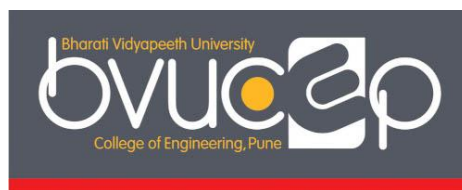




**Bharati Vidyapeeth**  
**(Deemed to be University)**  
**Pune, India**

**College of Engineering, Pune**



**B. Tech (Information Technology) Semester-I to VI**  
**(2023 CBCS COURSE)**

**With Minor Degree: Cloud Technologies**

**Program Curriculum**

**As Per NEP Guidelines**

## **VISION OF THE UNIVERSITY**

Social Transformation through Dynamic Education

## **MISSION OF THE UNIVERSITY**

- To make available quality education in different areas of knowledge to the students as per their choice and inclination
- To offer education to the students in a conducive ambience created by enriched infrastructure and academic facilities in its campuses.
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities
- To make available quality education to the students of rural, tribal and other deprived sections of the population

## **VISION OF THE INSTITUTE**

To be World Class Institute for Social Transformation Through Dynamic Education.

## **MISSION OF THE INSTITUTE**

- To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

## **VISION OF THE DEPARTMENT**

To be a leading Programme, transforming students into skilled IT professionals.

## **MISSION OF THE DEPARTMENT**

- Amplify the student's technical skills by conducting continuing education programs, organizing and participating in various technical events.
- Provide comprehensive support in synchronization with industry to achieve professional and technological excellence.
- Provide an environment for effective social and ethical skills.

## **PROGRAM EDUCATIONAL OBJECTIVES**

**PEO1:** Cultivate IT graduates for industry, pertaining to Information Technology solutions.

**PEO2:** Practice technical competency and teamwork abilities.

**PEO3:** Exhibit social responsibilities by following ethical practices in graduate's professional pursuits.

## **PROGRAM OUTCOMES**

**PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified to develop to the solution of complex engineering problems.

**PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

**PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

**PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

**PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

**PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

**PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

**PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

**PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

**PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

**PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

## **PROGRAM SPECIFIC OUTCOMES**

At the end of the program, Graduates will be able to

**PSO 1:** Use knowledge of core and allied courses for developing a computer-based system to deliver a quality product for real-world problems of society.

**PSO 2:** Apply modern IT tools and techniques for perusing student's professional career by practicing effective communication with team members.

**PSO 3:** Develop time-bound, cost-effective, and sustainable solutions by following professional ethics.

## CORELATION BETWEEN GRADUATE ATTRIBUTES AND PROGRAMME OUTCOMES

[illegible]

**A. DEFINITION OF CREDITS:**

|                                  |             |
|----------------------------------|-------------|
| 1 Hour Lecture (L) per week      | 1 credit    |
| 1 Hour Tutorial (T) per week     | 1 credit    |
| 1 Hour Practical (P) per week    | 0.5 credits |
| 2 Hours Practical (Lab) per week | 1 credit    |

**B. Course Code and Definition**

| <b>Course Code</b> | <b>Definitions</b>             |
|--------------------|--------------------------------|
| L                  | Lecture                        |
| T                  | Tutorial                       |
| P                  | Practical                      |
| TW                 | Term Work                      |
| O                  | Oral                           |
| SEE                | Semester End Examination       |
| MJ                 | Major (Core) Courses           |
| MI                 | Minor Courses                  |
| GE                 | General Elective Courses       |
| OE                 | Open Elective Courses          |
| SE                 | Skill Enhancement Courses      |
| AE                 | Ability Enhancement Courses    |
| VE                 | Vocational Enhancement Courses |
| VS                 | Vocational Skill Courses       |

|    |                            |
|----|----------------------------|
| VA | Value Added Courses        |
| CC | Co-curricular Courses      |
| EC | Extra-Curricular Courses   |
| ID | Inter-disciplinary Courses |
| MD | Multidisciplinary Courses  |
| RP | Research / Project Courses |
| PC | Practical Courses          |
| BS | Basic Science              |
| ES | Engineering Science        |
| AC | Audit Course               |
| EC | Extracurricular Activities |
| BM | Basic Mathematics          |
| BP | Basic Physics              |
| BC | Basic Chemistry            |
| UH | Universal Human Values     |



## Distribution of Courses

| Type of Course                              | No. of Courses | Percentage |
|---------------------------------------------|----------------|------------|
| Engineering and Basic Science               | 5              | 9.1%       |
| Core Course                                 | 26             | 48 %       |
| Ability Enhancement Course                  | 03             | 6 %        |
| Skill Based Course                          | 09             | 16.3%      |
| Universal Human Values                      | 01             | 1.9%       |
| Value Added Course                          | 02             | 3.6%       |
| Audit Course                                | 02             | 3.6%       |
| Extra-Curricular Activity (Social Activity) | 01             | 1.9%       |
| Professional Elective                       | 03             | 6 %        |
| Professional Skills                         | 01             | 1.9%       |
| Research Project and Seminar                | 02             | 4 %        |

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**  
**COLLEGE OF ENGINEERING, PUNE**  
**B. Tech. (Information Technology): Semester –I (2023 CBCS COURSE)**

| Sr. No | Category | Subject Code | Subject                             | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |          |           |            | Credits   |          |          |           |
|--------|----------|--------------|-------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|----------|-----------|------------|-----------|----------|----------|-----------|
|        |          |              |                                     | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR       | OR        | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.     | BM       | BM1113101    | Engineering Mathematics- I          | 3               | -         | 1        | 60                       | 40                  | -          | -        | -         | 100        | 3         | -        | 1        | 4         |
| 2.     | BC       | BC1113102    | Engineering Chemistry               | 3               | 2         | -        | 60                       | 40                  | 50         | -        | -         | 150        | 3         | 1        | -        | 4         |
| 3.     | ES       | ES1109103    | Digital Electronics                 | 4               | 2         | -        | 60                       | 40                  | 50         | -        | -         | 150        | 4         | 1        | -        | 5         |
| 4.     | MJ       | MJ1110104    | Structured Programming              | 4               | -         | -        | 60                       | 40                  | -          | -        | -         | 100        | 4         | -        | -        | 4         |
| 5.     | MJ       | MJ1110105    | Web Technologies                    | 4               | 2         | -        | 60                       | 40                  | 25         | -        | -         | 125        | 4         | 1        | -        | 5         |
| 6.     | AE       | AE1113106    | Communication Skills                | -               | 2         | -        | -                        | -                   | 50         | -        | -         | 50         | -         | 1        | -        | 1         |
| 7.     | SE       | SE1110107    | Information Technology Laboratory-I | -               | 2         | -        | -                        | -                   | 25         | -        | 25        | 50         | -         | 1        | -        | 1         |
| 8.     | SE       | SE1111108    | Computer Workshop Technology        | -               | 2         | -        | -                        | -                   | 25         | -        | -         | 25         | -         | 1        | -        | 1         |
|        |          |              | <b>Total</b>                        | <b>18</b>       | <b>12</b> | <b>1</b> | <b>300</b>               | <b>200</b>          | <b>225</b> | <b>0</b> | <b>25</b> | <b>750</b> | <b>18</b> | <b>6</b> | <b>1</b> | <b>25</b> |

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**  
**COLLEGE OF ENGINEERING, PUNE**  
**B. Tech. (Information Technology): Semester –II (2023 CBCS COURSE)**

| Sr. No | Category | Subject Code | Subject                              | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |          |           |            | Credits   |          |          |           |
|--------|----------|--------------|--------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|----------|-----------|------------|-----------|----------|----------|-----------|
|        |          |              |                                      | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR       | OR        | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.     | BM       | BM1113201    | Engineering Mathematics- II          | 3               | -         | 1        | 60                       | 40                  | -          | -        | -         | 100        | 3         | -        | 1        | 4         |
| 2.     | BP       | BP1113202    | Engineering Physics                  | 3               | 2         | -        | 60                       | 40                  | 50         | -        | -         | 150        | 3         | 1        | -        | 4         |
| 3.     | MJ       | MJ1110203    | Content Management System            | 4               | 2         | -        | 60                       | 40                  | 50         | -        | -         | 150        | 4         | 1        | -        | 5         |
| 4.     | MJ       | MJ1110204    | Computer Communication and Networks  | 4               | 2         | -        | 60                       | 40                  | 25         | -        | -         | 125        | 4         | 1        | -        | 5         |
| 5.     | MJ       | MJ1110205    | Object Oriented Programming          | 4               | -         | -        | 60                       | 40                  | -          | -        | -         | 100        | 4         | -        | -        | 4         |
| 6.     | UH       | UH1113206    | Universal Human Values               | -               | 2         | -        | -                        | -                   | 50         | -        | -         | 50         | -         | 1        | -        | 1         |
| 7.     | SE       | SE1110207    | Information Technology Laboratory-II | -               | 2         | -        | -                        | -                   | 25         | -        | 25        | 50         | -         | 1        | -        | 1         |
| 8.     | SE       | SE1111208    | Computer Aided Drawing & Design      | -               | 2         | -        | -                        | -                   | 25         | -        | -         | 25         | -         | 1        | -        | 1         |
|        |          |              | <b>Total</b>                         | <b>18</b>       | <b>12</b> | <b>1</b> | <b>300</b>               | <b>200</b>          | <b>225</b> | <b>0</b> | <b>25</b> | <b>750</b> | <b>18</b> | <b>6</b> | <b>1</b> | <b>25</b> |

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**  
**COLLEGE OF ENGINEERING, PUNE**  
**B. Tech. (Information Technology): Semester –III (2023 CBCS COURSE)**

| Sr. No | Category | Subject Code | Subject                                                                | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |           |           |            | Credits   |          |          |           |
|--------|----------|--------------|------------------------------------------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|-----------|-----------|------------|-----------|----------|----------|-----------|
|        |          |              |                                                                        | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR        | O R       | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.     | MJ       | MJ1110301    | Discrete Structure and Graph Theory                                    | 3               |           | -        | 60                       | 40                  | -          | -         | -         | 100        | 3         | -        | -        | 3         |
| 2.     | MJ       | MJ1110302    | Database Management Systems                                            | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 3.     | MJ       | MJ1110303    | Operating System                                                       | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25        | 150        | 3         | 1        | -        | 4         |
| 4.     | MJ       | MJ1110304    | Microprocessors and Microcontrollers                                   | 3               | -         | -        | 60                       | 40                  | -          | -         | -         | 100        | 3         | -        | -        | 3         |
| 5.     | MJ       | MJ1110305    | Data Structures                                                        | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 6      | SE       | SE1110306    | Information Technology Laboratory-III                                  | -               | 2         | 1        | -                        | -                   | 25         | 25        | -         | 50         | -         | 1        | 1        | 2         |
|        |          |              | <b>Total</b>                                                           | <b>15</b>       | <b>08</b> | <b>1</b> | <b>300</b>               | <b>200</b>          | <b>100</b> | <b>75</b> | <b>25</b> | <b>700</b> | <b>15</b> | <b>4</b> | <b>1</b> | <b>20</b> |
| 7      | AE       | AE1110307    | MOOC-I                                                                 | -               | -         | -        | -                        | -                   | -          | -         | -         | -          | -         | -        | -        | 2         |
| 8      | VA       | VA1110308    | Value Added Course-I<br>A) Internet Security<br>B) Data Analysis Tools | 2               | -         | -        | -                        | 100                 | -          | -         | -         | 100        | -         | -        | -        | 2         |

\* Indicate this is mandatory but the credits will not be considered in SGPA/CGPA. (As and when the students complete the course and submit the certificate, it should be reflected in the mark sheet. The student should clear the subject up to 7<sup>th</sup> Sem of his/her coursework.)

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**  
**COLLEGE OF ENGINEERING, PUNE**  
**B. Tech. (Information Technology): Semester –IV (2023 CBCS COURSE)**

| Sr. No | Category | Subject Code | Subject                                | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |           |           |            | Credits   |          |          |           |
|--------|----------|--------------|----------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|-----------|-----------|------------|-----------|----------|----------|-----------|
|        |          |              |                                        | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR        | OR        | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.     | MJ       | MJ1110401    | Formal Languages and Automata Theory   | 3               |           | -        | 60                       | 40                  | -          | -         | -         | 100        | 3         | -        | -        | 3         |
| 2      | MJ       | MJ1110402    | Advanced Database Management Systems   | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 3.     | MJ       | MJ1110403    | Software Engineering                   | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25        | 150        | 3         | 1        | -        | 4         |
| 4.     | MJ       | MJ1110404    | Computer Organization and Architecture | 3               | -         | -        | 60                       | 40                  |            | -         | -         | 100        | 3         | -        | -        | 3         |
| 5.     | MJ       | MJ1110405    | Applied Algorithms                     | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 6.     | SE       | SE1110406    | Information Technology Laboratory-IV   | -               | 2         | 1        | -                        | -                   | 25         | 25        | -         | 50         | -         | 1        | 1        | 2         |
|        |          |              | <b>Total</b>                           | <b>15</b>       | <b>08</b> | <b>1</b> | <b>300</b>               | <b>200</b>          | <b>100</b> | <b>75</b> | <b>25</b> | <b>700</b> | <b>15</b> | <b>4</b> | <b>1</b> | <b>20</b> |
| 7      | AC       | AC1113407    | Indian Knowledge System                | 2               | -         |          |                          | 100                 | -          | -         | -         | 100        | -         | -        | -        | 2         |
| 8      | EC       | EC1110408    | Social Activity                        | -               | -         | -        | -                        | -                   | -          | -         | -         | -          | -         | -        | -        | 2         |

**\* Indicate this is mandatory but the credits will not be considered in SGPA/CGPA. (As and when the students complete the course and submit the certificate, it should reflect in the marksheet. The student should clear the subject up to 7th Sem of his/her course.)**

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**

**COLLEGE OF ENGINEERING, PUNE**

**B. Tech. (Information Technology): Semester –V (2023 CBCS COURSE)**

| Sr. No. | Category | Course Codes | Subject                                                    | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |           |           |            | Credits   |          |          |           |
|---------|----------|--------------|------------------------------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|-----------|-----------|------------|-----------|----------|----------|-----------|
|         |          |              |                                                            | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR        | OR        | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.      | MJ       | MJ1110501    | Mobile Application Development                             | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 2.      | MJ       | MJ1110502    | Artificial Intelligence and Machine Learning               | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 3.      | MJ       | MJ1110503    | Data Ware Housing and Data Mining                          | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25        | 150        | 3         | 1        | -        | 4         |
| 4.      | MJ       | MJ1110504    | Distributed Systems                                        | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25        | 150        | 3         | 1        | -        | 4         |
| 5.      | MJ       | MJ1110505    | Agile Methodology                                          | 3               | -         | -        | 60                       | 40                  | -          | -         | -         | 100        | 3         | -        | -        | 3         |
| 6.      | SE       | SE1110506    | Information Technology Laboratory-V                        | -               | 2         | -        | -                        | -                   | 25         | 25        | -         | 50         | -         | 1        | -        | 1         |
|         |          |              | <b>Total</b>                                               | <b>15</b>       | <b>10</b> | <b>0</b> | <b>300</b>               | <b>200</b>          | <b>125</b> | <b>75</b> | <b>50</b> | <b>750</b> | <b>15</b> | <b>5</b> | <b>0</b> | <b>20</b> |
| 7       | VA       | VA1103507    | Value Added Course- II: Social Media and Digital Marketing | 2               | -         | -        | -                        | 100                 | -          | -         | -         | -          | -         | -        | -        | 2         |
| 8       | AE       | AE1103508    | MOOC - II                                                  | -               | -         | -        | -                        | -                   | -          | -         | -         | -          | -         | -        | -        | 2         |

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**  
**COLLEGE OF ENGINEERING, PUNE**  
**B. Tech. (Information Technology): Semester –VI (2023 CBCS COURSE)**

| Sr. No | Category | Course Codes | Subject                              | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |           |           |            | Credits   |          |          |           |
|--------|----------|--------------|--------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|-----------|-----------|------------|-----------|----------|----------|-----------|
|        |          |              |                                      | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR        | OR        | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.     | MJ       | MJ1110601    | Cloud Computing                      | 3               | -         | -        | 60                       | 40                  | -          | -         | -         | 100        | 3         | -        | -        | 3         |
| 2.     | MJ       | MJ1110602    | Deep Learning                        | 3               | -         | -        | 60                       | 40                  | -          | -         | -         | 100        | 3         | -        | -        | 3         |
| 3.     | MJ       | MJ1110603    | Software Testing                     | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25        | 150        | 3         | 1        | -        | 4         |
| 4.     | MJ       | MJ1110604    | Full Stack Web Development           | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -         | 150        | 3         | 1        | -        | 4         |
| 5.     | PE       | PE1110605    | Professional Elective-I              | 3               | 2         | -        | 60                       | 40                  | 25         | -         | -         | 125        | 3         | 1        | -        | 4         |
| 6.     | SE       | SE1110606    | Information Technology Laboratory-VI | -               | 2         | -        | -                        | -                   | 25         | 25        | -         | 50         | -         | 1        | -        | 1         |
| 7.     | PS       | PS1110607    | Professional Skills                  | -               | 2         | -        | -                        | -                   | 25         | -         | -         | 25         | -         | 1        | -        | 1         |
| 8.     | AC       | AC1110608    | Environmental Studies                | 4               | -         | -        | *40+20                   | ** 30+10            | -          | -         | -         | 100        | -         | -        | -        | 4         |
|        |          |              | <b>Total</b>                         | <b>19</b>       | <b>10</b> | <b>0</b> | <b>360</b>               | <b>240</b>          | <b>125</b> | <b>50</b> | <b>25</b> | <b>800</b> | <b>15</b> | <b>5</b> | <b>0</b> | <b>24</b> |

