless architecture</li> <li>○ JAMstack</li> <li>○ AI integration in web apps (chatbots, APIs)</li> </ul> </li> </ul> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Assessment:

### Internal Assessment: (50 marks)

### Evaluation Scheme:

The internal assessment, which is a project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

| The Rubric will have the following Evaluation Parameters: |                                                                           |       |
|-----------------------------------------------------------|---------------------------------------------------------------------------|-------|
| Evaluation Parameters                                     | Description / Evaluation Points                                           | Marks |
| <b>Requirement Analysis &amp; Planning</b>                | Clear understanding of problem statement, features, and user requirements | 10    |
| <b>Frontend Implementation</b>                            | UI design, responsiveness, and usability using frontend technologies      | 10    |
| <b>Backend &amp; Database Integration</b>                 | Server-side logic, database connectivity, CRUD operations                 | 10    |
| <b>Functionality &amp; Error Handling</b>                 | Proper working of features, validation, and exception handling            | 10    |
| <b>Documentation &amp; Presentation</b>                   | Project report, architecture explanation, and presentation clarity        | 10    |

Given below are sample projects but it is expected to work on similar sort of projects:

### Project 1: Student Management System Description:

Develop a web application to manage student records.

- Backend CRUD operations

**Project 2: Online Feedback / Complaint System Description:**

A web-based system where users can submit feedback or complaints.

## Course Syllabus

### Semester – VI

#### .6.1 Major (Core)

|                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                            | <b>Big Data Analytics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Credit</b>                                           | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b>                                         | <b>After successful completion of the course, learners will be able to:</b> <ol style="list-style-type: none"><li>1. To provide an overview of the big data platforms, its use cases and Hadoop ecosystem.</li><li>2. To introduce programming skills to build simple solutions using big data technologies such as MapReduce, Scripting for No SQL and R</li><li>3. To learn the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.</li><li>4. To enable students to have skills that will help them to solve complex real-world problems for decision support.</li></ol> |
| <b>Module 1 (Credit 1) Introduction to Big Data and Hadoop</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Learning Outcomes</b>                                       | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"><li>1. Understand the building blocks of Big Data Analytics.</li><li>2. Understand the building blocks of Big Data Analytics.</li><li>3. Explain the characteristics and types of Big Data.</li><li>4. Differentiate between traditional data processing and Big Data approaches.</li><li>5. Describe Hadoop architecture and its ecosystem components.</li></ol>                                                                                                                                                                         |



|                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Content Outline</b>                               | <ul style="list-style-type: none"> <li>• Introduction to Big Data</li> <li>• Big Data Characteristics and Types of Big Data</li> <li>• Traditional vs Big Data Business Approach</li> <li>• Case Study of Big Data Solutions</li> <li>• Concept of Hadoop</li> <li>• Core Hadoop Components</li> <li>• Hadoop Ecosystem</li> </ul>                                                                                                                                                                      |
| <b>Module 2 (Credit 1) Hadoop HDFS and MapReduce</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Learning Outcomes</b>                             | <p><b>After learning this module, learners will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand distributed file systems and HDFS architecture.</li> <li>2. Explain MapReduce programming model and execution flow.</li> <li>3. Apply MapReduce techniques to solve data processing problems.</li> <li>4. Analyze limitations of Hadoop and MapReduce.</li> </ol>                                                                                                              |
| <b>Content Outline</b>                               | <ul style="list-style-type: none"> <li>• Distributed File Systems</li> <li>• Physical Organization of Compute Nodes</li> <li>• Large Scale File System Organization</li> <li>• MapReduce Model: Map Tasks, Reduce Tasks, Combiners</li> <li>• MapReduce Execution and Fault Tolerance</li> <li>• Algorithms using MapReduce – Matrix Vector Multiplication</li> <li>• Relational Algebra Operations</li> <li>• Selection, Projection, Union, Intersection, Difference<br/>Hadoop Limitations</li> </ul> |

| <b>Module 3 (Credit 1) NoSQL</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                       | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand NoSQL concepts and business drivers.</li> <li>2. Identify different NoSQL data models and architectures.</li> <li>3. Analyze NoSQL solutions for handling Big Data problems.</li> <li>4. Select appropriate NoSQL systems for real-world applications.</li> </ol>                                                                                |
| <b>Content Outline</b>                         | <ul style="list-style-type: none"> <li>• Introduction to NoSQL</li> <li>• NoSQL Business Drivers</li> <li>• NoSQL Data Architecture Patterns</li> <li>• Key-Value Stores</li> <li>• Column Family Stores</li> <li>• Document Stores</li> <li>• Graph Stores</li> <li>• Variations of NoSQL Architectural Patterns</li> <li>• NoSQL Case Study</li> <li>• NoSQL Systems for Big Data Problems</li> <li>• Distribution Models: Master-Slave, Peer-to-Peer</li> </ul> |
| <b>Module 4 (Credit 1) Mining Data Streams</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Learning Outcomes</b>                       | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand the data stream model and stream processing challenges.</li> <li>2. Apply sampling and filtering techniques for data streams.</li> <li>3. Explain probabilistic algorithms for counting distinct elements.</li> <li>4. Analyze sliding window models for stream analytics.</li> </ol>                                                            |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Content Outline</b> | <ul style="list-style-type: none"> <li>• Stream Data Model</li> <li>• Data Stream Management Systems</li> <li>• Stream Sources and Stream Queries</li> <li>• Issues in Stream Processing</li> <li>• Sampling Techniques in Data Streams</li> <li>• Filtering Streams – Bloom Filters</li> <li>• Counting Distinct Elements in a Stream</li> <li>• Flajolet–Martin Algorithm</li> <li>• Counting Ones in a Window</li> <li>• DGIM Algorithm and Decaying Windows</li> </ul> |