**Professional Elective-I**

|   | Subject                           |
|---|-----------------------------------|
| 1 | Network Security and Cryptography |
| 2 | Information Retrieval             |
| 3 | Software Architecture             |

## **Environmental Studies:**

**\* 1. ESE: a. 40 Marks (MCQ based end of semester/term university examination, for Units I to VIII).**

**b. 20 Marks (Case Studies and Field Work report and presentation in a group, for Unit IX).**

**\*\* 2. IA: a. 30 Marks (Internation assessments comprising of Assignments/Seminars/Class work/Tests/projects, etc, for Unit I to VIII)**

**b. 10 Marks - Attendance for Unit I to VIII.**



**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**

**COLLEGE OF ENGINEERING, PUNE**

**TRACK-I**

**B. Tech. (Information Technology): Semester –VII (2023 CBCS COURSE)**

| Sr.No | Category | Subject Code | Subject                          | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |           |            |            | Credits  |           |          |           |
|-------|----------|--------------|----------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|-----------|------------|------------|----------|-----------|----------|-----------|
|       |          |              |                                  | L               | P         | T        | ES E                     | Internal Assessment | TW         | PR        | OR         | Total      | Th       | Pr/Or     | Tut      | Total     |
| 1     | MJ       | MJ1110701    | Agentic AI                       | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -          | 150        | 3        | 1         | -        | 4         |
| 2     | PE       | PE1110702    | Professional Elective Course-II  | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25         | 150        | 3        | 1         | -        | 4         |
| 3     | PE       | PE1110703    | Professional Elective Course-III | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25         | 150        | 3        | 1         | -        | 4         |
| 4     | RP       | RP1110704    | Major Project                    | -               | 16        | -        | -                        | -                   | 100        | -         | 50         | 150        | -        | 8         | -        | 8         |
|       |          |              | <b>Total</b>                     | <b>9</b>        | <b>22</b> | <b>-</b> | <b>180</b>               | <b>120</b>          | <b>175</b> | <b>25</b> | <b>100</b> | <b>600</b> | <b>9</b> | <b>11</b> | <b>-</b> | <b>20</b> |

Professional Elective Course (PEC) List

| <b>Professional Elective Course -II</b> | <b>Professional Elective Course -III</b> |
|-----------------------------------------|------------------------------------------|
| Natural Language Processing             | Storage Area Network                     |
| Soft Computing                          | Internet of Things                       |
| Web Application Security                | Web Services                             |
| Big Data Analytics                      | Project Planning and Management          |
| AI in Healthcare                        | Renewable Energy in Agriculture          |
| Naturopathy and Yogic Science           | Bhagwad Geeta and Modern Education       |

**B. Tech. (Information Technology): Semester –VIII (2023 CBCS COURSE)**

| Sr. No | Category | Subject Code | Subject                        | Teaching Scheme |          |          | Examination Scheme-Marks |                     |            |          |            |            | Credits  |           |     |           |
|--------|----------|--------------|--------------------------------|-----------------|----------|----------|--------------------------|---------------------|------------|----------|------------|------------|----------|-----------|-----|-----------|
|        |          |              |                                | L               | P        | T        | ESE                      | Internal Assessment | TW         | PR       | OR         | Total      | Th       | Pr/Or     | Tut | Total     |
| 1      | MJ       | MJ1110801    | Blockchain Technologies        | 3               | 2        | -        | 60                       | 40                  | 25         | -        | 25         | 150        | 03       | 01        | -   | 04        |
| 2      | CC       | CC1110802    | Seminar                        | -               | 4        | -        | -                        | -                   | 50         | -        | 50         | 100        | -        | 02        | -   | 02        |
| 3      | SE       | SE1110803    | Internship (Industry/In-house) | -               | -        | -        | -                        | -                   | 150        | -        | 100        | 250        | -        | 14        | -   | 14        |
|        |          |              | <b>Total</b>                   | <b>3</b>        | <b>6</b> | <b>-</b> | <b>60</b>                | <b>40</b>           | <b>225</b> | <b>-</b> | <b>175</b> | <b>500</b> | <b>3</b> | <b>17</b> |     | <b>20</b> |

**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)**

**COLLEGE OF ENGINEERING, PUNE**

**TRACK-II**

**B. Tech. (Information Technology): Semester –VII (2023 CBCS COURSE)**

| Sr. No | Category | Subject Code | Subject                        | Teaching Scheme |          |          | Examination Scheme-Marks |                     |            |          |            |            | Credits  |           |     |           |
|--------|----------|--------------|--------------------------------|-----------------|----------|----------|--------------------------|---------------------|------------|----------|------------|------------|----------|-----------|-----|-----------|
|        |          |              |                                | L               | P        | T        | ESE                      | Internal Assessment | TW         | PR       | OR         | Total      | Th       | Pr/Or     | Tut | Total     |
| 1      | MJ       | MJ1110801    | Blockchain Technologies        | 3               | 2        | -        | 60                       | 40                  | 25         | -        | 25         | 150        | 03       | 01        | -   | 04        |
| 2      | CC       | CC1110802    | Seminar                        | -               | 4        | -        | -                        | -                   | 50         | -        | 50         | 100        | -        | 02        | -   | 02        |
| 3      | SE       | SE1110803    | Internship (Industry/In-house) | -               | -        | -        | -                        | -                   | 150        | -        | 100        | 250        | -        | 14        | -   | 14        |
|        |          |              | <b>Total</b>                   | <b>3</b>        | <b>6</b> | <b>-</b> | <b>60</b>                | <b>40</b>           | <b>225</b> | <b>-</b> | <b>175</b> | <b>500</b> | <b>3</b> | <b>17</b> |     | <b>20</b> |

**B. Tech. (Information Technology): Semester –VIII (2023 CBCS COURSE)**

| Sr.No | Category | Subject Code | Subject                          | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |           |            |            | Credits  |           |          |           |
|-------|----------|--------------|----------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|-----------|------------|------------|----------|-----------|----------|-----------|
|       |          |              |                                  | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR        | OR         | Total      | Th       | Pr/Or     | Tut      | Total     |
| 1     | MJ       | MJ1110701    | Agentic AI                       | 3               | 2         | -        | 60                       | 40                  | 25         | 25        | -          | 150        | 3        | 1         | -        | 4         |
| 2     | PE       | PE1110702    | Professional Elective Course-II  | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25         | 150        | 3        | 1         | -        | 4         |
| 3     | PE       | PE1110703    | Professional Elective Course-III | 3               | 2         | -        | 60                       | 40                  | 25         | -         | 25         | 150        | 3        | 1         | -        | 4         |
| 4     | RP       | RP1110704    | Major Project                    | -               | 16        | -        | -                        | -                   | 100        | -         | 50         | 150        | -        | 8         | -        | 8         |
|       |          |              | <b>Total</b>                     | <b>9</b>        | <b>22</b> | <b>-</b> | <b>180</b>               | <b>120</b>          | <b>175</b> | <b>25</b> | <b>100</b> | <b>600</b> | <b>9</b> | <b>11</b> | <b>-</b> | <b>20</b> |

Professional Elective Course (PEC) List

| Professional Elective Course -II | Professional Elective Course -III  |
|----------------------------------|------------------------------------|
| Natural Language Processing      | Storage Area Network               |
| Soft Computing                   | Internet of Things                 |
| Big Data Analytics               | Web Services                       |
| Web Application Security         | Project Planning and Management    |
| AI in Healthcare                 | Renewable Energy in Agriculture    |
| Naturopathy and Yogic Science    | Bhagwad Geeta and Modern Education |

## Instructions

1. Students shall be permitted to opt for either Track-1 or Track-2.

A) If the student opts Track-1 then he/she has to perform Major Project in Semester-VII and undergo Internship in Sester-VIII.

B) If the student opts Track-2 then he/she has to undergo Internship in Semester-VII and perform Major Project in Sester-VIII.

## 2. Seminar:

### Objectives of the Seminar

The Seminar aims to:

- Develop **self-learning ability** and **research orientation**
- Enhance **technical understanding of emerging technologies**
- Improve **presentation and communication skills**

### Scope of Topics

Students must select a topic from **Emerging/Recent Technologies, Case Studies, Research-Oriented Topics, Interdisciplinary Topics**

### What Students Are Expected to Do

#### Topic Selection

#### Literature Survey

**Content Preparation**

**Report Writing**

**Presentation**

### **3. Major Project:**

#### **Objectives of the Major Project**

Students are expected to:

- Apply knowledge of Computer/IT engineering to solve **real-world problems**
- Develop **design, implementation, and testing skills**
- Work effectively in a **team environment**
- Demonstrate **innovation, problem-solving, and research aptitude**
- Learn **documentation, presentation, and communication skills**
- Get exposure to **research methodology and publication process**

#### **Nature of Projects**

Projects should be:

**Application-oriented / Industry-based / Research-based / Interdisciplinary**

Should **NOT be repetitive** of previous batches

Must include **significant development and/or research contribution**

### **Research Publication**

To encourage the students for writing research article/paper and presenting/publishing the same in journal/conference/symposium, the guides

will may give advantage of credits to the students, even if it is not mandatory.

## **4. Internship**

### **Objectives of Internship**

- To provide real-world exposure to professional environments
- To enhance technical, problem-solving, and teamwork skills
- To bridge the gap between academics and industry expectations
- To develop professional ethics, communication, and responsibility

### **Guidelines**

- 1) The students who receive internship in the industry (through institute or own efforts), will do it for one complete semester in the industry.

- 2) Those students who don not receive the internship in the industry, will have to perform it in-house. The Department will prepare modules for in-house internship based on recent domains/technology. The Department faculty plus external experts from industry fir the selected domain will deliver the sessions. In this case, the entire internship of one complete semester will be held in the institute itself.
- 3) The projects and the required computational facilities for these projects are available at FAIR Lab. The students may use facilities in IDEA and Intel Unnati Lab for this purpose.



**BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)  
COLLEGE OF ENGINEERING, PUNE**

**B. Tech. (Information Technology): Semester –III/IV/V/VI (NEP-2020 COURSE)**

**MINOR DEGREE (CLOUD TECHNOLOGIES)**

| Sr. No | Course Code | Subject                                     | Teaching Scheme |           |          | Examination Scheme-Marks |                     |            |          |            |            | Credits   |          |          |           |
|--------|-------------|---------------------------------------------|-----------------|-----------|----------|--------------------------|---------------------|------------|----------|------------|------------|-----------|----------|----------|-----------|
|        |             |                                             | L               | P         | T        | ESE                      | Internal Assessment | TW         | PR       | OR         | Total      | Th        | Pr/Or    | Tut      | Total     |
| 1.     | MI1110301   | SEM-III: Distributed Computing              | 3               | 2         | -        | 60                       | 40                  | 25         | -        | 25         | 150        | 3         | 1        | -        | 4         |
| 2      | MI1110401   | SEM-IV: Cloud Systems and Infrastructures   | 3               | 2         | -        | 60                       | 40                  | 25         | -        | 25         | 150        | 3         | 1        | -        | 4         |
| 3.     | MI1110501   | SEM-V: Cloud Virtualization                 | 3               | 2         | -        | 60                       | 40                  | 25         | -        | 25         | 150        | 3         | 1        | -        | 4         |
| 4.     | MI1110601   | SEM-VI: Cloud Containers and Orchestrations | 3               | 2         | -        | 60                       | 40                  | 25         | -        | 25         | 150        | 3         | 1        | -        | 4         |
| 5.     | RP1110602   | Sem-VI Project                              |                 | 8         | -        |                          |                     | 50         |          | 50         | 100        |           | 4        | -        | 4         |
|        |             | <b>Total</b>                                | <b>12</b>       | <b>16</b> | <b>-</b> | <b>240</b>               | <b>160</b>          | <b>150</b> | <b>-</b> | <b>150</b> | <b>700</b> | <b>12</b> | <b>8</b> | <b>-</b> | <b>20</b> |

# **B.Tech. (Information Technology)**

## **Semester-VII**

| Blockchain Technologies                                                                                                                                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                                                |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                                                       | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                                                                     | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                                                                                                                |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                                                                                          | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               |                  |
| Introduce to <ol style="list-style-type: none"> <li>1) blockchain fundamentals, consensus protocols, public and permissioned platforms, smart contracts, and real-world applications</li> <li>2) develop hands-on skills to build and evaluate secure decentralized applications and permissioned networks</li> <li>3) enable critical analysis of scalability, security, and governance challenges</li> </ol> |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| Students should have knowledge of <ol style="list-style-type: none"> <li>1. Programming in C/C++/Python</li> <li>2. Data Structures and Algorithms</li> <li>3. Basics of Computer Networks and Databases</li> <li>4. Discrete Mathematics / Probability at first-year level</li> </ol>                                                                                                                         |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| CO1: Understand blockchain architecture, cryptography (hashes, digital signatures), data structures (Merkle trees) and peer-to-peer networking                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| CO2: Analyze consensus mechanisms (PoW, PoS, pBFT, Raft) and their security/performance trade-offs.                                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO3: Understand Bitcoin and Ethereum; design, implement, and test basic smart contracts in Solidity                                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO4: Infer a permissioned blockchain application using Hyperledger Fabric (MSP, channels, ordering, chaincode) and relevant SDKs                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| CO5: Evaluate blockchain use cases in finance, supply chain, e-governance, healthcare/IoT, and propose suitable architectures                                                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO6: Identify privacy, security, and regulatory issues; perform risk analysis and propose mitigation (audits, formal verification, L2/sharding).                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                |             |                          |           |               |                  |
| <b>Unit I : Foundations of Blockchain &amp; Cryptography</b>                                                                                                                                                                                                                                                                                                                                                   |             |                          |           |               | <b>(6 Hours)</b> |

|                                                                                                                                                                                                                                                                                                                                         |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| History and motivation: digital money to distributed ledgers; blockchain components: block, hash chain, Merkle tree; cryptographic primitives: hash functions, public/private keys, digital signatures; P2P networks, nodes, miners/validators; immutability and transparency; public vs private vs consortium blockchains.             |                  |
|                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Unit II : Consensus Mechanisms &amp; Distributed Agreement</b>                                                                                                                                                                                                                                                                       | <b>(6 Hours)</b> |
| Consensus requirements and fault models; Nakamoto consensus and Proof of Work; alternatives: Proof of Stake, Proof of Capacity, Proof of Burn, Proof of Elapsed Time; classical consensus (Paxos, Raft) and Byzantine Fault Tolerance (pBFT); scalability and energy considerations; attacks (51%, selfish mining) and mitigations.     |                  |
|                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Unit III : Bitcoin, Ethereum &amp; Smart Contracts</b>                                                                                                                                                                                                                                                                               | <b>(6 Hours)</b> |
| Bitcoin overview: UTXO model, transactions, scripts, wallets, mining and mempool; Ethereum overview: accounts, EVM, gas, transactions; Solidity basics (types, functions, events, modifiers), standards (ERC-20/721 overview), DApps architecture, testing and deployment workflows.                                                    |                  |
|                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Unit IV : Permissioned Platforms &amp; Enterprise Blockchain</b>                                                                                                                                                                                                                                                                     | <b>(6 Hours)</b> |
| Hyperledger Fabric architecture: MSP, peers, ordering service, channels; chaincode lifecycle and SDKs; designing a permissioned network (policies, identities, endorsement); deployment considerations on containers/kubernetes; blockchain-as-a-service and cloud integration concepts.                                                |                  |
|                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Unit V : Applications &amp; Case Studies</b>                                                                                                                                                                                                                                                                                         | <b>(6 Hours)</b> |
| Financial services: payments, settlements, KYC/AML, asset tokenization; Supply chain and trade finance: provenance, tracking, invoice discounting; Government: digital identity, land records, PDS; Healthcare/IoT: data integrity, access control; cybersecurity and PKI use cases; evaluation frameworks (cost, throughput, privacy). |                  |
|                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Unit VI : Security, Privacy, Scalability &amp; Future Trends</b>                                                                                                                                                                                                                                                                     | <b>(6 Hours)</b> |
| Threats and vulnerabilities: Sybil, Eclipse, double spend, reorgs; smart contract risks and audits; privacy techniques: mixers, zk-SNARKs, ring signatures; scalability: sharding, rollups, state/payment channels; regulation, compliance, and ethics; Web3/DAO/DID trends and research directions.                                    |                  |
|                                                                                                                                                                                                                                                                                                                                         |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                        |                  |

|                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.                                                                                   |
| 2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.                                                 |
| 3. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block chain with Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer", 2018. |
| 4. Bahga, Vijay Madisetti, "Block chain Applications: A Hands-On Approach", Arshdeep Bahga, Vijay Madisetti publishers 2017                                                                                                   |