### **Reference Books**

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets, Cambridge University Press
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.
4. DT Editorial Services, —Big Data Black Book, Dreamtech Press
5. EMC Education Services, Data Science and Big Data Analytic, Wiley

### **Internal Assessment 50 Marks**

#### **Evaluation Scheme:**

**UT -25**

**Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

**Evaluation Parameters:**

| <b>The Rubric will have the following Evaluation Parameters:</b> |                                                      |              |
|------------------------------------------------------------------|------------------------------------------------------|--------------|
| <b>Evaluation Parameters</b>                                     | <b>Description / Evaluation Points</b>               | <b>Marks</b> |
| Conceptual Understanding                                         | Understanding of core subject concepts               | 5            |
| Problem Analysis                                                 | Appropriate problem identification and justification | 5            |
| Technical Design                                                 | Logical design / workflow (conceptual)               | 5            |
| Innovation & Originality                                         | Creativity in solution approach                      | 5            |
| Communication & Presentation                                     | Clarity and organization                             | 3            |
| Timeliness & Completeness                                        | On-time and complete submission                      | 2            |

**Given below are two sample projects but it is expected to work on similar sort of projects:**

**Project 1: Big Data Analysis Using Hadoop MapReduce****Project Description**

This project focuses on processing and analyzing a large dataset using the Hadoop ecosystem. MapReduce programming is used to extract meaningful insights from structured or semi-structured data.

**Project 2: Real-Time Data Stream Analysis Using Big Data Techniques****Project Description**

This project involves analyzing continuous data streams and applying data stream mining techniques such as filtering, sampling, and approximate counting.

**External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – VI

### .6.2 A. Major (Elective)

|                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                   | <b>Blockchain and Web3 Fundamentals</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Credit</b>                                  | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Course Outcomes</b>                                | <b>After successful completion of the course, learners will be able to</b> <ol style="list-style-type: none"><li>1. Understand the fundamental concepts, architecture, and working principles of blockchain technology.</li><li>2. Explain cryptographic foundations and consensus mechanisms used in blockchain networks.</li><li>3. Analyse smart contracts and decentralized applications (DApps) in the Web3 ecosystem.</li><li>4. Evaluate real-world use cases, challenges, and future trends of blockchain and Web3 technologies.</li></ol>                                                                            |
| <b>Module 1 (Credit 1) Introduction to Blockchain</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Learning Outcomes</b>                              | <b>After learning the module, learners will be able to</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                       | 1. Understand the evolution of blockchain technology and its core principles.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                       | 2. Explain how distributed ledger technology works.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                       | 3. Identify different types of blockchains and their applications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Content Outline</b>                                | <b>Introduction to Blockchain</b> <ul style="list-style-type: none"><li>• Definition and meaning of Blockchain</li><li>• Evolution of digital currencies and distributed systems</li><li>• Need for blockchain technology</li><li>• Characteristics of blockchain: decentralization, transparency, immutability</li><li>• Blockchain vs traditional centralized systems</li></ul> <b>Blockchain Architecture</b> <ul style="list-style-type: none"><li>• Blocks and block structure</li><li>• Hashing and cryptographic linking of blocks</li><li>• Distributed ledger concept</li><li>• Peer-to-peer network model</li></ul> |

|                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                       | <ul style="list-style-type: none"> <li>• Role of nodes and miners</li> </ul> <p><b>Types of Blockchain</b></p> <ul style="list-style-type: none"> <li>• Public blockchain</li> <li>• Private blockchain</li> <li>• Consortium blockchain</li> <li>• Permissioned vs permission-less blockchains</li> <li>• Use cases of different blockchain types</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Module 2 (Credit 1) Cryptography in Blockchain</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Learning Outcomes</b>                              | <b>After learning the module, learners will be able to</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                       | 1. Understand cryptographic concepts used in blockchain.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                       | 2. Explain different consensus mechanisms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                       | 3. Analyze how transactions are validated and secured.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Content Outline</b>                                | <p><b>Cryptography in Blockchain</b></p> <ul style="list-style-type: none"> <li>• Importance of cryptography in blockchain</li> <li>• Cryptographic hash functions</li> <li>• Public key and private key cryptography</li> <li>• Digital signatures</li> <li>• Wallets and address generation</li> </ul> <p><b>Consensus Mechanisms</b></p> <ul style="list-style-type: none"> <li>• Need for consensus in decentralized networks</li> <li>• Proof of Work (PoW)</li> <li>• Proof of Stake (PoS)</li> <li>• Delegated Proof of Stake (DPoS)</li> <li>• Practical Byzantine Fault Tolerance (PBFT – conceptual)</li> </ul> <p><b>Blockchain Transactions</b></p> <ul style="list-style-type: none"> <li>• Transaction lifecycle</li> <li>• Transaction validation process</li> <li>• Block confirmation and finality</li> <li>• Security aspects and attack scenarios (51% attack – conceptual)</li> </ul> |

|                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Module 3 (Credit 1) Web3 Platforms and Tools</b>      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Learning Outcomes</b>                                 | <b>After learning the module, learners will be able to</b> <ol style="list-style-type: none"> <li>1. Understand the concept and functioning of smart contracts.</li> <li>2. Explain decentralized applications (DApps).</li> <li>3. Identify key platforms used for Web3 development.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Content Outline</b>                                   | <p><b>Smart Contracts</b></p> <ul style="list-style-type: none"> <li>• Definition and features of smart contracts</li> <li>• Working of smart contracts</li> <li>• Advantages and limitations</li> <li>• Use cases of smart contracts</li> <li>• Smart contract security issues (conceptual)</li> </ul> <p><b>Decentralized Applications (DApps)</b></p> <ul style="list-style-type: none"> <li>• Definition and characteristics of DApps</li> <li>• Architecture of DApps</li> <li>• Frontend, backend, and blockchain integration</li> <li>• Difference between traditional apps and DApps</li> </ul> <p><b>Web3 Platforms and Tools</b></p> <ul style="list-style-type: none"> <li>• Introduction to Ethereum blockchain</li> <li>• Overview of Solidity (conceptual)</li> <li>• Web3.js and interaction with blockchain (conceptual)</li> <li>• Role of wallets (MetaMask – conceptual)</li> </ul> |
| <b>Module 4 (Credit 1) Blockchain and Web3 Use Cases</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Learning Outcomes</b>                                 | <b>After learning the module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Analyze real-world applications of blockchain and Web3.</li> <li>2. Understand emerging trends in decentralized technologies.</li> <li>3. Evaluate challenges and ethical concerns related to blockchain adoption.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |



|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Content Outline</b> | <p><b>Blockchain and Web3 Use Cases</b></p> <ul style="list-style-type: none"> <li>• Cryptocurrency and decentralized finance (DeFi)</li> <li>• Non-Fungible Tokens (NFTs)</li> <li>• Supply chain management</li> <li>• Healthcare and digital identity</li> <li>• Governance and voting systems</li> </ul> <p><b>Challenges and Limitations</b></p> <ul style="list-style-type: none"> <li>• Scalability issues</li> <li>• Energy consumption concerns</li> <li>• Security and privacy challenges</li> <li>• Regulatory and legal issues</li> <li>• Adoption barriers</li> </ul> <p><b>Future Trends</b></p> <ul style="list-style-type: none"> <li>• Web3 vision and decentralized internet</li> <li>• Layer 2 solutions (conceptual)</li> <li>• Interoperability between blockchain</li> <li>• Career opportunities in blockchain and Web3</li> </ul> |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Reference:**

1. Nakamoto, S. Bitcoin: A Peer-to-Peer Electronic Cash System.
2. Antonopoulos, A. M. Mastering Bitcoin. O'Reilly Media.
3. Antonopoulos, A. M., & Wood, G. Mastering Ethereum. O'Reilly Media.
4. Drescher, D. Blockchain Basics. Apress.
5. Ethereum Official Documentation.

**Internal Assessment 50 Marks**

**Evaluation Scheme:**

**UT -25**

**Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

**The Rubric will have the following Evaluation Parameters:**

| <b>The Rubric will have the following Evaluation Parameters:</b> |                                                                                          |              |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------|
| <b>Evaluation Parameters</b>                                     | <b>Description / Evaluation Points</b>                                                   | <b>Marks</b> |
| Conceptual Understanding                                         | Demonstrates understanding of blockchain principles, Web3 concepts, and decentralization | 5            |
| Problem Analysis & Use Case Selection                            | Identifies appropriate real-world problem and justifies blockchain usage                 | 5            |
| Technical Design                                                 | Designs logical blockchain / DApp workflow (conceptual)                                  | 5            |
| Innovation & Originality                                         | Shows originality in solution design and application                                     | 5            |
| Communication & Presentation                                     | Clear explanation, structured presentation, and documentation                            | 3            |
| Timeliness & Completeness                                        | Timely submission and completion as per guidelines                                       | 2            |

**Given below are two sample projects but it is expected to work on similar sort of projects**

**Project 1: Cryptocurrency Transaction Analysis**

Analyze cryptocurrency transaction data to understand transaction flow, confirmation time, and network activity using publicly available datasets (conceptual analysis only).

**Project 2: Supply Chain Transparency using Blockchain**

Design a conceptual blockchain-based solution to track product movement across supply chain stages ensuring transparency and traceability.

**External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – VI

### .6.2 B. Major (Elective)

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                              | <b>Software Architecture</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Credit</b>                                             | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Outcomes</b>                                           | <b>After successful completion of the course, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand architectural principles and styles.</li><li>2. Analyze system structures and quality attributes.</li><li>3. Design scalable and maintainable architectures.</li><li>4. Evaluate architectural trade-offs.</li></ol>                                                                                                                                                                       |
| <b>Module 1 (Credit 1) Introduction to Software Architecture</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Learning Outcomes</b>                                         | <b>After learning this module, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Define software architecture and explain its importance and role in software development.</li><li>2. Differentiate between architecture, design, and implementation levels of a software system.</li><li>3. Analyze various software architecture views and perspectives used to represent systems.</li><li>4. Explain how architectural decisions influence system quality and long-term maintainability.</li></ol> |
| <b>Content Outline</b>                                           | <ul style="list-style-type: none"><li>• Definition, Importance, and Role of Architecture</li><li>• Architecture vs Design vs Implementation</li><li>• Software Architecture Views and Perspectives</li></ul>                                                                                                                                                                                                                                                                                                                      |