|                                                                                                                                                                                          |                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Reference Books</b>                                                                                                                                                                   |                                 |
| 1. Mark Gates, "Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money", Wise Fox Publishing and Mark Gates 2017 |                                 |
| 2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Crypto currencies", O'Reilly Media, Inc. 2014.                                                                            |                                 |
| 3. Melanie Swan, "Block chain ", O'Reilly Media 2014.                                                                                                                                    |                                 |
| <b>List of Laboratory Exercises (Any 8 out of the following)</b>                                                                                                                         |                                 |
| 1. Compute SHA-256 digests; study avalanche effect.                                                                                                                                      |                                 |
| 2. Implement RSA keypair, encryption/decryption, and signatures.                                                                                                                         |                                 |
| 3. Build a minimal PoW blockchain; validate block links.                                                                                                                                 |                                 |
| 4. Create & verify a digitally signed document/transaction.                                                                                                                              |                                 |
| 5. Construct a 5-node chain; simulate tampering & validate chain integrity.                                                                                                              |                                 |
| 6. Write/deploy/test a Solidity smart contract on local Ethereum (Ganache/Hardhat).                                                                                                      |                                 |
| 7. Interact with contracts via Web3.js/ethers.js; add unit tests.                                                                                                                        |                                 |
| 8. Set up a basic Hyperledger Fabric test network; deploy chaincode.                                                                                                                     |                                 |
| 9. Design a permissioned use case (KYC or lot tracking) using Fabric SDK.                                                                                                                |                                 |
| 10. Analyze a real Bitcoin/Ethereum transaction via explorer; decode scripts/logs.                                                                                                       |                                 |
| 11. Explore Layer-2: demo a payment channel or rollout concept.                                                                                                                          |                                 |
| 12. Security lab: reproduce a re-entrancy bug and fix via CEI pattern & SafeMath.                                                                                                        |                                 |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                            |                                 |
| Students should perform project similar to following in group of 2-3 students                                                                                                            |                                 |
| 1. Supply-chain provenance tracker with QR codes and blockchain-backed audit trail.                                                                                                      |                                 |
| 2. E-KYC consortium prototype with verifiable credentials and selective disclosure.                                                                                                      |                                 |
| 3. Decentralized certificate issuance and on-chain verification portal for an institute.                                                                                                 |                                 |
| 4. IoT data integrity pipeline (edge signing + blockchain anchoring).                                                                                                                    |                                 |
| 5. Land records registry mock-up with role-based access and dispute logging.                                                                                                             |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                           |                                 |
| Unit Test -1                                                                                                                                                                             | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                             | Unit – IV, Unit – V, Unit – VI  |

| Seminar                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|----|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                       |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |    |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                              | -           | End Semester Examination | -         | Lecture       | -  |
| Practical:                                                                                                                                                                                                                                                                                                                                                                            | 04 Hrs/Week | Internal Assessment      | -         |               |    |
|                                                                                                                                                                                                                                                                                                                                                                                       |             | Term Work                | 50 Marks  | Practical     | 02 |
|                                                                                                                                                                                                                                                                                                                                                                                       |             | Oral                     | 50 Marks  |               |    |
| Total                                                                                                                                                                                                                                                                                                                                                                                 | 04 Hrs/Week | Total                    | 100 Marks | Total         | 02 |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |    |
| The Seminar aims to:                                                                                                                                                                                                                                                                                                                                                                  |             |                          |           |               |    |
| 1) Develop <b>self-learning ability</b> and <b>research orientation</b>                                                                                                                                                                                                                                                                                                               |             |                          |           |               |    |
| 2) Enhance <b>technical understanding of emerging technologies</b>                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |    |
| 3) Improve <b>presentation and communication skills</b>                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |    |
| 4) Encourage <b>analytical and critical thinking</b>                                                                                                                                                                                                                                                                                                                                  |             |                          |           |               |    |
| 5) Prepare students for <b>industry discussions, higher studies, and interviews</b>                                                                                                                                                                                                                                                                                                   |             |                          |           |               |    |
| <b>GUIDELINES:</b>                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |    |
| <b>Scope of Topics</b>                                                                                                                                                                                                                                                                                                                                                                |             |                          |           |               |    |
| Students must select a topic from <b>recent, relevant, and advanced areas</b> such as:                                                                                                                                                                                                                                                                                                |             |                          |           |               |    |
| <p><b>i) Emerging/Recent Technologies</b></p> <p><b>ii) Case Studies such as</b></p> <p>Real-world system implementations (e.g., Smart Cities, Aadhaar, UPI)</p> <p>Failure analysis of major IT systems</p> <p>Security breaches (e.g., ransomware attacks)</p> <p>Tech product architecture (e.g., Netflix, Google, Amazon systems)</p> <p><b>iii) Research-Oriented Topics</b></p> |             |                          |           |               |    |

|                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Survey papers from IEEE, Springer, ACM</p> <p>Comparative analysis of algorithms/technologies</p> <p>Recent innovations (last 3–5 years)</p> <p><b>iv) Interdisciplinary Topics such as</b></p> <p>AI in Healthcare</p> <p>IT in Agriculture</p> <p>Smart Education Systems</p> <p>Sustainable Technologies</p> |
| <b>What Students Are Expected to Do</b>                                                                                                                                                                                                                                                                            |
| <p><b>Step 1: Topic Selection</b></p> <p>Choose a <b>unique topic</b> (no duplication in the batch) and get approval from <b>seminar guide/faculty</b></p>                                                                                                                                                         |
| <p><b>Step 2: Literature Survey</b></p> <p>Refer <b>minimum 5–8 quality sources like</b> Research papers (IEEE, Springer, etc.), Technical blogs (credible sources), White papers / Industry reports</p> <p>Focus on <b>recent developments (last 5 years)</b></p>                                                 |
| <b>Step 3: Content Preparation</b>                                                                                                                                                                                                                                                                                 |
| <p><b>Step 4: Report Writing</b></p> <p><b>Students must submit a Seminar Report (Approx. 20–25 pages)</b></p> <p><b>containing:</b></p> <ul style="list-style-type: none"> <li>• Abstract (1 page)</li> </ul>                                                                                                     |

- Introduction
- Detailed explanation
- Diagrams / charts
- Case study (if applicable)
- Conclusion
- References (IEEE format)

#### **Step 5: Presentation**

Prepare **PPT (10–15 slides)**

Duration: **15–20 minutes presentation + 5–10 minutes Q&A**

Use diagrams, flowcharts, visuals

#### **Step 6: Demonstration (Optional but Highly Encouraged)**

- Simulation / small prototype / video demo
- Tools: Python, MATLAB, IoT kits, etc.



| Internship                                                                               |                                 |                          |                                 |               |    |
|------------------------------------------------------------------------------------------|---------------------------------|--------------------------|---------------------------------|---------------|----|
| TEACHING SCHEME                                                                          |                                 | EXAMINATION SCHEME       |                                 | CREDIT SCHEME |    |
| Lecture:                                                                                 | -                               | End Semester Examination | -                               | Lecture       | -  |
| Practical:                                                                               | -                               | Internal Assessment      | -                               |               |    |
|                                                                                          |                                 | Term Work                | 150 Marks                       | Practical     | -  |
|                                                                                          |                                 | Oral                     | 100 Marks                       |               |    |
| Total                                                                                    | -                               | Total                    | 250 Marks                       | Total         | 14 |
| Course Objective:                                                                        |                                 |                          |                                 |               |    |
| The Internship aims to:                                                                  |                                 |                          |                                 |               |    |
| 1) Provide <b>real-world exposure</b> to professional environments                       |                                 |                          |                                 |               |    |
| 2) Enhance <b>technical, problem-solving, and teamwork skills</b>                        |                                 |                          |                                 |               |    |
| 3) Bridge the gap between <b>academics and industry expectations</b>                     |                                 |                          |                                 |               |    |
| 4) Develop <b>professional ethics, communication, and responsibility</b>                 |                                 |                          |                                 |               |    |
| GUIDELINES:                                                                              |                                 |                          |                                 |               |    |
| Internship Structure                                                                     |                                 |                          |                                 |               |    |
| Component                                                                                | Industry Internship             |                          | In-House Internship             |               |    |
| Duration                                                                                 | One full semester (16–20 weeks) |                          | One full semester (16–20 weeks) |               |    |
| Mode                                                                                     | At Industry/Organization        |                          | Within Institute                |               |    |
| Credits                                                                                  | 14                              |                          | 14                              |               |    |
| Mentorship                                                                               | Industry + Faculty Mentor       |                          | Faculty + Industry Expert       |               |    |
| Evaluation                                                                               | Continuous + Final              |                          | Continuous + Final              |               |    |
| Industry Internship                                                                      |                                 |                          |                                 |               |    |
| Allocation                                                                               |                                 |                          |                                 |               |    |
| <ul style="list-style-type: none"><li>Students may obtain internships through:</li></ul> |                                 |                          |                                 |               |    |

- Institute
- Off-campus applications
- Faculty/Alumni references

### Approval

- Internship must be approved by:
  - Department Internship Coordinator
  - Concerned Faculty Mentor

### Requirements

- Minimum **16 weeks duration**
- Work must be relevant to:
  - IT / Computer Science / Emerging Technologies
- Student must submit:
  - Offer Letter
  - Joining Report
  - Weekly Logbook

### Monitoring

- Weekly progress submission (online/offline)
- Minimum **2 reviews** by faculty mentor
- Feedback from industry supervisor

### Deliverables

- Internship Report (standard format)
- Work Diary / Logbook
- Project/Task Completion Proof
- Presentation & Viva

### In-House Internship

### Structure

- Designed by department in emerging domains, such as:
  - Artificial Intelligence / Machine Learning
  - Data Science
  - Cybersecurity
  - IoT / Embedded Systems
  - Cloud Computing / DevOps
  - Web/App Development

#### **Execution Model**

- Combination of:
  - Structured Modules (30–40%)
  - Hands-on Project Work (60–70%)

#### **Mentorship**

- Internal Faculty Mentor
- External Industry Expert (minimum 20–30% involvement)

#### **Weekly Schedule**

- Technical sessions (lectures/workshops)
- Lab/practical implementation
- Project development
- Weekly review meetings

#### **Deliverables**

- Module Assignments
- Mini Projects (phase-wise)
- Final Capstone Project
- Documentation + Presentation

#### **Common Guidelines (Applicable to Both)**

#### **Attendance**

- Minimum 80% attendance mandatory
- Industry: certified by company
- In-house: monitored by department

**Logbook**

- Weekly record of:
  - Tasks performed
  - Skills learned
  - Challenges faced

# **B.Tech. (Information Technology)**

## **Semester-VIII**

| Agentic Artificial Intelligence                                                                                                                                                                                                                                                                                                                                                |             |                          |           |               |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                       | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                                     | 02 Hrs/Week | Internal Assessment      | 40 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                                                                                |             | Termwork                 | 25 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                |             | Practical                | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                                                          | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               |                  |
| 1) Understand intelligent agents and autonomous AI systems.<br>2) Design LLM-powered reasoning and planning agents.<br>3) Implement tool-augmented and memory-enabled agents.<br>4) Build multi-agent collaborative solutions.<br>5) Evaluate safety, ethics, and deployment of agentic systems.                                                                               |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| Students should have knowledge of<br>1) Python Programming<br>2) Machine Learning basics<br>3) NLP fundamentals.                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| CO1: Explain intelligent agent architectures.                                                                                                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO2: Design reasoning-based agents.                                                                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO3: Implement planning and tool-using agents.                                                                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| CO4: Develop multi-agent systems.                                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| CO5: Evaluate reliability and safety.                                                                                                                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| CO6: Deploy real-world applications.                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| <b>Unit I: Introduction to Agentic AI</b>                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               | <b>(6 Hours)</b> |
| Introduction to Artificial Intelligence Agents, Agent vs Model vs Workflow<br>Characteristics of Agentic Systems (autonomy, memory, planning, feedback),<br>Types of Agents: Simple Reflex, Model-based, Goal-based, Utility-based,<br>Learning Agents, PEAS description and task environments, Architecture of<br>Intelligent Agents, Applications of Agentic AI in Industry. |             |                          |           |               |                  |
| <b>Unit II : LLMs and Reasoning for Agents</b>                                                                                                                                                                                                                                                                                                                                 |             |                          |           |               | <b>(6 Hours)</b> |
| Overview of Large Language Models (LLMs), Prompt Engineering ,<br>techniques, Chain-of-Thought reasoning, ReAct (Reason + Act) paradigm, Tool<br>usage and function calling, Memory in LLMs (short-term, long-term, vector<br>DBs), Retrieval Augmented Generation (RAG), Self-reflection and self-<br>correction.                                                             |             |                          |           |               |                  |
| <b>Unit III : Planning, Decision Making and Learning</b>                                                                                                                                                                                                                                                                                                                       |             |                          |           |               | <b>(6 Hours)</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Problem solving by search, State-space representation, Classical planning algorithms, Heuristic search (A*, Greedy), Reinforcement Learning for Agents,                                                                                                                                                                                                                                                                                                                                                                                         |                  |
| Policy-based decision making, Markov Decision Process (MDP), Multi-step task decomposition                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit IV : Agent Frameworks and Implementation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>(6 Hours)</b> |
| LangChain basics, Agents, Tools, Chains, AutoGen framework, CrewAI and collaborative agents, API integrations and tool building, Memory management with vector databases (FAISS/Chroma), Building task-specific AI assistants, Case studies: chatbot, research assistant, automation bot                                                                                                                                                                                                                                                        |                  |
| <b>Unit V : Multi-Agent Systems and Collaboration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>(6 Hours)</b> |
| Concept of Multi-Agent Systems (MAS), Cooperative vs Competitive agents, Communication protocols, Role-based agents, Swarm intelligence basics, Task allocation and coordination, Distributed problem solving, Applications: healthcare, smart cities, cybersecurity, robotics                                                                                                                                                                                                                                                                  |                  |
| <b>Unit VI : Title</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(6 Hours)</b> |
| Hallucination detection and mitigation, Reliability and robustness, Ethical issues and responsible AI, Bias and fairness, Agent evaluation metrics, Monitoring and logging, Deployment using APIs and cloud, Real-world case studies and future trends                                                                                                                                                                                                                                                                                          |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |
| 1. Stuart Russell & Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i> , Pearson                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |
| 2. Chip Huyen, <i>AI Engineering</i> , O'Reilly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |
| 3. LangChain Documentation and LLM Agent Framework Guides                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |
| 1. Tom Mitchell, <i>Machine Learning</i> , McGraw Hill                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |
| 2. Sutton & Barto, <i>Reinforcement Learning: An Introduction</i> , MIT Press                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |
| <b>List of Laboratory Exercises (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |
| <ol style="list-style-type: none"> <li>1. Python environment setup for LLM APIs</li> <li>2. Prompt engineering experiments</li> <li>3. Build a simple rule-based agent</li> <li>4. Implement ReAct-based tool agent</li> <li>5. Create a memory-enabled chatbot using vector DB</li> <li>6. RAG-based document assistant</li> <li>7. Multi-agent collaboration using CrewAI/AutoGen</li> <li>8. Task planning with search algorithms</li> <li>9. Deploy agent using Flask/FastAPI</li> <li>10. Mini project: Autonomous AI assistant</li> </ol> |                  |

|                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                     |
| <ol style="list-style-type: none"> <li>1. Research paper summarizer agent</li> <li>2. Personal productivity assistant</li> <li>3. Smart customer support agent</li> <li>4. Multi-agent knowledge retrieval system</li> <li>5. Healthcare or agriculture advisory agent</li> </ol> |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                                    |
| Unit – I, Unit – II, Unit - III                                                                                                                                                                                                                                                   |
| Unit – IV, Unit – V, Unit – VI                                                                                                                                                                                                                                                    |



| Professional Elective II: Natural Language Processing                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                              |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                     | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                   | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                              |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                              |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                        | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                     |             |                          |           |               |                  |
| 1) Understand linguistic fundamentals and challenges of NLP.<br>2) Apply text preprocessing and feature engineering techniques.<br>3) Implement classical and deep learning models for NLP.<br>4) Develop applications such as classification, translation, and chatbots.<br>5) Evaluate NLP systems using standard metrics. |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                         |             |                          |           |               |                  |
| Students should have knowledge of<br>1. Artificial Intelligence & Machine Learning<br>2. Data Mining and Analytics<br>3. Python Programming                                                                                                                                                                                  |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| CO1: Explain levels of language processing and NLP pipeline.                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| CO2: Implement text preprocessing and representation models.                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| CO3: Build machine learning models for text classification.                                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO4: Apply sequence models and transformers for NLP tasks.                                                                                                                                                                                                                                                                   |             |                          |           |               |                  |
| CO5: Develop real-world NLP applications.                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| CO6: Understand ethical issues and responsible AI in language technologies                                                                                                                                                                                                                                                   |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| <b>Unit I : Introduction to NLP</b>                                                                                                                                                                                                                                                                                          |             |                          |           |               | <b>(6 Hours)</b> |
| Overview and applications of NLP, Ambiguity in natural language, Levels: morphology, syntax, semantics, pragmatics, NLP pipeline, Regular expressions, Tokenization, stemming, lemmatization, Stop word removal.                                                                                                             |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| <b>Unit II : Text Representation</b>                                                                                                                                                                                                                                                                                         |             |                          |           |               | <b>(6 Hours)</b> |
| Bag of Words, TF-IDF, N-grams and language models, Vector space model, Word embeddings: Word2Vec, GloVe, FastText, Similarity measures, Dimensionality reduction for text.                                                                                                                                                   |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| <b>Unit III : Classical NLP &amp; ML Models</b>                                                                                                                                                                                                                                                                              |             |                          |           |               | <b>(6 Hours)</b> |
| Text classification, Naïve Bayes, SVM, Logistic Regression, POS tagging, Named Entity Recognition, Chunking and parsing, Evaluation metrics: precision, recall, F1.                                                                                                                                                          |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| <b>Unit IV : Sequence &amp; Deep Learning for NLP</b>                                                                                                                                                                                                                                                                        |             |                          |           |               | <b>(6 Hours)</b> |