|                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Module 2 (Credit 1) Architectural Styles and Patterns</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Learning Outcomes</b>                                     | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Identify and explain common architectural styles such as layered, client-server, microservices, and event-driven architectures.</li> <li>2. Apply design patterns (Singleton, Factory, Observer, MVC) to solve recurring design problems.</li> <li>3. Compare different architectural styles based on application requirements and constraints.</li> <li>4. Select appropriate architecture styles and patterns for specific software applications.</li> </ol> |
| <b>Content Outline</b>                                       | <ul style="list-style-type: none"> <li>• Layered, Client-Server, Microservices, Event-driven Architecture</li> <li>• Design Patterns: Singleton, Factory, Observer, MVC</li> <li>• Selecting Architecture Styles for Applications</li> </ul>                                                                                                                                                                                                                                                                                                                          |
| <b>Module 3 (Credit 1) Architecture Documentation</b>        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Learning Outcomes</b>                                     | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Describe different architecture views including logical, development, process, and physical views.</li> <li>2. Create effective architecture documentation using standard techniques and tools.</li> <li>3. Apply UML diagrams to model and communicate architectural designs.</li> <li>4. Analyze the role of documentation in improving system understanding and communication among stakeholders.</li> </ol>                                                |
| <b>Content Outline</b>                                       | <ul style="list-style-type: none"> <li>• Views: Logical, Development, Process, Physical</li> <li>• Documentation Techniques and Tools</li> <li>• UML for Architectural Modeling</li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |

| <b>Module 4 (Credit 1) Architectural Evaluation and Case studies</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                                             | <p><b>After learning this module, learners will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Analyze key quality attributes such as performance, scalability, and reliability in software architectures.</li> <li>2. Apply architecture evaluation methods like ATAM and CBAM to assess architectural decisions.</li> <li>3. Evaluate risks, trade-offs, and design alternatives in architectural solutions.</li> <li>4. Analyze real-world software architecture case studies from web, cloud, and enterprise applications.</li> <li>5. Design high-level architectures considering modern application requirements and constraints.</li> </ol> |
| <b>Content Outline</b>                                               | <ul style="list-style-type: none"> <li>• Quality Attributes: Performance, Scalability, Reliability</li> <li>• Evaluation Methods: ATAM, CBAM</li> <li>• Risk Assessment and Trade-off Analysis</li> <li>• Real-world Software Architecture Examples</li> <li>• Architecture for Web, Cloud, and Enterprise Applications</li> </ul>                                                                                                                                                                                                                                                                                                                                |

### **Reference Books**

1. Software Architecture in Practice – Len Bass
2. Documenting Software Architectures – Paul Clements
3. Pattern-Oriented Software Architecture – Frank Buschmann
4. Clean Architecture – Robert C. Martin
5. Building Microservices – Sam Newman
6. Designing Data-Intensive Applications – Martin Kleppmann

### **Internal Assessment 50 Marks**

#### **Evaluation Scheme:**

**UT -25**

**Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

**Evaluation Parameters:**

| The Rubric will have the following Evaluation Parameters: |                                                      |       |
|-----------------------------------------------------------|------------------------------------------------------|-------|
| Evaluation Parameters                                     | Description / Evaluation Points                      | Marks |
| Conceptual Understanding                                  | Understanding of core subject Concepts               | 5     |
| Problem Analysis                                          | Appropriate problem identification and justification | 5     |
| Technical Design                                          | Logical design / workflow (conceptual)               | 5     |
| Innovation & Originality                                  | Creativity in solution approach                      | 5     |
| Communication & Presentation                              | Clarity and organization                             | 3     |
| Team Collaboration                                        | Active participation                                 | 2     |

Given below are two sample projects but it is expected to work on similar sort of projects:

**Project 1: Online Learning Management System (LMS) – Architecture Design**  
**Project Description**

Design the complete software architecture for an Online Learning Management System used by students, instructors, and administrators

**Project 2: E-Commerce Application Architecture with Microservices**  
**Project Description**

Design and analyze the architecture of an E-Commerce System using modern architectural styles.

**External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – VI

### .6.2 C. Major (Electives)

|                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                        | <b>Cloud Computing and Web Services</b>                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Credit</b>                                       | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Outcomes</b>                                     | <b>After successful completion of the course, learners will be able to:</b> <ol style="list-style-type: none"><li>1. Understand cloud computing concepts, models, and services.</li><li>2. Analyze cloud architecture and deployment strategies.</li><li>3. Apply cloud services for storage, computing, and application deployment.</li><li>4. Evaluate web services and cloud-based solutions for real-world applications.</li></ol> |
| <b>Module 1 (Credit 1) Introduction to Cloud Computing</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Learning Outcomes</b>                                   | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"><li>1. Define cloud computing and explain its evolution and characteristics.</li><li>2. Identify cloud service models (IaaS, PaaS, SaaS).</li><li>3. Differentiate between cloud deployment models.</li><li>4. Explain basic cloud architecture and components.</li></ol>                                                               |
| <b>Content Outline</b>                                     | <ul style="list-style-type: none"><li>• Definition, Evolution, and Characteristics of Cloud Computing</li><li>• Cloud Computing Architecture</li><li>• Service Models: IaaS, PaaS, SaaS</li><li>• Deployment Models: Public, Private, Hybrid, Community</li></ul>                                                                                                                                                                      |

| <b>Module 2 (Credit 1)</b><br><b>Architectural Styles and Patterns</b> |                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                                               | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Explain virtualization concepts and types.</li> <li>2. Identify the role of hypervisors and virtual machines.</li> <li>3. Differentiate cloud storage types: object, block, and file storage.</li> <li>4. Explain containerization concepts and Docker basics.</li> </ol> |
| <b>Content Outline</b>                                                 | <ul style="list-style-type: none"> <li>• Virtualization Concepts and Types</li> <li>• Hypervisors and Virtual Machines</li> <li>• Cloud Storage: Object, Block, and File Storage</li> <li>• Introduction to Containers and Docker</li> </ul>                                                                                                                                     |
| <b>Module 3 (Credit 1) Architecture Documentation</b>                  |                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Learning Outcomes</b>                                               | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Explain web services and their role in cloud applications.</li> <li>2. Differentiate between SOAP and REST web services.</li> <li>3. Design basic RESTful APIs using JSON/XML.</li> <li>4. Identify features of major cloud platforms (AWS, Azure, GCP).</li> </ol>       |
| <b>Content Outline</b>                                                 | <ul style="list-style-type: none"> <li>• Web Services: SOAP and REST</li> <li>• RESTful APIs and JSON/XML</li> <li>• Introduction to Cloud Platforms: AWS, Azure, Google Cloud</li> <li>• Cloud Application Development Basics</li> </ul>                                                                                                                                        |



| <b>Module 4 (Credit 1) Architectural Evaluation and Case studies</b> |                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                                             | <p><b>After learning this module, learners will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Identify cloud security issues and challenges.</li> <li>2. Explain identity and access management (IAM) concepts.</li> <li>3. Apply basic cloud monitoring and cost management techniques.</li> <li>4. Analyze real-world cloud application case studies.</li> </ol> |
| <b>Content Outline</b>                                               | <ul style="list-style-type: none"> <li>• Cloud Security Issues and Challenges</li> <li>• Identity and Access Management (IAM)</li> <li>• Cloud Monitoring and Cost Management</li> <li>• Case Studies: Cloud-based Applications (E-commerce, LMS, Banking)</li> </ul>                                                                                                              |

#### **Reference Books**

1. **Cloud Computing – Rajkumar Buyya**
2. **Cloud Computing Concepts – Thomas Erl**
3. **Cloud Computing Bible – Barrie Sosinsky**
4. **Web Services Essentials – Ethan Cerami**

#### **Internal Assessment 50 Marks**

#### **Evaluation Scheme:**

**UT -25**

**Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

### Evaluation Parameters:

| The Rubric will have the following Evaluation Parameters: |                                                      |       |
|-----------------------------------------------------------|------------------------------------------------------|-------|
| Evaluation Parameters                                     | Description / Evaluation Points                      | Marks |
| Conceptual Understanding                                  | Understanding of core subject concepts               | 5     |
| Problem Analysis                                          | Appropriate problem identification and justification | 5     |
| Technical Design                                          | Logical design / workflow (conceptual)               | 5     |
| Innovation & Originality                                  | Creativity in solution approach                      | 5     |
| Communication & Presentation                              | Clarity and organization                             | 3     |
| Team Collaboration                                        | Active participation and coordination                | 2     |

**Given below are two sample projects but it is expected to work on similar sort of projects:**

#### **Project 1: Cloud-Based File Storage System**

Design a simple cloud storage architecture

Features: upload, download, access control

Focus: cloud services, storage, security

#### **Project 2: RESTful Web Service for Student Management**

Design REST APIs for student data

Use JSON, CRUD operations

Focus: web services + cloud deployment (conceptual)

#### **External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – VI

### .6.3 A. Major (Electives)

|                                                             |                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                         | <b>Software Testing and Quality Assurance</b>                                                                                                                                                                                                                                                                                                                                  |
| <b>Course Credit</b>                                        | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Outcomes</b>                                      | <b>After successful completion of the course, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand software quality concepts and testing fundamentals.</li><li>2. Apply software testing techniques and tools.</li><li>3. Analyze defects and quality metrics.</li><li>4. Evaluate testing strategies and improvement processes.</li></ol> |
| <b>Module 1 (Credit 1) Introduction to Software Testing</b> |                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Learning Outcomes</b>                                    | <b>After learning the module, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand, analyze, and apply module-specific concepts.</li></ol>                                                                                                                                                                                                 |
| <b>Content Outline</b>                                      | <ul style="list-style-type: none"><li>• Definition, Objectives, and Principles of Testing</li><li>• Testing Life Cycle</li><li>• Levels of Testing: Unit, Integration, System, Acceptance</li></ul>                                                                                                                                                                            |
| <b>Module 2 (Credit 1) Testing Techniques</b>               |                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Learning Outcomes</b>                                    | <b>After learning the module, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand, analyze, and apply module-specific concepts.</li></ol>                                                                                                                                                                                                 |
| <b>Content Outline</b>                                      | <ul style="list-style-type: none"><li>• Black-box, White-box, Grey-box Testing</li><li>• Boundary Value Analysis, Equivalence Partitioning</li><li>• Regression, Smoke, Sanity, Performance Testing</li></ul>                                                                                                                                                                  |
| <b>Module 3 (Credit 1) Software Quality Assurance</b>       |                                                                                                                                                                                                                                                                                                                                                                                |

|                                                                   |                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                                          | <b>After learning the module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand, analyze, and apply module-specific concepts.</li> </ol>                                                                                                                                                               |
| <b>Content Outline</b>                                            | <ul style="list-style-type: none"> <li>• Quality Models and Standards (ISO 9001, CMMI)</li> <li>• Verification and Validation</li> <li>• Review Techniques: Walkthroughs, Inspections</li> </ul>                                                                                                                                        |
| <b>Module 4 (Credit 1) Test Automation, Metrics and Reporting</b> |                                                                                                                                                                                                                                                                                                                                         |
| <b>Learning Outcomes</b>                                          | <b>After learning the module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand, analyze, and apply module-specific concepts.</li> </ol>                                                                                                                                                               |
| <b>Content Outline</b>                                            | <ul style="list-style-type: none"> <li>• Overview of Automated Testing Tools (Selenium, JUnit)</li> <li>• Scripting and Test Execution</li> <li>• Continuous Integration and Testing</li> <li>• Test Metrics and Measurements</li> <li>• Defect Tracking and Reporting</li> <li>• Risk-based Testing and Process Improvement</li> </ul> |