|                                                                                                                                                                                              |                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| RNN, LSTM, GRU, Sequence labelling, Attention mechanism, Encoder–decoder models, Text generation, Sentiment analysis with deep networks.                                                     |                                 |
| <b>Unit V : Transformer Based NLP</b>                                                                                                                                                        | <b>(6 Hours)</b>                |
| Transformer architecture, BERT, GPT overview, Transfer learning in NLP, Fine tuning for tasks, Question answering, Text summarization                                                        |                                 |
|                                                                                                                                                                                              |                                 |
| <b>Unit VI : NLP Applications &amp; Ethics</b>                                                                                                                                               | <b>(6 Hours)</b>                |
| Machine translation, Chatbots & dialogue systems, Information retrieval, Speech to text overview, Bias, fairness, and ethics in NLP, Multilingual and low-resource NLP.                      |                                 |
|                                                                                                                                                                                              |                                 |
| <b>Textbooks</b>                                                                                                                                                                             |                                 |
| 1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson Education. |                                 |
| 2. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit, O'Reilly Media.                                     |                                 |
| 3. Palash Goyal, Sumit Pandey, and Karan Jain, Deep Learning for Natural Language Processing: Creating Neural Networks with Python, Springer.                                                |                                 |
|                                                                                                                                                                                              |                                 |
| <b>Reference Books</b>                                                                                                                                                                       |                                 |
| 1. Jacob Eisenstein, <i>Introduction to Natural Language Processing</i> , MIT Press.                                                                                                         |                                 |
| 2. Yoav Goldberg, <i>Neural Network Methods for Natural Language Processing</i> , Morgan & Claypool Publishers.                                                                              |                                 |
|                                                                                                                                                                                              |                                 |
| <b>List of Laboratory Exercises (if applicable)</b>                                                                                                                                          |                                 |
| 1. To implement a complete text preprocessing pipeline for raw textual data.                                                                                                                 |                                 |
| 2. To represent documents using TF–IDF and compute similarity.                                                                                                                               |                                 |
| 3. To build a machine learning model for text classification                                                                                                                                 |                                 |
| 4. POS Tagging & Named Entity Recognition using spaCy                                                                                                                                        |                                 |
| 5. To implement deep learning for NLP.                                                                                                                                                       |                                 |
| 6. To apply transfer learning using transformer models.                                                                                                                                      |                                 |
| 7. Develop a rule/ML based chatbot                                                                                                                                                           |                                 |
| 8. To implement extractive text summarization.                                                                                                                                               |                                 |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                |                                 |
| Course Faculty members are advised to design and assign Project Based Learning (PBL) topics aligned with the units and outcomes of the prescribed syllabus.                                  |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                               |                                 |
| Unit Test -1                                                                                                                                                                                 | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                 | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective II:Soft Computing                                                                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                    |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                           | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                                         | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                    |             | Term Work                | 25 Marks  | Oral          | 01               |
|                                                                                                                                                                                                                                                                                                                                                                                    |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                                                              | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| 1. To introduce the fundamental soft computing techniques including fuzzy logic, artificial neural networks, genetic algorithms, and swarm intelligence.<br>2. To enable students to apply these techniques for solving real-world problems in prediction, classification, decision-making, and optimization                                                                       |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| Students should have knowledge of<br>1. Basic mathematics, set theory, logic and probability.<br>2. Fundaments of programming, algorithm and problem solving                                                                                                                                                                                                                       |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO1: Explain soft computing concepts and applications.                                                                                                                                                                                                                                                                                                                             |             |                          |           |               |                  |
| CO2: Apply fuzzy logic for reasoning and control problems.                                                                                                                                                                                                                                                                                                                         |             |                          |           |               |                  |
| CO3: Describe ANN architecture and basic working.                                                                                                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO4: Apply ANN training using backpropagation and evaluate performance.                                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO5: Apply genetic algorithms for optimization problems.                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| CO6: Use PSO and ACO for optimization and real-world applications.                                                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Unit I : Introduction to Soft Computing</b>                                                                                                                                                                                                                                                                                                                                     |             |                          |           |               | <b>(6 Hours)</b> |
| Definition, motivation and need of soft computing in real-world problem solving, limitations of hard computing approaches, soft computing versus conventional computing, characteristics of soft computing such as approximation, uncertainty handling, learning and adaptability, relationship of soft computing with artificial intelligence and machine learning, applications. |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Unit II : Fuzzy Logic</b>                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               | <b>(6 Hours)</b> |
| Crisp sets and fuzzy sets, fuzzy set representation, membership functions, operations on fuzzy sets, linguistic variables, fuzzy relations and composition, fuzzy rule base and IF–THEN rules, fuzzy reasoning and approximate reasoning, fuzzy inference system architecture, Mamdani fuzzy model and Sugeno fuzzy model, defuzzification methods, fuzzy control system concept.  |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Unit III : ANN Basics and Architecture</b>                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               | <b>(6 Hours)</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Biological neuron versus artificial neuron, artificial neuron model, neural network architectures, single-layer networks and multi-layer networks, activation functions: step, sigmoid, tanh and ReLU, learning paradigms, perceptron model, perceptron learning rule, limitations of single-layer perceptron, introduction to multi-layer perceptron and its working.                                                                                                                  |                  |
| <b>Unit IV: ANN Training and Models</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>(6 Hours)</b> |
| Multi-layer perceptron in detail, backpropagation algorithm and training steps, gradient descent concept, learning rate and epochs, error functions, training and testing process, generalization, overfitting and underfitting, methods to improve training such as normalization and regularization, overview of advanced neural network models such as radial basis function networks, Hopfield networks, applications of ANN in prediction, classification and pattern recognition. |                  |
| <b>Unit V: Genetic Algorithms</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>(6 Hours)</b> |
| Introduction to optimization and search, evolutionary computing fundamentals, genetic algorithm terminology including population, chromosome, gene and fitness function, chromosome encoding techniques, selection methods: roulette wheel and tournament selection, crossover techniques: single-point, two-point and uniform crossover, mutation operation and its importance, elitism, genetic algorithm workflow, stopping criteria, applications of genetic algorithms.            |                  |
| <b>Unit VI: Swarm Intelligence and Applications</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(6 Hours)</b> |
| Swarm intelligence concept, particle swarm optimization basics, PSO algorithm steps, ant colony optimization basics, ACO algorithm steps, comparison of GA and swarm methods, applications and case studies of soft computing in prediction, classification, decision-making and optimization.                                                                                                                                                                                          |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |
| 1. S. N. Sivanandam, S. N. Deepa, <i>Principles of Soft Computing</i> , Wiley India                                                                                                                                                                                                                                                                                                                                                                                                     |                  |
| 2. J. S. R. Jang, C. T. Sun, E. Mizutani, <i>Neuro-Fuzzy and Soft Computing</i> , Prentice Hall                                                                                                                                                                                                                                                                                                                                                                                         |                  |
| 3. Timothy J. Ross, <i>Fuzzy Logic with Engineering Applications</i> , Wiley                                                                                                                                                                                                                                                                                                                                                                                                            |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |
| 1. Simon Haykin, <i>Neural Networks and Learning Machines</i> , Pearson                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |
| 2. David E. Goldberg, <i>Genetic Algorithms in Search, Optimization and Machine Learning</i> , Addison-Wesley                                                                                                                                                                                                                                                                                                                                                                           |                  |
| 3. Xin-She Yang, <i>Nature-Inspired Optimization Algorithms</i> , Elsevier                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
| 4. Witold Pedrycz, <i>Fuzzy Sets, Fuzzy Logic, and Fuzzy Methods with Applications</i> , Wiley                                                                                                                                                                                                                                                                                                                                                                                          |                  |
| <b>List of Laboratory Exercises:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |

1. Design a flowchart showing soft-computing based problem-solving pipeline.
2. Implement fuzzy set operations, define membership functions, compute union, intersection, complement for given fuzzy sets, plot membership functions
3. Design a fuzzy inference system, create rule base, perform fuzzification, inference, defuzzification for a simple control problem (fan speed or temperature control).
4. Implement a single-layer perceptron for binary classification on a small dataset, show learning iterations and final weights.
5. Implement activation functions and forward pass for a simple neural network, compare outputs for different activation functions.

6. Implement a multi-layer perceptron with backpropagation for classification, train-test split, report accuracy and loss curve values.
7. Experiment on overfitting and generalization, train ANN with different epochs or network sizes, compare training accuracy vs testing accuracy, write observations.
8. Implement a genetic algorithm to optimize a mathematical function, define encoding, fitness, selection, crossover, mutation, show best fitness per generation.
9. Implement PSO or ACO for an optimization problem, compare results with GA on solution quality and iterations, write a short case study using one dataset.
10. Download historical stock price data for one NSE stock, prepare input features using past closing prices and moving average, train an Artificial Neural Network model to predict the next-day closing price, and report the performance using MSE or RMSE with a short conclusion.

### **Project Based Learning**

#### **Objective**

Develop a small working project using any one soft computing technique from the syllabus, and demonstrate its implementation on a real dataset or real problem.

Choose any broad domain from following:

1. ANN based prediction or classification system
2. Genetic algorithm based optimization system
3. PSO or ACO based optimization system
4. Hybrid approach (optional) using GA/PSO for ANN tuning

Students must design a problem statement, collect a dataset or define input-output values, implement the selected technique, and show results with proper evaluation.

### **Syllabus for Unit Tests (if applicable)**

|              |                                 |
|--------------|---------------------------------|
| Unit Test -1 | Unit – I, Unit – II, Unit - III |
| Unit Test -2 | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective II: Web Application Security                                                                                                                                                                                                                                                                                   |             |                          |           |               |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                      |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                             | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                           | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                      |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                                      |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                             |             |                          |           |               |                  |
| 1) To understand the architecture of web applications and common security challenges.<br>2) To apply secure coding principles and defensive techniques to build secure web applications.<br>3) To familiarize students with security testing tools, methodologies, and best practices.                                               |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| Students should have knowledge of<br>1) Basic Web Technologies (HTML, CSS, JavaScript)<br>2) Computer Networks and Internet Fundamentals                                                                                                                                                                                             |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| CO1: Understand web application architecture, protocols, and security fundamentals.                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO2: Apply secure authentication, authorization, and session management techniques.                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO3: Identify and analyse common web application vulnerabilities and threats.                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| CO4: Implement secure coding practices to mitigate web-based attacks.                                                                                                                                                                                                                                                                |             |                          |           |               |                  |
| CO5: Perform web application security testing using industry-standard tools.                                                                                                                                                                                                                                                         |             |                          |           |               |                  |
| CO6: Evaluate real-world web security incidents and recommend appropriate countermeasures.                                                                                                                                                                                                                                           |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| <b>Unit I : Introduction to Web Application Security</b>                                                                                                                                                                                                                                                                             |             |                          |           |               | <b>(6 Hours)</b> |
| Overview of Web Applications and Architecture, Client–Server Model, HTTP/HTTPS Protocols, Common Web Technologies (HTML, CSS, JavaScript, PHP, ASP.NET, APIs), Security Goals: Confidentiality, Integrity, Availability (CIA Triad), Threat Landscape and Attack Surface of Web Applications, Basics of Cryptography in Web Security |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| <b>Unit II : Authentication and Authorization</b>                                                                                                                                                                                                                                                                                    |             |                          |           |               | <b>(6 Hours)</b> |

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| Authentication Mechanisms (Passwords, MFA, OAuth, SSO), Authorization Models (RBAC, ABAC), Session Management and Cookies, Token-Based Authentication (JWT), Common Vulnerabilities: Broken Authentication, Session Hijacking, Credential Stuffing; Secure Login and Logout Design |                  |
| <b>Unit III : Web Application Vulnerabilities</b>                                                                                                                                                                                                                                  | <b>(6 Hours)</b> |
| OWASP Top 10 Overview, Injection Attacks (SQL Injection, Command Injection), Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), Security Misconfiguration, Insecure Direct Object References (IDOR), File Upload and Path Traversal Vulnerabilities                    |                  |
|                                                                                                                                                                                                                                                                                    |                  |
| <b>Unit IV : Secure Coding and Defensive Techniques</b>                                                                                                                                                                                                                            | <b>(6 Hours)</b> |
| Secure Coding Principles, Input Validation and Output Encoding, Secure Use of APIs, Error Handling and Logging, Secure Database Access, Password Storage and Hashing, Security Headers (CSP, HSTS, X-Frame-Options)                                                                |                  |
|                                                                                                                                                                                                                                                                                    |                  |
| <b>Unit V : Web Application Testing and Tools</b>                                                                                                                                                                                                                                  | <b>(6 Hours)</b> |
| Web Application Security Testing Methodologies, Black Box, White Box, and Gray Box Testing, Vulnerability Scanning vs Penetration Testing, Security Testing Tools: Burp Suite, OWASP ZAP, Nikto; Secure Development Lifecycle (SDLC), Threat Modelling                             |                  |
|                                                                                                                                                                                                                                                                                    |                  |
| <b>Unit VI : Advanced Topics and Case Studies</b>                                                                                                                                                                                                                                  | <b>(6 Hours)</b> |
| Web Application Firewalls (WAF), API Security, Cloud and Container Security (Basics), Secure Deployment, Incident Response and Monitoring, Legal, Ethical, and Compliance Issues<br>Case Studies of Real-World Web Attacks                                                         |                  |
|                                                                                                                                                                                                                                                                                    |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                   |                  |
| 1. <b>Dafydd Stuttard, Marcus Pinto</b> , <i>The Web Application Hacker's Handbook</i> , 2nd Edition, Wiley Publishing.                                                                                                                                                            |                  |
| 2. <b>Andrew Hoffman</b> , <i>Web Application Security: Exploitation and Countermeasures for Modern Web Applications</i> , O'Reilly Media.                                                                                                                                         |                  |
|                                                                                                                                                                                                                                                                                    |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                             |                  |
| 1. <b>Michal Zalewski</b> , <i>The Tangled Web: A Guide to Securing Modern Web Applications</i> , No Starch Press.                                                                                                                                                                 |                  |
| 2. <b>OWASP Foundation</b> , <i>OWASP Top 10 Web Application Security Risks</i> .                                                                                                                                                                                                  |                  |

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| 3. <b>Laura Bell, Michael Brunton-Spall</b> , <i>Security Testing with OWASP ZAP</i> , O'Reilly Media.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 4. <b>William Stallings</b> , <i>Cryptography and Network Security</i> , Pearson Education.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>List of Laboratory Exercises (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <ol style="list-style-type: none"> <li>1. Study of web application architecture and HTTP request–response analysis</li> <li>2. Setting up a vulnerable web application (DVWA / WebGoat / Juice Shop)</li> <li>3. Identifying SQL Injection vulnerabilities</li> <li>4. Exploiting and preventing Cross-Site Scripting (XSS) attacks</li> <li>5. Cross-Site Request Forgery (CSRF) attack simulation and defense</li> <li>6. Session hijacking and cookie security analysis</li> <li>7. Secure authentication and password hashing implementation</li> <li>8. Web application vulnerability scanning using OWASP ZAP</li> <li>9. Manual penetration testing using Burp Suite</li> <li>10. Secure file upload and input validation techniques</li> <li>11. Implementation of security headers and HTTPS</li> <li>12. Mini project: Security assessment of a sample web application</li> </ol> |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