#### **Reference:**

1. "Software Engineering" — by Ian
2. "Software Engineering: A Practitioner's Approach" — by Roger S. Pressman & David Lowe
3. "Fundamentals of Software Engineering" — by Rajib Mall
4. "Head First Software Development" — by Dan Pilone & Russ Miles
5. "Agile Software Development: Principles, Patterns, and Practices" — by Robert C. Martin

#### **Internal Assessment 50 Marks**

#### **Evaluation Scheme:**

#### **UT -25**

#### **Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

### **Evaluation Parameters:**

| <b>The Rubric will have the following Evaluation Parameters:</b> |                                                      |              |
|------------------------------------------------------------------|------------------------------------------------------|--------------|
| <b>Evaluation Parameters</b>                                     | <b>Description / Evaluation Points</b>               | <b>Marks</b> |
| Conceptual Understanding                                         | Understanding of core subject concepts               | 5            |
| Problem Analysis                                                 | Appropriate problem identification and justification | 5            |
| Technical Design                                                 | Logical design / workflow (conceptual)               | 5            |
| Innovation & Originality                                         | Creativity in solution approach                      | 5            |
| Communication & Presentation                                     | Clarity and organization                             | 3            |
| Team Collaboration                                               | Active participation                                 | 2            |

**Given below are two sample projects but it is expected to work on similar sort of projects**

#### **Project 1 — Student Management System (SMS)**

##### **Description**

Create a complete system to manage student records — add/edit/delete students, classes, grades, etc.

#### **Project 2 — Online Bookstore**

##### **Description**

Build an online bookstore where users can browse books, add to cart, place orders.

#### **External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester - VI

### .6.3 B. Major (Electives)

|                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                       | <b>Cyber Security and Ethical Hacking</b>                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Credit</b>                                      | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Outcomes</b>                                    | <b>After successful completion of the course, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand cybersecurity concepts, threats, and vulnerabilities.</li><li>2. Analyze security mechanisms and attack techniques.</li><li>3. Apply ethical hacking tools and techniques for system security.</li><li>4. Evaluate security policies, legal, and ethical aspects of cybersecurity.</li></ol> |
| <b>Module 1 (Credit 1) Introduction to Cyber Security</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Learning Outcomes</b>                                  | <b>After learning this module, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Define cyber security and explain its importance.</li><li>2. Explain security goals: confidentiality, integrity, and availability.</li><li>3. Identify common cyber threats and attack types.</li><li>4. Analyze malware, phishing, and social engineering attacks.</li></ol>                                          |
| <b>Content Outline</b>                                    | <ul style="list-style-type: none"><li>• Cyber Security Fundamentals</li><li>• Security Goals: Confidentiality, Integrity, Availability (CIA)</li><li>• Types of Cyber Threats and Attacks</li><li>• Malware, Phishing, Social Engineering</li></ul>                                                                                                                                                                                 |

| <b>Module 2 (Credit 1) Network and System Security</b>          |                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning Outcomes</b>                                        | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Explain network security concepts and mechanisms.</li> <li>2. Identify the role of firewalls, IDS, and IPS.</li> <li>3. Apply authentication and authorization techniques.</li> <li>4. Explain basic operating system security concepts.</li> </ol>         |
| <b>Content Outline</b>                                          | <ul style="list-style-type: none"> <li>• Network Security Concepts</li> <li>• Firewalls, IDS, IPS</li> <li>• Authentication and Authorization</li> <li>• Operating System Security</li> </ul>                                                                                                                                                                      |
| <b>Module 3 (Credit 1) Ethical Hacking Techniques and Tools</b> |                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Learning Outcomes</b>                                        | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Explain ethical hacking concepts and phases.</li> <li>2. Perform basic footprinting and reconnaissance activities.</li> <li>3. Identify vulnerabilities using assessment techniques.</li> <li>4. Demonstrate basic use of ethical hacking tools.</li> </ol> |
| <b>Content Outline</b>                                          | <ul style="list-style-type: none"> <li>• Ethical Hacking Concepts and Phases</li> <li>• Footprinting and Reconnaissance</li> <li>• Vulnerability Assessment and Penetration Testing</li> <li>• Introduction to Tools: Nmap, Metasploit, Wireshark</li> </ul>                                                                                                       |
| <b>Module 4 (Credit 1) Cyber Laws, Ethics, and Case Studies</b> |                                                                                                                                                                                                                                                                                                                                                                    |

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| <b>Learning Outcomes</b> | <b>After learning this module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Explain cyber laws and legal frameworks.</li> <li>2. Analyze ethical issues in cyber security practices.</li> <li>3. Describe incident response and digital forensics basics.</li> <li>4. Analyze real-world cyber security case studies.</li> </ol> |
| <b>Content Outline</b>   | <ul style="list-style-type: none"> <li>• Cyber Laws and IT Act</li> <li>• Ethical Issues in Cyber Security</li> <li>• Incident Response and Digital Forensics Basics</li> <li>• Case Studies of Cyber Attacks and Security Breaches</li> </ul>                                                                                                              |

### **Reference Books**

1. Cyber Security – Nina Godbole
2. The Web Application Hacker's Handbook – Dafydd Stuttard
3. Ethical Hacking and Network Defense – Michael T. Simpson
4. Hacking: The Art of Exploitation – Jon Erickson

### **Internal Assessment 50 Marks**

#### **Evaluation Scheme:**

**UT -25**

**Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.



### Evaluation Parameters:

| The Rubric will have the following Evaluation Parameters: |                                                      |       |
|-----------------------------------------------------------|------------------------------------------------------|-------|
| Evaluation Parameters                                     | Description / Evaluation Points                      | Marks |
| Conceptual Understanding                                  | Understanding of core subject concepts               | 5     |
| Problem Analysis                                          | Appropriate problem identification and justification | 5     |
| Technical Design                                          | Logical design / workflow (conceptual)               | 5     |
| Innovation & Originality                                  | Creativity in solution approach                      | 5     |
| Communication & Presentation                              | Clarity and organization                             | 3     |
| Team Collaboration                                        | Active participation and coordination                | 2     |

**Given below are two sample projects but it is expected to work on similar sort of projects:**

#### **Project 1: Vulnerability Assessment of a Website**

Identify common vulnerabilities  
SQL Injection, XSS (theoretical/demo)  
Focus: ethical hacking methodology

#### **Project 2: Cyber Attack Case Study Analysis**

Study a real cyber-attack (ransomware, data breach)  
Analyze attack method, impact, prevention  
Focus: cyber security awareness & ethics

#### **External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – VI

### .6.3 C. Major (Electives)

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|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                              | <b>Internet of Things (IoT)</b>                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Credit</b>                             | <b>4 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Outcomes</b>                           | <b>After successful completion of the course, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand fundamental concepts and architecture of IoT systems.</li><li>2. Explain sensors, actuators, and communication protocols.</li><li>3. Analyze IoT platforms, data handling, and security issues.</li><li>4. Evaluate real-world IoT applications and future trends.</li></ol> |
| <b>Module 1 (Credit 1) Introduction to IoT</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Learning Outcomes</b>                         | <b>After learning the module, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand, analyze, and apply module-specific concepts.</li></ol>                                                                                                                                                                                                                                      |
| <b>Content Outline</b>                           | <ul style="list-style-type: none"><li>• Definition, Characteristics, and Components of IoT</li><li>• IoT Architecture and Reference Model</li><li>• IoT Communication Models and Protocols</li><li>• IoT Enabling Technologies</li></ul>                                                                                                                                                                            |
| <b>Module 2 (Credit 1) Sensors and Actuators</b> |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Learning Outcomes</b>                         | <b>After learning the module, learners will be able to:</b><br><br><ol style="list-style-type: none"><li>1. Understand, analyze, and apply module-specific concepts.</li></ol>                                                                                                                                                                                                                                      |
| <b>Content Outline</b>                           | <ul style="list-style-type: none"><li>• Types of Sensors and Actuators</li><li>• Data Acquisition and Signal Conditioning</li><li>• Microcontroller Interfacing</li></ul>                                                                                                                                                                                                                                           |

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| <b>Module 3 (Credit 1) IoT Platforms and Cloud Integration</b>       |                                                                                                                                                                                                                                                                                                         |
| <b>Learning Outcomes</b>                                             | <b>After learning the module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand, analyze, and apply module-specific concepts.</li> </ol>                                                                                                                               |
| <b>Content Outline</b>                                               | <ul style="list-style-type: none"> <li>• Overview of IoT Platforms (Arduino, Raspberry Pi, ESP32)</li> <li>• Cloud Platforms for IoT (AWS IoT, ThingsBoard)</li> <li>• Data Storage, Visualization, and Analytics</li> </ul>                                                                            |
| <b>Module 4 (Credit 1) IoT Security and Privacy and Applications</b> |                                                                                                                                                                                                                                                                                                         |
| <b>Learning Outcomes</b>                                             | <b>After learning the module, learners will be able to:</b> <ol style="list-style-type: none"> <li>1. Understand, analyze, and apply module-specific concepts.</li> </ol>                                                                                                                               |
| <b>Content Outline</b>                                               | <ul style="list-style-type: none"> <li>• Security Challenges in IoT</li> <li>• Data Encryption, Authentication, and Access Control</li> <li>• Ethical, Legal, and Social Issues</li> <li>• Smart Homes, Smart Cities, Healthcare, Industrial IoT</li> <li>• Case Studies and Emerging Trends</li> </ul> |

#### **Reference Book:**

1. Bahga & Madisetti – Internet of Things: A Hands-On Approach.
2. IEEE IoT Journal.
3. AWS IoT Documentation.

#### **Internal Assessment 50 Marks**

#### **Evaluation Scheme:**

**UT -25**

**Project – 25**

The project evaluation, will be done by conducting a project presentation at the College level, where an External Examiner (Industry Expert or Subject Expert) appointed by the College will be evaluating the project depending on evaluation rubrics given below.

### **Evaluation Parameters:**

| <b>The Rubric will have the following Evaluation Parameters:</b> |                                                      |              |
|------------------------------------------------------------------|------------------------------------------------------|--------------|
| <b>Evaluation Parameters</b>                                     | <b>Description / Evaluation Points</b>               | <b>Marks</b> |
| Conceptual Understanding                                         | Understanding of core subject concepts               | 5            |
| Problem Analysis                                                 | Appropriate problem identification and justification | 5            |
| Technical Design                                                 | Logical design / workflow (conceptual)               | 5            |
| Innovation & Originality                                         | Creativity in solution approach                      | 5            |
| Communication & Presentation                                     | Clarity and organization                             | 3            |
| Team Collaboration                                               | Active participation                                 | 2            |

**Given below are two sample projects but it is expected to work on similar sort of projects**

#### **Project 1: Smart Home Energy Monitoring System:**

Design a conceptual IoT- based system using sensors and cloud integration to monitor and optimize household energy consumption.