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| <b>1. Web Application Architecture &amp; Threat Analysis</b><br>Analyse a sample web application architecture and identify trust boundaries, attack surfaces, and possible threats.               |                                 |
| <b>2. Secure Communication (HTTP vs HTTPS)</b><br>Evaluate risks of using HTTP for login pages and propose a secure HTTPS implementation.                                                         |                                 |
| <b>3. Designing Secure Authentication System</b><br>Improve a basic username–password system by adding MFA, secure session handling, and protection against brute force attacks.                  |                                 |
| <b>4. Role-Based vs Attribute-Based Access Control</b><br>Design an authorization model (RBAC/ABAC) for a hospital or banking system and justify your choice.                                     |                                 |
| <b>5. SQL Injection Case Study</b><br>Analyse a vulnerable login query, demonstrate SQL injection, and redesign it using prepared statements.                                                     |                                 |
| <b>6. Cross-Site Scripting (XSS) Prevention</b><br>Identify XSS vulnerability in a comment section and implement input validation and output encoding defences.                                   |                                 |
| <b>7. Secure Password Storage</b><br>Replace plaintext password storage with secure hashing (bcrypt/Argon2) and explain the importance of salting.                                                |                                 |
| <b>8. Web Application Security Testing</b><br>Perform black-box testing using OWASP ZAP or Burp Suite and document identified vulnerabilities.                                                    |                                 |
| <b>9. Threat Modelling Using STRIDE</b><br>Apply STRIDE methodology to a payment gateway system and suggest mitigation strategies.                                                                |                                 |
| <b>10. Incident Response &amp; Secure Deployment</b><br>Develop an incident response plan for a compromised web application and recommend secure deployment practices (WAF, monitoring, logging). |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                    |                                 |
| Unit Test -1                                                                                                                                                                                      | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                      | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective II: Big Data Analytics                                                                                                                                                                                            |             |                          |           |               |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|----|
| TEACHING SCHEME                                                                                                                                                                                                                         |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |    |
| Lecture:                                                                                                                                                                                                                                | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03 |
| Practical:                                                                                                                                                                                                                              | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |    |
|                                                                                                                                                                                                                                         |             | Term Work                | 25 Marks  | Practical     | 01 |
|                                                                                                                                                                                                                                         |             | Oral                     | 25 Marks  |               |    |
| Total                                                                                                                                                                                                                                   | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04 |
| <b>Course Objective:</b>                                                                                                                                                                                                                |             |                          |           |               |    |
| 1) Understand fundamentals of big data and distributed computing.<br>2) Learn Hadoop ecosystem and data processing frameworks.<br>3) Apply NoSQL databases for large-scale applications.<br>4) Perform real-time analytics using Spark. |             |                          |           |               |    |
| <b>Prerequisite,</b>                                                                                                                                                                                                                    |             |                          |           |               |    |

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| Students should have knowledge of                                                                                                                                                                                                                                                    |                  |
| 1) Database Management Systems.                                                                                                                                                                                                                                                      |                  |
| 2) Data Warehousing & Data Mining                                                                                                                                                                                                                                                    |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                              |                  |
| CO1: Explain characteristics and challenges of Big Data.                                                                                                                                                                                                                             |                  |
| CO2: Implement HDFS and MapReduce programs.                                                                                                                                                                                                                                          |                  |
| CO3: Use NoSQL databases for scalable storage.                                                                                                                                                                                                                                       |                  |
| CO4: Perform analytics using Apache Spark                                                                                                                                                                                                                                            |                  |
| CO5: Build streaming applications for real-time data.                                                                                                                                                                                                                                |                  |
| CO6: Design big data solutions for real-world domains                                                                                                                                                                                                                                |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit I : Introduction to Big Data</b>                                                                                                                                                                                                                                             | <b>(6 Hours)</b> |
| Definition, 5Vs of Big Data, Types of data: structured, semi-structured, unstructured Traditional vs Big Data analytics, Big data lifecycle, Distributed computing concepts, Applications: healthcare, smart city, finance, social media, Challenges: scalability, security, privacy |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit II : Hadoop Ecosystem</b>                                                                                                                                                                                                                                                    | <b>(6 Hours)</b> |
| Hadoop architecture, HDFS: NameNode, DataNode, replication, YARN resource management, MapReduce programming model, Combiner, Partitioner, Job scheduling, Hive, Pig, Sqoop, Flume overview                                                                                           |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit III : NoSQL Databases</b>                                                                                                                                                                                                                                                    | <b>(6 Hours)</b> |
| Need for NoSQL, CAP theorem, BASE properties, Key-value, column, document, graph stores, MongoDB architecture and CRUD, HBase fundamentals, Data modeling for big data                                                                                                               |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit IV : Apache Spark Analytics</b>                                                                                                                                                                                                                                              | <b>(6 Hours)</b> |
| Limitations of MapReduce, Spark architecture, RDDs, Data Frames, Datasets, Spark SQL, MLlib introduction, GraphX overview .                                                                                                                                                          |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit V : Stream Processing</b>                                                                                                                                                                                                                                                    | <b>(6 Hours)</b> |
| Real-time vs batch analytics, Spark Streaming, Kafka architecture, Flink overview, Windowing, event processing, IoT data analytics.                                                                                                                                                  |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit VI : Big Data Security &amp; Applications</b>                                                                                                                                                                                                                                | <b>(6 Hours)</b> |
| Data governance and ethics, Security in Hadoop, Visualization of big data, Cloud platforms: AWS EMR, Azure HDInsight, Domain applications, Project design methodology.                                                                                                               |                  |
|                                                                                                                                                                                                                                                                                      |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                     |                  |
| 1. Tom White, <i>Hadoop: The Definitive Guide</i> , 4th Edition, O'Reilly Media, 2015.                                                                                                                                                                                               |                  |
| 2. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, <i>Learning Spark: Lightning-Fast Big Data Analysis</i> , 2nd Edition, O'Reilly Media, 2020.                                                                                                                        |                  |

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| 3. Seema Acharya, Subhashini Chellappan, <i>Big Data Analytics</i> , 2nd Edition, Wiley India, 2019.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 4. Bill Franks, <i>Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics</i> , Wiley, 2012.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 5. Raj Kamal, <i>Big Data Analytics</i> , McGraw Hill Education (India), 2019.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>List of Laboratory Exercises (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <ol style="list-style-type: none"> <li>1. To install Hadoop in pseudo-distributed mode and perform basic HDFS file operations.</li> <li>2. Write a MapReduce program (Java/Python) to count frequency of each word in a large text dataset</li> <li>3. Create a Hive database for Student/Customer/Sales dataset and perform: Create external table from CSV file <ul style="list-style-type: none"> <li>• Load dataset into Hive</li> <li>• Execute queries:</li> <li>• Count records</li> <li>• Group by category</li> <li>• Top 5 highest sales</li> <li>• Average purchase per user</li> </ul> Export query result to HDFS. </li> <li>4. Design a MongoDB database for an E-commerce product catalog.</li> <li>5. Using PySpark: <ul style="list-style-type: none"> <li>• Load a CSV dataset (e.g., COVID, weather, banking).</li> <li>• Perform: <ul style="list-style-type: none"> <li>○ Filtering</li> <li>○ GroupBy</li> <li>○ Join two datasets</li> </ul> </li> <li>• Create DataFrame and run Spark SQL queries.</li> <li>• Save result in Parquet format</li> </ul> </li> <li>6. Build a predictive model using Spark MLlib.</li> </ol> |

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| <ul style="list-style-type: none"> <li>• Use dataset such as house price or customer churn.</li> <li>• Perform: <ul style="list-style-type: none"> <li>○ Data cleaning</li> <li>○ Feature vector creation</li> <li>○ Train/Test split</li> </ul> </li> <li>• Apply: <ul style="list-style-type: none"> <li>○ Linear Regression / Classification</li> </ul> </li> <li>• Evaluate accuracy.</li> </ul> <p>7. To implement real-time data ingestion. Create a Kafka producer–consumer system.</p> <ul style="list-style-type: none"> <li>• Install Kafka server.</li> <li>• Create topic “sensor_data”.</li> <li>• Producer sends JSON records (temperature, time).</li> <li>• Consumer reads and stores to file/Spark.</li> <li>• Integrate with Spark Streaming to display live count.</li> </ul> <p>8. Big Data Visualization using Tableau/Power BI: visualize large datasets processed through Spark/Hive.</p> |                                 |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                 |
| <p>The following are sample Project Based Learning (PBL) suggestions provided for reference. Students may opt for any one project of their choice based on their interest and aligned with the concepts, tools, and technologies covered in the subject curriculum.</p> <ul style="list-style-type: none"> <li>• Develop a big data solution to analyze real-time traffic data to predict congestion and suggest alternate routes.</li> <li>• Build a personalized product recommendation engine using customer purchase history.</li> <li>• Analyze Twitter data to measure public opinion on a product/movie/election.</li> <li>• Analyze hospital records to predict readmission risk.</li> <li>• Detect anomalies from server log files.</li> <li>• Process IoT energy meter data to forecast consumption.</li> </ul>                                                                                        |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective II: AI in Healthcare                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |                          |           |               |                  |
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| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                          |           |               |                  |
| <ul style="list-style-type: none"> <li>• Understand the role of AI in modern healthcare systems</li> <li>• Learn key AI/ML techniques applied to medical data</li> <li>• Explore real-world healthcare applications (diagnostics, imaging, prediction)</li> <li>• Develop hands-on skills for building AI-based healthcare solutions</li> <li>• Understand ethical, legal, and privacy challenges</li> </ul>                                                                                                                              |             |                          |           |               |                  |
| <b>Prerequisite,</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| Students should have knowledge of Artificial Intelligence and Machine Learning concepts                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                          |           |               |                  |
| CO1: <b>Explain</b> the fundamentals of healthcare systems and the role of Artificial Intelligence in transforming healthcare applications.                                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| CO2: <b>Apply</b> machine learning algorithms and data preprocessing techniques to analyze healthcare datasets.                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| CO3: <b>Analyze</b> medical images using deep learning techniques such as CNNs for disease detection and diagnosis.                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               |                  |
| CO4: <b>Apply and analyze</b> Natural Language Processing techniques to extract meaningful insights from clinical text data.                                                                                                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| CO5: <b>Evaluate</b> AI-based predictive models and IoT-integrated healthcare systems for real-time monitoring and decision-making.                                                                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               |                  |
| CO6: <b>Design</b> ethical, secure, and explainable AI solutions for healthcare applications considering legal and societal implications.                                                                                                                                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| <b>Unit I : Introduction to AI in Healthcare</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                          |           |               | <b>(6 Hours)</b> |
| Overview of Healthcare Systems (EHR, EMR, HIS)<br>Role of AI in Healthcare Transformation<br>Types of Medical Data: <ul style="list-style-type: none"> <li>• Structured (EHR, lab reports)</li> <li>• Unstructured (clinical notes, images)</li> </ul> AI vs Traditional Healthcare Analytics<br>Applications of AI: <ul style="list-style-type: none"> <li>• Diagnosis, Treatment Recommendation, Drug Discovery</li> </ul> Challenges in Healthcare AI: <ul style="list-style-type: none"> <li>• Data Quality, Privacy, Bias</li> </ul> |             |                          |           |               |                  |

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| <b>Unit II : Machine Learning Fundamentals for Healthcare</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>(6 Hours)</b> |
| Supervised Learning: <ul style="list-style-type: none"> <li>Classification (Disease Prediction)</li> <li>Regression (Risk Prediction)</li> </ul> Unsupervised Learning: <ul style="list-style-type: none"> <li>Clustering (Patient Segmentation)</li> </ul> Evaluation Metrics: <ul style="list-style-type: none"> <li>Accuracy, Precision, Recall, F1-score, ROC</li> </ul> Data Preprocessing: <ul style="list-style-type: none"> <li>Missing values, normalization, feature selection</li> </ul> Handling Imbalanced Medical Data |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit III : Deep Learning in Medical Imaging</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>(6 Hours)</b> |
| Introduction to Deep Learning<br>Convolutional Neural Networks (CNN)<br>Applications: <ul style="list-style-type: none"> <li>X-ray Analysis</li> <li>MRI/CT Scan Interpretation</li> </ul> Image Preprocessing Techniques<br>Transfer Learning in Healthcare<br>Case Study: Disease Detection from Images                                                                                                                                                                                                                            |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit IV : Natural Language Processing (NLP) in Healthcare</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(6 Hours)</b> |
| Clinical Text Processing<br>Electronic Health Records (EHR) Analysis<br>Named Entity Recognition (NER)<br>Sentiment Analysis in Patient Feedback<br>Chatbots and Virtual Health Assistants<br>Tools: NLTK, SpaCy, Transformers (basic exposure)                                                                                                                                                                                                                                                                                      |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| <b>Unit V : AI in Predictive Healthcare &amp; IoT Integration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>(6 Hours)</b> |
| Predictive Analytics: <ul style="list-style-type: none"> <li>Disease Prediction Models</li> <li>Risk Scoring Systems</li> </ul> Time Series Analysis for Patient Monitoring<br>AI + IoT in Healthcare: <ul style="list-style-type: none"> <li>Wearable Devices</li> <li>Smart Monitoring Systems</li> </ul> Real-time Data Processing<br>Case Study: Smart Healthcare Systems                                                                                                                                                        |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |

| <b>Unit VI : Ethics, Regulations &amp; Future Trends</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>(6 Hours)</b> |
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| Ethical Issues in AI Healthcare: <ul style="list-style-type: none"> <li>• Bias, Fairness, Transparency</li> </ul> Data Privacy & Security: <ul style="list-style-type: none"> <li>• HIPAA (conceptual), Indian Health Data Policies</li> </ul> Explainable AI (XAI) in Healthcare<br>Regulatory Challenges<br>Future Trends: <ul style="list-style-type: none"> <li>• AI in Personalized Medicine</li> <li>• Robotics in Surgery</li> <li>• AI-driven Drug Discovery</li> </ul>                                                                                                   |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |
| 1) Artificial Intelligence in Healthcare – Adam Bohr and Kaveh Memarzadeh, Academic Press<br>2) Deep Learning for Healthcare – Kevin Johnson, Elsevier<br>3) Machine Learning for Healthcare – Andreas Holzinger (Ed.), Springer                                                                                                                                                                                                                                                                                                                                                  |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |
| Introduction to Machine Learning – Ethem Alpaydin, MIT Press<br>Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press<br>Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer<br>Healthcare Data Analytics – Chandan K. Reddy and Charu C. Aggarwal, CRC Press<br>Artificial Intelligence: A Modern Approach – Stuart Russell and Peter Norvig, Pearson<br>Biomedical Informatics – Edward H. Shortliffe and James J. Cimino, Springer<br>Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron, O'Reilly |                  |
| <b>Sample List of Laboratory Exercises (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |
| Data preprocessing on healthcare datasets<br>Disease prediction using Logistic Regression / Decision Tree<br>Patient clustering using K-Means<br>Medical image classification using CNN (basic implementation)<br>NLP on clinical text (NER or keyword extraction)<br>Build a simple healthcare chatbot<br>Predictive model using time-series patient data<br>Mini-project development                                                                                                                                                                                            |                  |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |

The following are sample Project Based Learning (PBL) suggestions provided for reference. Students may opt for any one project of their choice based on their interest and aligned with the concepts, tools, and technologies covered in the subject curriculum.

- AI-based Disease Prediction System
- Smart Patient Monitoring System (IoT + AI)
- Healthcare Chatbot
- Medical Image Diagnosis Tool
- Mental Health Prediction App

**Syllabus for Unit Tests (if applicable)**

|              |                                 |
|--------------|---------------------------------|
| Unit Test -1 | Unit – I, Unit – II, Unit - III |
| Unit Test -2 | Unit – IV, Unit – V, Unit – VI  |



| Professional Elective II: Naturopathy and Yogic Science                                                                                                                                                                                                                                            |             |                          |           |               |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                    |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                           | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                         | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                    |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                    |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                              | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| <ul style="list-style-type: none"> <li>To introduce students to principles of naturopathy and yogic science.</li> <li>To promote holistic health, stress management, and lifestyle awareness.</li> <li>To develop practical skills in yoga, meditation, and natural healing techniques.</li> </ul> |             |                          |           |               |                  |
| <b>Prerequisite,</b>                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| No prerequisite                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO1: Explain the fundamental concepts and principles of naturopathy and yoga                                                                                                                                                                                                                       |             |                          |           |               |                  |
| CO2: Describe the human body's natural healing mechanisms and health concepts                                                                                                                                                                                                                      |             |                          |           |               |                  |
| CO3: Apply principles of diet and natural therapies for maintaining health                                                                                                                                                                                                                         |             |                          |           |               |                  |
| CO4: Demonstrate various yogic practices including asanas and pranayama                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO5: Analyze the role of yoga in stress management and mental well-being                                                                                                                                                                                                                           |             |                          |           |               |                  |
| CO6: Evaluate and adopt yogic lifestyle practices for preventive healthcare                                                                                                                                                                                                                        |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Unit I : Introduction to Naturopathy and Yoga</b>                                                                                                                                                                                                                                               |             |                          |           |               | <b>(6 Hours)</b> |
| Definition, history, and philosophy of naturopathy<br>Principles of naturopathy (Five elements theory)<br>Basics of yoga: meaning, origin, and types<br>Eight limbs of Yoga (Ashtanga Yoga)<br>Relevance of naturopathy and yoga in modern life                                                    |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Unit II : Human Body and Natural Healing</b>                                                                                                                                                                                                                                                    |             |                          |           |               | <b>(6 Hours)</b> |
| Structure and functions of human body (basic overview)<br>Concept of health and disease in naturopathy<br>Body's self-healing mechanisms<br>Role of diet, sleep, and lifestyle<br>Introduction to Panchamahabhutas and Tridosha concept Handling<br>Imbalanced Medical Data                        |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| <b>Unit III : Diet, Nutrition and Natural Therapies</b>                                                                                                                                                                                                                                            |             |                          |           |               | <b>(6 Hours)</b> |
| Principles of naturopathic diet (satvik, rajasic, tamasic)<br>Balanced diet and nutrition basics<br>Fasting therapy: types and benefits<br>Hydrotherapy, mud therapy, and sun therapy<br>Detoxification techniques                                                                                 |             |                          |           |               |                  |