#### **Project 2: Healthcare Remote Monitoring System:**

Analyze IoT use in patient monitoring using wearable sensors and data transmission models.

#### **External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.

## Semester – VI

### .6.4 Community Engagement (CE)

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|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b>                                      | <b>Digital Literacy and Community Outreach</b>                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Credits</b>                                    | <b>2 Credits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Outcomes</b>                                   | <ol style="list-style-type: none"><li>1. Understand basic digital literacy concepts and the importance of digital skills in daily life.</li><li>2. Use digital tools safely and responsibly for communication, information access, and services.</li><li>3. Create awareness about digital platforms and e-governance services among the community.</li><li>4. Apply digital knowledge to support community outreach and social inclusion initiatives.</li></ol> |
| <b>Module 1 (Credit 1) Digital Literacy Fundamentals</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Learning Outcomes</b>                                 | <ol style="list-style-type: none"><li>1. Understand fundamental digital literacy concepts and digital devices.</li><li>2. Use basic digital tools for communication and information access.</li><li>3. Practice safe, ethical, and responsible use of digital technologies.</li></ol>                                                                                                                                                                            |

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| <b>Course Outline</b>                                                 | <p><b>Introduction to Digital Literacy</b></p> <ul style="list-style-type: none"> <li>• Meaning and importance of digital literacy</li> <li>• Digital divide and digital inclusion</li> </ul> <p><b>Digital Devices and Platforms</b></p> <ul style="list-style-type: none"> <li>• Computers, smartphones, tablets</li> <li>• Operating systems and basic applications (conceptual)</li> </ul> <p><b>Internet Basics</b></p> <ul style="list-style-type: none"> <li>• Internet services and applications</li> <li>• Email, search engines, and social media (overview)</li> </ul> <p><b>Digital Safety and Ethics</b></p> <ul style="list-style-type: none"> <li>• Cyber safety and security</li> <li>• Password management and online privacy</li> <li>• Cyberbullying and responsible digital behaviour</li> </ul> <p><b>Digital Payments and Services (Overview)</b></p> <ul style="list-style-type: none"> <li>• UPI, online banking, and digital wallets</li> <li>• Introduction to e-governance services</li> </ul> |
| <b>Module 2 (Credit 1) Community Outreach and Digital Empowerment</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Learning Outcomes</b>                                              | <ol style="list-style-type: none"> <li>1. Apply digital literacy skills to community-based activities.</li> <li>2. Promote awareness of digital services and government initiatives.</li> <li>3. Plan and participate in community outreach programs using digital tools.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| <b>Course Outline</b> | <p><b>Digital Empowerment and Society</b></p> <ul style="list-style-type: none"> <li>• Role of digital literacy in social development</li> <li>• Digital inclusion for rural and underserved communities</li> </ul> <p><b>E-Governance and Public Digital Services</b></p> <ul style="list-style-type: none"> <li>• Digital India initiatives (overview)</li> <li>• Online public services: education, healthcare, banking, and welfare schemes</li> </ul> <p><b>Community Outreach Programs</b></p> <ul style="list-style-type: none"> <li>• Planning digital awareness campaigns</li> <li>• Conducting workshops and training sessions</li> <li>• Use of digital media for community engagement</li> </ul> <p><b>Social Responsibility and Ethics</b></p> <ul style="list-style-type: none"> <li>• Ethical use of digital platforms</li> <li>• Accessibility and inclusivity in digital systems</li> </ul> <p><b>Case Studies</b></p> <ul style="list-style-type: none"> <li>• Successful digital literacy and community outreach initiatives</li> </ul> |
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### Module 1

Identify common digital tools used in daily life and demonstrate their usage.  
 Create a short presentation on cyber safety and responsible internet use.  
 Conduct a quiz or worksheet on digital literacy concepts.

### Module 2

Plan a digital awareness program for a local community (conceptual).  
 Prepare posters or digital content promoting digital payments or e-governance services.  
 Write a brief report on the impact of digital literacy in community development.

### Assessment

#### Internal Assessment: (50 Marks)

#### Evaluation Scheme:

The Internal Assessment shall be conducted based on Project Development, Presentation, and Report Writing, evaluated using a well-defined rubric.

Students are required to select and develop one appropriate project related to the course, demonstrating practical understanding and application of concepts learned. Two sample project topics are provided for reference; however, students are encouraged to choose a relevant and sufficiently advanced project topic aligned with their interests and capabilities, subject to faculty approval.

The project evaluation will be carried out through project demonstration and viva/presentation, based on the following rubric:

| <b>Evaluation Criteria</b>                | <b>Description</b>                                                                                                      | <b>Marks</b> |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------|
| 1. Core Functional Implementation         | Correct implementation of core features, completeness of functionality, and logical flow of the application             | 20           |
| 2. User Interface Design & Responsiveness | Quality of user interface design, usability, layout consistency, and responsiveness (where applicable)                  | 10           |
| 3. Code Quality & Structure               | Code organization, readability, use of meaningful names, modularity, and adherence to coding standards                  | 10           |
| 4. Input Validation & Error Handling      | Proper handling of user input, validation techniques, and error/exception management                                    | 5            |
| 5. Project Documentation / Report         | Quality of project report/documentation including problem statement, methodology, screenshots, results, and Conclusions | 5            |

#### **External Assessment: (Marks 50)**

End Semester examination of 50 marks for 2 hours duration will be conducted by the college.