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| <b>Unit IV : Yogic Practices</b>                                                                                                                                                                                                                                                                                                         | <b>(6 Hours)</b> |
| Asanas: types and benefits (standing, sitting, supine)<br>Pranayama techniques (Anulom Vilom, Kapalbhati, Bhastrika)<br>Meditation techniques and relaxation methods<br>Surya Namaskar: steps and benefits<br>Yoga for physical fitness and flexibility                                                                                  |                  |
| <b>Unit V : Stress Management and Mental Health</b>                                                                                                                                                                                                                                                                                      | <b>(6 Hours)</b> |
| Causes and effects of stress in modern life<br>Yogic approach to stress management<br>Mindfulness and meditation practices<br>Emotional balance through yoga<br>Yoga for improving concentration and productivity                                                                                                                        |                  |
| <b>Unit VI : Lifestyle Management and Preventive Healthcare</b>                                                                                                                                                                                                                                                                          | <b>(6 Hours)</b> |
| Yogic lifestyle (Dinacharya and Ritucharya concepts)<br>Prevention of lifestyle diseases (diabetes, hypertension, obesity)<br>Workplace wellness and ergonomics<br>Role of yoga in IT professionals' life <ul style="list-style-type: none"> <li>Integration of naturopathy in daily routine</li> </ul>                                  |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                         |                  |
| 1) "Nature Cure for Common Diseases" – Dr. H.K. Bakhru<br>2) "Light on Yoga" – B.K.S. Iyengar<br>3) "The Complete Book of Yoga" – Swami Vivekananda (compiled works)                                                                                                                                                                     |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                   |                  |
| "Yoga and Naturopathy" – Ministry of AYUSH, Government of India<br>"Pranayama" – Swami Kuvalayananda<br>"Asana Pranayama Mudra Bandha" – Swami Satyananda Saraswati<br>"Integral Yoga" – Sri Aurobindo<br>"The Science of Yoga" – Ann Swanson                                                                                            |                  |
| <b>ASSIGNMENTS / CONTINUOUS ASSESSMENT</b><br><b>(if applicable)</b>                                                                                                                                                                                                                                                                     |                  |
| 1. Yoga Practice Diary (Weekly Logbook)<br>2. Diet Plan Preparation for Healthy Lifestyle<br>3. Case Study on Stress Management using Yoga<br>4. Presentation on Natural Therapy (Hydro/Mud/Sun Therapy)<br>5. Self-Assessment Report (Before & After Yoga Practice)<br>6. Mini Project: Design a "Healthy Routine for IT Professionals" |                  |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                            |                  |

The following are sample Project Based Learning (PBL) suggestions provided for reference. Students may opt for any one project of their choice based on their interest and aligned with the concepts, tools, and technologies covered in the subject curriculum.

- Posture Detection using AI
- Stress Detection using Wearables
- Yoga Recommendation Chatbot
- Smart Yoga Assistant App
- Smart Yoga Mat (IoT)

**Syllabus for Unit Tests (if applicable)**

|              |                                 |
|--------------|---------------------------------|
| Unit Test -1 | Unit – I, Unit – II, Unit - III |
| Unit Test -2 | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective III: Storage Area Network                                                                                                                                                                                                                                                          |             |                          |           |               |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                          |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                 | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                               | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                          |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                          |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                    | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| 1) To understand storage architectures and storage networking technologies used in enterprise data centers.<br>2) To study SAN design, management, data protection, and business continuity concepts for reliable storage systems.                                                                       |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                     |             |                          |           |               |                  |
| Students should have knowledge of                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| 1) Computer Networks fundamentals                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| 2) Operating Systems fundamentals                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                  |             |                          |           |               |                  |
| CO1: Analyze enterprise storage fundamentals, performance, and data lifecycle.                                                                                                                                                                                                                           |             |                          |           |               |                  |
| CO2: Understand Direct Attached Storage architecture and host interaction.                                                                                                                                                                                                                               |             |                          |           |               |                  |
| CO3: Evaluate RAID and storage virtualization techniques.                                                                                                                                                                                                                                                |             |                          |           |               |                  |
| CO4: Analyze SAN and Fibre Channel architectures.                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| CO5: Compare IP storage and NAS solutions.                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| CO6: Apply business continuity and disaster recovery concepts.                                                                                                                                                                                                                                           |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Unit I : Storage Fundamentals</b>                                                                                                                                                                                                                                                                     |             |                          |           |               | <b>(6 Hours)</b> |
| Data and importance of storage in business, evolution of storage technology, data center infrastructure, storage system environment, storage terminology and performance measures, disk drive components, disk performance basics, information lifecycle, challenges in managing enterprise information. |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Unit II : Direct Attached Storage</b>                                                                                                                                                                                                                                                                 |             |                          |           |               | <b>(6 Hours)</b> |
| Intelligent storage system, intelligent storage array, storage array components, direct attached storage concepts, DAS types, benefits and limitations, disk interfaces overview, SCSI basics, SCSI command model, host components and logical components of host environment.                           |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Unit III : RAID and Virtualization</b>                                                                                                                                                                                                                                                                |             |                          |           |               | <b>(6 Hours)</b> |
| Need of RAID, RAID array components, RAID implementation concepts, RAID levels and comparison, RAID impact on performance, hot spares, storage virtualization basics, virtualization in I/O path, block level virtualization, file level virtualization, symmetric and asymmetric virtualization.        |             |                          |           |               |                  |

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| <b>Unit IV : SAN and Fibre Channel</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(6 Hours)</b>                |
| SAN evolution, SAN components, SAN architecture, SAN fabric, Fibre Channel protocol stack overview, FC ports and addressing, FC topologies,                                                                                                                                                                                                                                                                                                                                |                                 |
| point-to-point, arbitrated loop, switched fabric, Fibre Channel switches and directors, zoning, LUN masking, SAN performance basics.                                                                                                                                                                                                                                                                                                                                       |                                 |
| <b>Unit V : IP Storage</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>(6 Hours)</b>                |
| iSCSI fundamentals, initiator and target, iSCSI protocol working, iSCSI discovery and session, IP SAN, FCIP and iFCP overview, NAS fundamentals, file systems and file servers, NFS and SMB concepts, NAS performance factors, comparison of NAS, FC SAN and iSCSI SAN, backup and restore basics, backup topology, replication basics.                                                                                                                                    |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |
| <b>Unit VI : Business Continuity and Case Studies</b>                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>(6 Hours)</b>                |
| Information availability, planned and unplanned outages, impact of downtime, BC and DR concepts, RTO and RPO, failure analysis and single points of failure, monitoring in data centers, SAN security basics, storage security domains, CAS fundamentals, enterprise SAN design considerations, real-world case studies.                                                                                                                                                   |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
| 1. G. Somasundaram, <i>Information Storage and Management</i> , Wiley                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |
| 2. Ulf Troppens, Rainer Erkens, Wolfgang Müller, <i>Storage Networks Explained</i> , Wiley                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
| 3. Robert Spalding, <i>Storage Area Networks: Designing and Implementing a Mass Storage System</i> , Addison-Wesley                                                                                                                                                                                                                                                                                                                                                        |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                 |
| 1. W. Curtis Preston, <i>Backup &amp; Recovery</i> , O'Reilly Media                                                                                                                                                                                                                                                                                                                                                                                                        |                                 |
| 2. Chris Poelker, <i>Storage Area Networks For Dummies</i> , Wiley                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |
| 3. S. Kembel, <i>The Fibre Channel Consultant</i> , Addison-Wesley                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                              |                                 |
| Students must work in groups of 2–3 and select a SAN-based mini project (given or approved topic), define the problem and objectives, design the architecture with diagrams, implement using tools or simulation, and include at least three syllabus concepts like RAID, Fibre Channel, iSCSI, NAS, zoning, LUN masking, backup, replication, BC/DR, monitoring, or security, then submit a report with results and demonstrate the project with a presentation and viva. |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                             |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective-III :Internet of Things                                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                                                                             |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                                                                                    | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                                                                                                  | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                             |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                             |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                                                                                                                       | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |                  |
| Students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                          |           |               |                  |
| <ol style="list-style-type: none"> <li>1. Understand end-to-end IoT system architecture.</li> <li>2. Analyze communication protocols and middleware for IoT.</li> <li>3. Design scalable IoT-cloud-edge architectures.</li> <li>4. Evaluate IoT security, privacy, and governance challenges.</li> <li>5. Integrate AI/ML with IoT for intelligent automation.</li> <li>6. Understand industrial IoT (IIoT) and emerging trends.</li> </ol> |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| Students should have knowledge of                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| <ol style="list-style-type: none"> <li>1) Microprocessors-Microcontrollers</li> <li>2) Computer Architecture</li> <li>3) Computer Communications and Network</li> <li>4) Cloud and Distributed Computing</li> </ol>                                                                                                                                                                                                                         |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                                                                                                     |             |                          |           |               |                  |
| CO1: Analyze IoT system architecture and design models                                                                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| CO2: Select appropriate communication protocols                                                                                                                                                                                                                                                                                                                                                                                             |             |                          |           |               |                  |
| CO3: Design edge-cloud integrated IoT solutions                                                                                                                                                                                                                                                                                                                                                                                             |             |                          |           |               |                  |
| CO4: Apply AI/ML techniques to IoT data                                                                                                                                                                                                                                                                                                                                                                                                     |             |                          |           |               |                  |
| CO5: Evaluate and design secure IoT systems                                                                                                                                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| CO6: Analyze industrial IoT systems and emerging technologies                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| <b>Unit I : IoT Architecture and Design Principles</b>                                                                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                          |           |               | <b>(6 Hours)</b> |
| Evolution of IoT: From Embedded Systems to Cyber-Physical Systems                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| IoT Ecosystem and Stakeholders                                                                                                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| IoT Reference Models (3-layer, 5-layer, IoT-A, Cisco Model) Functional Blocks of IoT                                                                                                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| IoT Design Methodology                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| Characteristics of IoT Systems: Scalability, Reliability, Latency, Power Efficiency                                                                                                                                                                                                                                                                                                                                                         |             |                          |           |               |                  |
| Comparison: IoT vs M2M vs CPS                                                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| IoT Standardization Bodies (IEEE, IETF, ITU-T, OneM2M)                                                                                                                                                                                                                                                                                                                                                                                      |             |                          |           |               |                  |
| <b>Unit II : IoT Communication Technologies and Protocol Stack</b>                                                                                                                                                                                                                                                                                                                                                                          |             |                          |           |               | <b>(7 Hours)</b> |

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| <b>Physical &amp; Network Layer</b> <ul style="list-style-type: none"> <li>• RFID, NFC</li> <li>• BLE, Zigbee, Z-Wave</li> <li>• Wi-Fi 6/6E</li> <li>• LoRaWAN, Sigfox</li> </ul>                                                                                                                                                                                                                                |                  |
| <ul style="list-style-type: none"> <li>• NB-IoT, LTE-M, 5G for IoT</li> <li>• IPv6 and 6LoWPAN</li> </ul> <b>Transport &amp; Application Layer</b> <ul style="list-style-type: none"> <li>• MQTT (architecture, QoS levels)</li> <li>• CoAP</li> <li>• AMQP</li> <li>• HTTP/REST in IoT</li> <li>• DDS</li> <li>• Comparison of protocols (latency, power, bandwidth)</li> </ul> <b>IoT Gateway Architecture</b> |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |
| <b>Unit III : Edge Computing, Fog Computing and IoT Middleware</b>                                                                                                                                                                                                                                                                                                                                               | <b>(6 Hours)</b> |
| Limitations of Cloud-only IoT<br>Edge Computing Architecture<br>Fog Computing Model (Cisco Model) Edge<br>AI Concepts<br>IoT Middleware Platforms<br>Containerization in IoT (Docker for edge devices)<br>Microservices Architecture for IoT<br>Real-time data streaming (Kafka basics)                                                                                                                          |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |
| <b>Unit IV : IoT Data Analytics and AI Integration</b>                                                                                                                                                                                                                                                                                                                                                           | <b>(6 Hours)</b> |
| IoT Data Characteristics (Volume, Velocity, Variety) Stream<br>Processing vs Batch Processing<br>Time-series databases<br>Data Preprocessing for IoT<br>AI/ML in IoT<br>TinyML Concepts Edge<br>AI vs Cloud AI<br>Predictive<br>Maintenance<br>Smart Decision Systems<br>Case Study: Smart Healthcare / Smart Agriculture / Smart Manufacturing                                                                  |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |
| <b>Unit V : IoT Security, Privacy and Trust Management</b>                                                                                                                                                                                                                                                                                                                                                       | <b>(6 Hours)</b> |

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| Security Challenges in IoT<br>Attack Surfaces in IoT Systems<br>Device-level security<br>Secure Boot and Firmware<br>Protection Cryptographic Protocols<br>in IoT<br>Authentication and Authorization (OAuth, JWT) Blockchain<br>for IoT (Conceptual)<br>Privacy Issues and Data Protection<br>Regulatory Frameworks (GDPR, Indian DPDP Act – Overview)<br>Secure IoT Architecture Design |                  |
|                                                                                                                                                                                                                                                                                                                                                                                           |                  |
| <b>Unit VI : Industrial IoT (IIoT), Smart Systems and Emerging Trends</b>                                                                                                                                                                                                                                                                                                                 | <b>(5 Hours)</b> |
| Industrial IoT (IIoT) Architecture<br>SCADA and IoT Integration<br>Digital Twin Concept                                                                                                                                                                                                                                                                                                   |                  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Smart Cities, Smart Grid, Autonomous Systems, Industry 4.0, Robotics + IoT,<br>Sustainable IoT & Green Computing<br>Future Trends: 6G IoT, Quantum IoT (Conceptual), AIoT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |
| 1. Arshdeep Bahga & Vijay Madisetti – Internet of Things: A Hands-On Approach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| 2. Raj Kamal – Internet of Things: Architecture and Design Principles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
| 3. Olivier Hersent – The Internet of Things                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                 |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                 |
| 1. Samuel Greengard – The Internet of Things                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                 |
| 2. Perry Lea – Internet of Things for Architects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |
| 3. McEwen & Cassimally – Designing the Internet of Things                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 |
| 4. Research papers from IEEE IoT Journal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| 1. Design an IoT system to monitor and optimize electricity usage across college buildings.<br>2. Design an IoT + AI system for real-time parking detection and slot allocation<br>3. Design a water leakage detection and usage optimization system<br>4. Design an IIoT system to detect machine failure using vibration sensors.<br>5. Design an IoT-based real-time production monitoring system<br>6. Design a temperature monitoring IoT system with alert mechanisms<br>7. Use IoT sensors + ML model for traffic prediction<br>8. Design wearable IoT system for heart-rate, SpO2 monitoring.<br>9. Design soil-moisture-based automated irrigation system<br>10. Design a complete secure IoT home system<br>11. Study Mirai botnet and propose a secure architecture. |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Unit – I, Unit – II, Unit - III |



|              |                                |
|--------------|--------------------------------|
| Unit Test -2 | Unit – IV, Unit – V, Unit – VI |
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| Professional Elective Course - III<br>Web Services                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                          |           |               |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               |                  |
| <ol style="list-style-type: none"> <li>1. To Understand Web Services and implementation model for SOA</li> <li>2. To Understand the SOA, its Principles and Benefits</li> <li>3. To Understand XML concepts</li> <li>4. To Understand paradigms needed for testing Web Services</li> <li>5. To explore different Test Strategies for SOA-based applications</li> <li>6. To explore modern Web Service technologies including RESTful services, Microservices architecture, security, and cloud deployment concepts.</li> </ol> |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |                  |
| Students should have knowledge of <ul style="list-style-type: none"> <li>• Basic knowledge of Programming (Java / Python / C++).</li> <li>• Understanding of Object-Oriented Programming concepts.</li> <li>• Fundamentals of Computer Networks and Internet concepts (HTTP, TCP/IP).</li> <li>• Basic knowledge of XML and JSON.</li> <li>• Familiarity with Database concepts and SQL.</li> </ul>                                                                                                                            |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                          |           |               |                  |
| CO1: Understand the principles of SOA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| CO2: Efficiently use market leading environment tools to create and consume web services                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                          |           |               |                  |
| CO3: Identify and select the appropriate framework components in creation of webservice solution                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |                  |
| CO4: Apply OOP principles to creation of webservice solutions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                          |           |               |                  |
| CO5: Explain and apply service registration and discovery mechanisms using UDDI architecture and related standards.                                                                                                                                                                                                                                                                                                                                                                                                            |             |                          |           |               |                  |
| CO6: Design and evaluate modern Web Services using RESTful architecture, Microservices principles, and implement appropriate security mechanisms.                                                                                                                                                                                                                                                                                                                                                                              |             |                          |           |               |                  |
| <b>Unit I : introduction to Web Services</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                          |           |               | <b>(6 Hours)</b> |
| Evolution and Emergence of Web Services : Evolution of distributed computing. Core distributed computing technologies – client/server, CORBA, JAVA RMI, Micro Soft DCOM, MOM, Challenges in Distributed Computing, Introduction to Web Services : The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services.                                                                                                        |             |                          |           |               |                  |

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| <b>Unit II : Web Service Architecture</b>                                                                                                                                                                                                                                                                                                                                                                                                    | <b>(6 Hours)</b> |
| Web Service Architecture: Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication, basic steps of implementing web services.                                                                                                                                                                                 |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
| <b>Unit III : Overview of XML</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>(6 Hours)</b> |
| Brief Over View of XML : XML Document structure, XML namespaces, Defining structure in XML documents, Reuse of XML schemes, Document navigation and transformation. SOAP : Simple Object Access Protocol, Inter- application communication and wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAP envelope, Encoding, Service Oriented Architectures, SOA revisited, Service roles in a SOA, Reliable messaging |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
| <b>Unit IV : Describing Web Services</b>                                                                                                                                                                                                                                                                                                                                                                                                     | <b>(6 Hours)</b> |
| Describing Web Services : WSDL introduction, non functional service description, WSDL1.1 Vs WSDL 2.0, WSDL document, WSDL elements, WSDL binding, WSDL tools, WSDL port type, limitations of WSDL.                                                                                                                                                                                                                                           |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
| <b>Unit V : Registering and Discovering Services</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>(6 Hours)</b> |
| Registering and Discovering Services : The role of service registries, Service discovery, Universal Description, Discovery, and Integration, UDDI Architecture, UDDI Data Model, Interfaces, UDDI Implementation                                                                                                                                                                                                                             |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
| <b>Unit VI : Modern Web Services and Microservices</b>                                                                                                                                                                                                                                                                                                                                                                                       | <b>(6 Hours)</b> |
| Modern Web Services : REST architecture, HTTP methods, REST vs SOAP, JSON/XML, Designing REST APIs. Microservices Architecture : Monolithic vs Microservices, API Gateway, Inter-service communication, Service discovery.\                                                                                                                                                                                                                  |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                              |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |
| 1. Web Services & SOA Principles and Technology, Second Edition, Michael P. Papazoglou.                                                                                                                                                                                                                                                                                                                                                      |                  |
| 2. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India.                                                                                                                                                                                                                                                                                                                                                     |                  |
| 3. Developing Enterprise Web Services, S. Chatterjee, J. Webber, Pearson Education                                                                                                                                                                                                                                                                                                                                                           |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |
| 1. XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.                                                                                                                                                                                                                                                                                                                                                                 |                  |
| 2. Building web Services with Java, 2nd Edition, S. Graham and others, Pearson Education.                                                                                                                                                                                                                                                                                                                                                    |                  |

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| 3. Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |
| 4. McGovern, et al., "Java web Services Architecture", Morgan Kaufmann Publishers, 2005.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |
| <b>Project Based Learning</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
| <ol style="list-style-type: none"> <li>1. Create a well-formed XML document and validate it using DTD/XSD.</li> <li>2. Perform XML transformation using XSLT and convert XML data into HTML format.</li> <li>3. Develop a simple SOAP-based Web Service (e.g., Calculator Service) and test it using a SOAP client.</li> <li>4. Generate and analyze a WSDL document for a given Web Service and identify its major elements.</li> <li>5. Demonstrate Service Registration and Discovery concepts using UDDI architecture (theoretical/tool-based).</li> <li>6. Develop a RESTful Web Service implementing CRUD operations using JSON.</li> <li>7. Test REST APIs using Postman and demonstrate HTTP methods (GET, POST, PUT, DELETE).</li> <li>8. Implement authentication and authorization in REST APIs using JWT or OAuth 2.0 concepts.</li> <li>9. Design and implement a basic Microservices application with two interacting services.</li> <li>10. Document REST APIs using Swagger/OpenAPI and deploy the application in a cloud or local environment.</li> <li>11.</li> </ol> |                                 |
| <b>Syllabus for Unit Tests</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Unit – IV, Unit – V, Unit – VI  |

| Professional Elective-III:<br>Renewable Energy in Agriculture                                                                                                                                                                            |             |                          |           |               |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                                                                                                                                                                          |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                                                                                                                                                                 | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                                                                                                                                                                               | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                                                                                                                                                                          |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                                                                                                                                                                          |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                                                                                                                                                                    | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                 |             |                          |           |               |                  |
| 1) To introduce renewable energy technologies applicable in agriculture<br>2) To integrate IT concepts with sustainable agricultural practices<br>3) To develop practical skills in designing smart energy-based farming solutions       |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                     |             |                          |           |               |                  |
| Students should have knowledge of<br>1) Software Engineering<br>2) Basic Mathematics with Probability and Statistics                                                                                                                     |             |                          |           |               |                  |
|                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                  |             |                          |           |               |                  |
| CO1: Explain energy requirements and renewable sources in agriculture                                                                                                                                                                    |             |                          |           |               |                  |
| CO2: Apply solar energy systems for agricultural applications                                                                                                                                                                            |             |                          |           |               |                  |
| CO3: Analyze wind and hydro energy feasibility for farming                                                                                                                                                                               |             |                          |           |               |                  |
| CO4: Evaluate biomass and bioenergy solutions for sustainability                                                                                                                                                                         |             |                          |           |               |                  |
| CO5: Design IoT-based smart renewable energy systems in agriculture                                                                                                                                                                      |             |                          |           |               |                  |
| CO6: Assess economic and environmental impact of renewable technologies                                                                                                                                                                  |             |                          |           |               |                  |
|                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Unit I : Introduction to Energy &amp; Agriculture:</b>                                                                                                                                                                                |             |                          |           |               | <b>(6 Hours)</b> |
| Energy demand in agriculture sector<br>Conventional vs Renewable energy<br>Environmental impact & sustainability<br>Overview of renewable energy sources (solar, wind, biomass, hydro)<br>Energy policies in agriculture (India context) |             |                          |           |               |                  |
|                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Unit II : Solar Energy Applications in Agriculture:</b>                                                                                                                                                                               |             |                          |           |               | <b>(6 Hours)</b> |
| Basics of solar radiation & photovoltaic systems<br>Solar panels: types, efficiency, installation basics<br>Solar water pumping systems<br>Solar dryers, greenhouse heating<br>Case studies of solar farming                             |             |                          |           |               |                  |
|                                                                                                                                                                                                                                          |             |                          |           |               |                  |
| <b>Unit III : Wind &amp; Micro-Hydro Energy Systems:</b>                                                                                                                                                                                 |             |                          |           |               | <b>(6 Hours)</b> |
| Wind energy fundamentals<br>Small wind turbines for farms                                                                                                                                                                                |             |                          |           |               |                  |

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| Micro-hydro systems for irrigation<br>Hybrid systems (solar + wind)<br>Feasibility analysis                                                                                                                                                                                         |                  |
| <b>Unit IV : Biomass &amp; Bioenergy:</b>                                                                                                                                                                                                                                           | <b>(6 Hours)</b> |
| Types of biomass (agricultural waste, animal waste)<br>Biogas technology & design<br>Biofuels (biodiesel, ethanol)<br>Waste-to-energy systems<br>Environmental and economic benefits                                                                                                |                  |
| <b>Unit V : IoT &amp; Smart Energy Systems in Agriculture:</b>                                                                                                                                                                                                                      | <b>(6 Hours)</b> |
| Introduction to IoT in agriculture<br>Smart irrigation using renewable energy<br>Sensors, controllers, and automation<br>Energy monitoring systems<br>Integration of AI/ML for energy optimization                                                                                  |                  |
| <b>Unit VI : Energy Management, Economics &amp; Sustainability:</b>                                                                                                                                                                                                                 | <b>(6 Hours)</b> |
| Energy auditing in agriculture<br>Cost-benefit analysis of renewable systems<br>Government schemes & subsidies<br>Sustainable farming models<br>Future trends (AI, Smart Grids, Precision Farming)                                                                                  |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                    |                  |
| 1) "Renewable Energy Technologies" – Chetan Singh Solanki                                                                                                                                                                                                                           |                  |
| 2) "Non-Conventional Energy Sources" – G.D. Rai                                                                                                                                                                                                                                     |                  |
| 3) "Solar Energy: Principles of Thermal Collection and Storage" – Sukhatme                                                                                                                                                                                                          |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                              |                  |
| 1) "Renewable Energy Resources" – John Twidell & Tony Weir                                                                                                                                                                                                                          |                  |
| 2) "Bioenergy: Principles and Applications" – Anju Dahiya                                                                                                                                                                                                                           |                  |
| <b>List of Laboratory Exercises</b>                                                                                                                                                                                                                                                 |                  |
| 1. Study of solar panel characteristics<br>2. Design of solar-powered irrigation system (simulation)<br>3. IoT-based smart irrigation prototype<br>4. Biogas plant model demonstration<br>5. Energy consumption monitoring using sensors<br>6. Case study analysis using data tools |                  |
| 6. Conduct Risk analysis for system under development                                                                                                                                                                                                                               |                  |

| <b>Sample Project Based Learning (if applicable) Topics</b>                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <p>Students have to implement the software project of any one of the following topics:</p> <ol style="list-style-type: none"> <li>1. Smart Solar Irrigation System with Mobile App</li> <li>2. AI-based Energy Optimization for Farms</li> <li>3. IoT-enabled Biogas Monitoring System</li> <li>4. Hybrid Renewable Energy Model for Smart Farm</li> <li>5. Precision Farming using Renewable Energy</li> <li>6. Solar-powered Cold Storage System</li> </ol> |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Unit – IV, Unit – V, Unit – VI  |

| <b>Professional Elective-III: Project Planning and Management</b>                                                                                                                                                                                                                                                                                            |             |                           |           |                      |                  |
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| <b>TEACHING SCHEME</b>                                                                                                                                                                                                                                                                                                                                       |             | <b>EXAMINATION SCHEME</b> |           | <b>CREDIT SCHEME</b> |                  |
| Lecture:                                                                                                                                                                                                                                                                                                                                                     | 03 Hrs/Week | End Semester Examination  | 60 Marks  | Lecture              | 03               |
| Practical:                                                                                                                                                                                                                                                                                                                                                   | 02 Hrs/Week | Internal Assessment       | 40 Marks  |                      |                  |
|                                                                                                                                                                                                                                                                                                                                                              |             | Term Work                 | 25 Marks  | Practical            | 01               |
|                                                                                                                                                                                                                                                                                                                                                              |             | Oral                      | 25 Marks  |                      |                  |
| Total                                                                                                                                                                                                                                                                                                                                                        | 05 Hrs/Week | Total                     | 150 Marks | Total                | 04               |
| <b>Course Objective:</b>                                                                                                                                                                                                                                                                                                                                     |             |                           |           |                      |                  |
| 1) Define and highlight importance of software project management.                                                                                                                                                                                                                                                                                           |             |                           |           |                      |                  |
| 2) To make them understand the concepts of Project Management for planning to execution of projects.                                                                                                                                                                                                                                                         |             |                           |           |                      |                  |
| <b>Prerequisite:</b>                                                                                                                                                                                                                                                                                                                                         |             |                           |           |                      |                  |
| Students should have knowledge of                                                                                                                                                                                                                                                                                                                            |             |                           |           |                      |                  |
| 1) Software Engineering                                                                                                                                                                                                                                                                                                                                      |             |                           |           |                      |                  |
| 2) Basic Mathematics with Probability and Statistics                                                                                                                                                                                                                                                                                                         |             |                           |           |                      |                  |
|                                                                                                                                                                                                                                                                                                                                                              |             |                           |           |                      |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to:                                                                                                                                                                                                                                                                      |             |                           |           |                      |                  |
| CO1: To understand the basic concepts, terminologies and issues of software project management.                                                                                                                                                                                                                                                              |             |                           |           |                      |                  |
| CO2: To understand the use of project planning tools.                                                                                                                                                                                                                                                                                                        |             |                           |           |                      |                  |
| CO3: To understand the project life cycle.                                                                                                                                                                                                                                                                                                                   |             |                           |           |                      |                  |
| CO4: To understand the project management in testing phase.                                                                                                                                                                                                                                                                                                  |             |                           |           |                      |                  |
| CO5: To understand the project management in testing phase.                                                                                                                                                                                                                                                                                                  |             |                           |           |                      |                  |
| CO6: To understand advanced project management techniques.                                                                                                                                                                                                                                                                                                   |             |                           |           |                      |                  |
|                                                                                                                                                                                                                                                                                                                                                              |             |                           |           |                      |                  |
| <b>Unit I : Introduction to Project Management:</b>                                                                                                                                                                                                                                                                                                          |             |                           |           |                      | <b>(6 Hours)</b> |
| Importance of Software Project Management, Activities Methodologies, Categorization of Software Projects, Setting objectives, Management Principles, Management Control, Project portfolio Management, Cost-benefit Evaluation Technology, Risk evaluation, Strategic Program Management, Project progress and performance Customer acceptance               |             |                           |           |                      |                  |
|                                                                                                                                                                                                                                                                                                                                                              |             |                           |           |                      |                  |
| <b>Unit II : Project Planning:</b>                                                                                                                                                                                                                                                                                                                           |             |                           |           |                      | <b>(6 Hours)</b> |
| Project Planning: Objectives of Project Planning, Project Schedules, Activities, Sequencing and Scheduling, Network Planning Models, Forward Pass & backward Pass Techniques, Critical Path Method, Risk Identification, Assessment, Monitoring, PERT Technique, Monte Carlo Simulation, Resource Allocation, Creation of Critical Patterns, Cost schedules. |             |                           |           |                      |                  |
|                                                                                                                                                                                                                                                                                                                                                              |             |                           |           |                      |                  |
| <b>Unit III : Project Life Cycle and Effort Estimation:</b>                                                                                                                                                                                                                                                                                                  |             |                           |           |                      | <b>(6 Hours)</b> |



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| Software Process and Process Models, Choice of Process Models, Mental Delivery, Rapid Application Development, Agile Methods, Extreme Programming, Managing Interactive Processes, Basics of Software Estimation,                                                                                                                                                                                                                                                                                                                     |                  |
| Effort and Cost estimation techniques, COCOMO II, DevOps lifecycle for business Agility, DevOps and continuous testing, DevOps influence on architecture, CI/CD concepts and Continuous Testing                                                                                                                                                                                                                                                                                                                                       |                  |
| <b>Unit IV : Project Management Techniques:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>(6 Hours)</b> |
| Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS), Stakeholder Management - Agile estimation techniques such as Story Points, Planning Poker, and Velocity, Change Management and Configuration Management Planning                                            |                  |
| <b>Unit V : Project management in the testing phase:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>(6 Hours)</b> |
| Introduction, What is testing?, what are the activities that makeup testing?, test scheduling and types of tests, people issues in testing, management, structures for testing in global teams, metrics for testing phase. Project management in the Maintenance Phase: Introduction, Activities during Maintenance Phase, management issues during Maintenance Phase, Configuration management during Maintenance Phase, estimating size, effort, and people resources for the maintenance phase, metrics for the maintenance phase. |                  |
| <b>Unit VI : Advanced Project Management and Closure:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>(6 Hours)</b> |
| Reducing Project duration -crashing project activities to speed up a project; Project Risk Management, Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lesson learned analysis; acknowledging successes and failures; Project management templates and other resources; Case study-based learning and industry simulation exercises                                                         |                  |
| <b>Textbooks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| 1. Prasanna Chandra; Projects- Planning, Analysis, Selection, Financing, Implementation and Review', VI Edition, Tata Mc Graw Hill, 8th Edition 2015.                                                                                                                                                                                                                                                                                                                                                                                 |                  |
| 2. Ramesh Gopaldaswamy: "Managing Global Projects ", Tata McGraw Hill, 2013.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |
| 3. Pankaj Jalote, "Software Project Management in practice", Pearson Education, New Delhi, 2002                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |
| <b>Reference Books</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |
| 1. Jack T. Marchewka, Information Technology Project Management, 4th edition Wiley India, 2009                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |

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| 2. John M. Nicholas, Project Management for Business and Technology, 3rd edition<br>Pearson Education                                                                                                                                                                        |                                 |
| <b>List of Laboratory Exercises</b>                                                                                                                                                                                                                                          |                                 |
| 7. Study of project management techniques and tools.<br>8. Construction of project plan using Gantt Chart.<br>9. Explore the various Agile Models.<br>10. Create SRS of a Online Library Management System .<br>11. Prepare a project plan of a system using applicable tool |                                 |
| 6. Conduct Risk analysis for system under development                                                                                                                                                                                                                        |                                 |
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                |                                 |
| Students have to implement the software project of any one of the following topics:<br>7. Banking, Financial services and Insurance (BFSI)<br>8. Retail & eCommerce<br>9. Personal Services<br>10. Human Resource<br>11. Entertainment<br>12. Healthcare                     |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                               |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                 | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                                                                                                 | Unit – IV, Unit – V, Unit – VI  |



| Professional Elective-III: Bhagwad<br>Gita and Modern Education                         |             |                          |           |               |                  |
|-----------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|------------------|
| TEACHING SCHEME                                                                         |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |                  |
| Lecture:                                                                                | 03 Hrs/Week | End Semester Examination | 60 Marks  | Lecture       | 03               |
| Practical:                                                                              | 02 Hrs/Week | Internal Assessment      | 40 Marks  |               |                  |
|                                                                                         |             | Term Work                | 25 Marks  | Practical     | 01               |
|                                                                                         |             | Oral                     | 25 Marks  |               |                  |
| Total                                                                                   | 05 Hrs/Week | Total                    | 150 Marks | Total         | 04               |
| <b>Course Objective:</b>                                                                |             |                          |           |               |                  |
| 1) To understand the philosophical foundations of the Bhagavad Gita                     |             |                          |           |               |                  |
| 2) To relate Gita's teachings with modern education, leadership, and life skills        |             |                          |           |               |                  |
| 3) To develop ethical thinking, emotional balance, and decision-making abilities        |             |                          |           |               |                  |
| <b>Prerequisite:</b>                                                                    |             |                          |           |               |                  |
| No prerequisite                                                                         |             |                          |           |               |                  |
| <b>Course Outcomes:</b> On completion of the course, students will have the ability to: |             |                          |           |               |                  |
| CO1: Explain key concepts of Bhagwad Geeta and their relevance to education             |             |                          |           |               |                  |
| CO2: Apply principles of emotional intelligence and self-management                     |             |                          |           |               |                  |
| CO3: Analyze ethical dilemmas using Karma Yoga principles                               |             |                          |           |               |                  |
| CO4: Evaluate leadership styles based on Gita teachings.                                |             |                          |           |               |                  |
| CO5: Compare traditional and modern knowledge systems.                                  |             |                          |           |               |                  |
| CO6: Develop solutions for real-life problems using Gita philosophy.                    |             |                          |           |               |                  |
|                                                                                         |             |                          |           |               |                  |
| <b>Unit I : Introduction to Bhagwad Geeta &amp; Educational Philosophy:</b>             |             |                          |           |               | <b>(6 Hours)</b> |
| Context: Mahabharata and Kurukshetra battlefield                                        |             |                          |           |               |                  |
| Structure: 18 Chapters overview                                                         |             |                          |           |               |                  |
| Concept of Dharma, Karma, and Knowledge                                                 |             |                          |           |               |                  |
| Education in ancient India vs modern system                                             |             |                          |           |               |                  |
| Relevance of Gita in contemporary education                                             |             |                          |           |               |                  |
|                                                                                         |             |                          |           |               |                  |
| <b>Unit II : Self-Management and Emotional Intelligence:</b>                            |             |                          |           |               | <b>(6 Hours)</b> |
| Concept of Atman (Self)                                                                 |             |                          |           |               |                  |
| Mind control (Manas, Buddhi, Chitta, Ahankara)                                          |             |                          |           |               |                  |
| Stress management through Gita                                                          |             |                          |           |               |                  |
| Emotional intelligence and stability                                                    |             |                          |           |               |                  |
| Practical techniques: meditation, detachment                                            |             |                          |           |               |                  |
|                                                                                         |             |                          |           |               |                  |
| <b>Unit III : Karma Yoga and Professional Ethics:</b>                                   |             |                          |           |               | <b>(6 Hours)</b> |
| Nishkama Karma (selfless action)                                                        |             |                          |           |               |                  |
| Duty vs Desire                                                                          |             |                          |           |               |                  |
| Work ethics in professional life                                                        |             |                          |           |               |                  |

|                                                                            |  |
|----------------------------------------------------------------------------|--|
| Integrity, accountability, and discipline<br>Case studies from IT industry |  |
|----------------------------------------------------------------------------|--|

|                                                                                                                                                                                                                                |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
|                                                                                                                                                                                                                                |                  |
| <b>Unit IV : Leadership and Decision Making:</b>                                                                                                                                                                               | <b>(6 Hours)</b> |
| Leadership qualities of Shri Krishna<br>Decision-making under uncertainty<br>Conflict resolution<br>Value-based leadership<br>Application in organizational behavior                                                           |                  |
|                                                                                                                                                                                                                                |                  |
| <b>Unit V : Knowledge Systems and Learning Approaches:</b>                                                                                                                                                                     | <b>(6 Hours)</b> |
| Jnana Yoga and critical thinking<br>Types of knowledge: Para & Apra<br>Lifelong learning concepts<br>Comparison with modern pedagogies (constructivism, experiential learning)<br>Role of teacher as mentor (Guru concept)     |                  |
|                                                                                                                                                                                                                                |                  |
| <b>Unit VI : Holistic Development and Modern Applications:</b>                                                                                                                                                                 | <b>(6 Hours)</b> |
| Personality development through Gita<br>Work-life balance<br>Sustainability and ethical living<br>Gita in modern domains: AI ethics, management, innovation<br>Case-based applications                                         |                  |
|                                                                                                                                                                                                                                |                  |
| <b>Textbooks</b>                                                                                                                                                                                                               |                  |
| 1) Bhagavad Gita As It Is                                                                                                                                                                                                      |                  |
| 2) The Bhagavad Gita                                                                                                                                                                                                           |                  |
|                                                                                                                                                                                                                                |                  |
| <b>Reference Books</b>                                                                                                                                                                                                         |                  |
| The Difficulty of Being Good<br>Bhagavad Gita for Daily Living<br>The Bhagavad Gita and Modern Life<br>Gitamrutam<br>Seven Habits of Highly Effective People (for comparison with modern frameworks)                           |                  |
|                                                                                                                                                                                                                                |                  |
| <b>List of Assignments</b>                                                                                                                                                                                                     |                  |
| Reflective journal on “My Role as Arjuna”<br>Case study: Ethical dilemma in IT industry<br>Presentation on one chapter of Bhagwad Geeta<br>Comparative study: Gita vs Modern Psychology<br>Essay: “Karma Yoga in Student Life” |                  |

Group discussion report on leadership lessons

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Project Based Learning (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| Students have to implement the software project of any one of the following topics:<br>Gita-based stress management mobile app<br>AI Ethics model inspired by Gita principles<br>Workplace ethics framework using Karma Yoga<br>Digital storytelling: Arjuna's dilemma in modern context<br>Smart habit tracker based on Gita teachings<br>Chatbot for Gita-based counseling<br>Emotional intelligence assessment tool<br>Leadership training module using Gita |                                 |
| <b>Syllabus for Unit Tests (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |
| Unit Test -1                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Unit – I, Unit – II, Unit - III |
| Unit Test -2                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Unit – IV, Unit – V, Unit – VI  |

| Major project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |                          |           |               |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|-----------|---------------|----|
| TEACHING SCHEME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             | EXAMINATION SCHEME       |           | CREDIT SCHEME |    |
| Lecture:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | -           | End Semester Examination | -         | Lecture       | -  |
| Practical:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 16 Hrs/Week | Internal Assessment      | -         |               |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             | Term Work                | 100 Marks | Practical     | 08 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             | Oral                     | 50 Marks  |               |    |
| Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 16 Hrs/Week | Total                    | 150 Marks | Total         | 08 |
| <b>Objective:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                          |           |               |    |
| Apply knowledge of Computer/IT engineering to solve <b>real-world problems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                          |           |               |    |
| Develop <b>design, implementation, and testing skills</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |    |
| Work effectively in a <b>team environment</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |                          |           |               |    |
| Demonstrate <b>innovation, problem-solving, and research aptitude</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                          |           |               |    |
| Learn <b>documentation, presentation, and communication skills</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |    |
| Get exposure to <b>research methodology and publication process</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                          |           |               |    |
| <b>GUIDELINES:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                          |           |               |    |
| <b>Nature of Projects</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |    |
| Projects should be:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                          |           |               |    |
| <ul style="list-style-type: none"> <li>• <b>Application-oriented / Industry-based / Research-based</b></li> <li>• Preferably in domains like: <ul style="list-style-type: none"> <li>○ AI/ML, Data Science, IoT, Cybersecurity, Cloud Computing, Blockchain</li> <li>○ Social impact projects (Smart Campus, Healthcare, Agriculture, Environment)</li> </ul> </li> <li>• Should <b>NOT be repetitive</b> of previous batches</li> <li>• Must include <b>significant development and/or research contribution</b></li> </ul> |             |                          |           |               |    |
| <b>Project Phases (What Students Are Expected To Do)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                          |           |               |    |
| <b>Phase 1: Problem Identification &amp; Proposal (Weeks 1–3)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                          |           |               |    |
| <ul style="list-style-type: none"> <li>• Identify a real-world problem or research gap</li> <li>• Conduct literature survey</li> <li>• Define:</li> </ul>                                                                                                                                                                                                                                                                                                                                                                    |             |                          |           |               |    |

- Problem Statement
- Objectives
- Scope
- Expected Outcomes
- Submit:
  - Project Proposal Document
  - Guide Allotment Form

## **Phase 2: System Design & Planning (Weeks 4–6)**

- Prepare:
    - System Architecture
    - UML Diagrams (Use Case, Class, Sequence)
    - Technology Stack Selection
  - Develop:
    - Project Plan (Gantt Chart)
  - Submit:
    - Design Document
- 

## **◆ Phase 3: Implementation (Weeks 7–12)**

- Coding and development
  - Module-wise implementation
  - Weekly progress updates to guide
  - Maintain:
    - Version control (Git recommended)
    - Logbook
- 

## **◆ Phase 4: Testing & Validation (Weeks 13–14)**

- Unit Testing, Integration Testing



- Performance evaluation
- Validation against objectives
- Prepare test reports

#### ◆ Phase 5: Documentation & Final Submission (Weeks 15–16)

- Submit:
  - Final Project Report
  - Source Code
  - User Manual
  - PPT Presentation

#### Expected Deliverables

Each group must submit:

- Project Proposal
- Design Document
- Weekly Logbook
- Source Code (with proper documentation)
- Test Reports
- Final Project Report (as per institute format)
- Final Presentation & Demonstration

#### Rubrics (Evaluation Criteria)

| Criteria       | Excellent (A)        | Good (B)     | Average (C)         | Poor (D)   |
|----------------|----------------------|--------------|---------------------|------------|
| Understanding  | Deep, clear concepts | Good grasp   | Basic understanding | Weak       |
| Implementation | Fully functional     | Minor issues | Partial             | Incomplete |
| Documentation  | Well-structured      | Mostly clear | Some gaps           | Poor       |
| Presentation   | Confident, clear     | Good         | Average             | Unclear    |

| Innovation                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Highly creative | Some creativity | Minimal | None |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|---------|------|
| <b>Learning Outcomes: Research Paper / Technical Paper/ Patent / Innovation Disclosure/ Research / Analytical Output/ Startup / Product Development</b>                                                                                                                                                                                                                                                                                                          |                 |                 |         |      |
| <p>After completing the SOps project, students should be able to:</p> <ul style="list-style-type: none"> <li>• Understand real-world problem-solving approaches</li> <li>• Apply theoretical concepts in practical scenarios</li> <li>• Develop planning and execution skills</li> <li>• Improve documentation and reporting ability</li> <li>• Enhance teamwork and communication skills</li> <li>• Gain hands-on experience with tools/technologies</li> </ul> |                 |                 |         |      |
| <b>Research Publication</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                 |         |      |
| <p>To encourage the students for writing research article/paper and presenting/publishing</p> <p>the same in journal/conference/symposium, the guides may give advantage of credits to the students, even if it is not mandatory.</p>                                                                                                                                                                                                                            |                 |                 |         |      |

## **B. Tech (All Programmes) – 2023 Course Rules and Regulations**

### **(I) Theory**

#### ***(A) Theory Examination***

Theory examination consists of: (i) End semester examination (ESE), and (ii) Internal assessment (IA).

(i) ESE is of 60 marks for theory courses.

(ii) IA is of 40 marks. Out of 40 marks, 20 marks will be for Unit Tests and 20 marks will be for Project Based Learning for a given course. Two Unit Tests, each of 20 marks, will be conducted. Average of marks obtained in these two unit tests will be considered as UT marks. Roll numbers allotted to the students shall be the examination numbers for the conduction of unit tests.

#### ***(B) Standard of Passing***

(i) There is a separate passing of 40% of 60 marks, i.e. 24 marks, for ESE for a given course.

(ii) There is a separate passing of 40% of 40 marks, i.e. 16, for IA for a given course.

(iii) A student who fails at ESE in a given course has to reappear only at ESE as a backlog student and clear the head of passing. Similarly, a student who fails at IA in a given course has to reappear only at IA as a backlog student and clear the head of passing

### **(II) Practical**

#### ***(A) Practical Examination***

Practical examination consists of: (i) Term work, and (ii) Practical/Oral examination for a given course based on term work.

(i) Term work (TW): TW marks are as mentioned in the curriculum structure.

(ii) Practical/Oral (PR/OR): PR/OR marks are as mentioned in the curriculum structure.

#### ***(B) Conduction of practical/oral examination***

(i) A student will be permitted to appear for practical/oral examination only if he/she submits term work of a given course.

(ii) Practical/oral examination shall be conducted in the presence of internal and external examiners appointed by university.

***(B) Standard of Passing***

(i) A student shall pass both heads TW and PR/OR separately with minimum 40% of total marks of respective head.

**(III) MOOC and Social Activity Course**

(i) If a student completes one MOOC during a programme, he/ she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course. It is mandatory for a student to complete atleast two MOOC to obtain degree in a given discipline. Students shall register to MOOCs which are offered by any one the following agencies:

- (a) SWAYAM : [www.swayam.gov.in](http://www.swayam.gov.in)
- (b) NPTEL : [www.onlinecourse.nptel.ac.in](http://www.onlinecourse.nptel.ac.in)
- (c) Course Era : [www.coursera.org](http://www.coursera.org)
- (d) edX online learning : [www.edx.org](http://www.edx.org)
- (e) MIT Open Course ware : [www.ocw.mit.edu](http://www.ocw.mit.edu)
- (f) Udemy : [www.udemy.com](http://www.udemy.com)
- (g) Spoken tutorial : [www.spoken-tutorial.org](http://www.spoken-tutorial.org)

(ii) If a student completes social activity, he/she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course/ activity from the relevant authorities. It is mandatory for a student to complete atleast one social activities to obtain degree in a given discipline.

(iv) The additional credits for MOOC and Social Activity will be given only after verification of the authentic document by the Head of the Department and a separate mark-sheet will be submitted by the Head of the Department along with the course examiner

**(IV) A. T. K. T**

(i) A student who is granted term for B. Tech. Semester-I, III, V, VII will be allowed to keep term for his/her B. Tech. Semester-II, IV, VI, VIII examination, respectively even if he/she appears and fails or does not appear at B. Tech. Semester-I,III, V, VII examination respectively.

(ii) A student shall be allowed to keep term for the B. Tech. Semester-III course if he/she has a backlog of any number of Heads of passing at B. Tech. Semester-I & II taken together.

(iii) A student shall be allowed to keep term for the B. Tech. Semester-V of respective course if he/she has no backlog of B. Tech. Semester-I & II and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-III & IV taken together.

(iv) A student shall be allowed to keep term for the B. Tech. Semester- VII of respective course if he/she has no backlog of B. Tech. Semester-I, II, III, IV and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-V & VI taken together.

#### **(V) Grade Point, Grade Letter and Equivalent Marks**

The student must obtain a minimum Grade Point of 5.0 (40% marks) in ESE and also in combined ESE + IA. A student who fails in ESE of a course has to reappear only to ESE as a backlog student and clear that head of passing.

Award of the Class for the Degree considering CGPA: A student who has completed the minimum credits specified for the programme shall be declared to be passed in the programme. The CGPA will be computed every year of all the courses of that year. The grade will be awarded according to the CGPA of every year.

| <b>Range of CGPA</b>               | <b>Final Grade</b> | <b>Performance Descriptor</b> | <b>Equivalent range of Marks (%)</b> |
|------------------------------------|--------------------|-------------------------------|--------------------------------------|
| $9.50 \leq \text{CGPA} \leq 10.00$ | O                  | Outstanding                   | $80 \leq \text{Marks} \leq 100$      |
| $9.00 \leq \text{CGPA} \leq 9.49$  | A+                 | Excellent                     | $70 < \text{Marks} < 80$             |
| $8.00 \leq \text{CGPA} \leq 8.99$  | A                  | Very Good                     | $60 < \text{Marks} < 70$             |
| $7.00 \leq \text{CGPA} \leq 7.99$  | B+                 | Good                          | $55 < \text{Marks} < 60$             |
| $6.00 \leq \text{CGPA} \leq 6.99$  | B                  | Average                       | $50 < \text{Marks} < 55$             |
| $5.00 \leq \text{CGPA} \leq 5.99$  | C                  | Satisfactory                  | $40 \leq \text{Marks} < 50$          |
| CGPA below 5.00                    | F                  | Fail                          | Marks Below 40                       |

#### **(VI) Minor Programme**

(i) A students shall receive a MINOR degree when he/she acquire additional 20 credits in a given specialization defined by the UG programmes offered at the institute.

- (ii) The theory and practical/oral components for a given course are mentioned in curriculum structure. The theory and examination for a given course are mentioned in Section I and II.
- (iii) The grade point, grade letter and equivalent marks system for MINOR programme is mentioned in Section V.
- (iv) The MINOR DEGREE programme is OPTIONAL. The interested students may opt MINOR programme.
- (v) A student shall complete the MINOR program prior to his/her graduation.