JOY UNIVERSITY

Established vide Tamil Nadu State Pvt. Universities Act 2019

# SCHOOL OF COMPUTATIONAL INTELLIGENCE

***Outcome Based Curriculum Framework with CBCS***

***for***

## *BACHELOR OF TECHNOLOGY (ARTIFICIAL INTELLIGENCE & INTERNET OF THINGS)*

***( B. Tech. CSE - AI & IoT) - BTAT***

***Students admitted from 2025 -26 onwards***

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## VISION

§ To create and nurture a multidisciplinary global university with highest academics, research and ethical standards in a creative and innovative environment.

## MISSION

§ To be a premier University of choice for all stakeholders and contribute for academic demographic dividend. To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.

## QUALITY OBJECTIVES

- To disseminate knowledge with skills through teaching, training, seminars, workshops, conferences and symposia in Engineering and Technology, Art and Design, Management and Commerce, Allied Health Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences, Law and Agricultural Sciences to enable students to meet the current needs and trends of industries, business and society.
- To provide technical and scientific solutions to real time problems posed by industries, business and society in all Schools of Joy University.
- To inculcate quality, integrity, team work, compassion, ethics in new generation students for catering to various needs of society.
- To promote the spirit of entrepreneurship in the young generation to help and create more career opportunities in the society by incubating a nurturing technology product idea backed by Technology Business Incubation.
- To identify and nurture leadership and innovate skills in students to become future leaders to enrich society.
- To develop collaborations and partnerships with International global and reputed Universities, research establishments, Government and NGO's, industries and businesses. To support both faculties and students for international exposure.

**SCHOOL OF COMPUTATIONAL INTELLIGENCE**

## VISION

The SOCI envisions a 'cooperatively competitive' academic environment in the thematic areas of the school and relevant research backed by quality education to churn out graduates with professional acumen, exceptional leadership and a humane heart to meet both national and global needs.

## MISSION

The SOCI offers a value-based, technology-oriented education striving to achieve high levels of academic excellence, intellectually competence and exemplary values. The tri-value system of our school is designed to deliver education through three interconnected values: **Learning, Transmutation** and **Transformation**.

## PROGRAMME EDUCATIONAL OBJECTIVES

**PEO 1**: Graduates will have the ability and attitude to acquire new skills and adapt recent technological changes.

**PEO 2**: To prepare the graduates to serve in the industries related to Computer Science and Engineering or to do higher education and research.

**PEO 3**: Graduates will work with professionalism and ethics by contributing to the advancement of the society.

## GRADUATE ATTRIBUTES

*The Graduate Attributes of B.Tech CSE (AI and IoT) BTAT are:*

GA1: Apply appropriate knowledge in the field of AI and IoT to identify, formulate, analyze, and solve complex engineering problems in order to reach substantive conclusions.

GA2: Self-learn and engage in use of advanced computing tools related to AI and IoT.

GA3: Develop sustainable computing solutions in broader economic, societal and environmental contexts.

GA4: Think critically, creatively and analytically as a AI scientist, whilst being able to work effectively, independently and collaboratively as part of a team in research, technology development and entrepreneurial ventures.

GA5: Apply evolving ethics and privacy laws across various domains and territories.

GA6: Effectively communicate engineering concepts and ideas to peers in written or oral forms.

GA7: Be motivated to engage in independent and life-long learning in the broadest context of evolving technological challenges.

## PROGRAMME OUTCOMES

On completion of the **B.Tech CSE (AI and IoT) Programme,** students should be able to:

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAM SPECIFIC OUTCOMES

**PSO 1:** Design and build AI based IoT systems for various applications using analytical, logical and problem-solving skills.

**PSO 2:** Develop AI-powered software systems to activate, control and operate AI based IoT systems.

**PSO 3:** Apply IoT concepts with the help of AI to solve real-world problems in a variety of domains including industrial, communication, healthcare, military, etc.

## Summary of Credits

| Semester | I | II | III | IV | V | VI | VII | VIII | Total |
|---|---|---|---|---|---|---|---|---|---|
| Credits | 20 | 21 | 21 | 20 | 24 | 20 | 20 | 21 | 167 |
| Contact Hrs./Week | 24 | 24 | 24 | 22 | 26 | 22 | 17 | 06 | 165 |

## SEMESTER WISE CREDIT STRUCTURE

| Sl. No. | Category of Courses | 1st Year | | 2nd Year | | 3rd Year | | 4th Year | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sem I | Sem II | Sem III | Sem IV | Sem V | Sem VI | Sem VII | Sem VIII | |
| 1. | Departmental Core | 08 | 07 | 20 | 11 | 12 | 11 | 07 | – | **76** |
| 2. | Discipline Specific Electives (DSE) | – | – | – | 06 | 06 | 06 | 06 | 06 | **30** |
| 3. | Open Electives | – | – | – | – | 03 | 03 | 03 | – | **09** |
| 4. | Applied Sciences | 08 | 11 | – | – | – | – | – | – | **19** |
| 5. | Internships/ Field Visits | – | – | – | – | – | – | 02 | – | **02** |
| 6. | Mini Project / Project | – | – | – | – | – | – | 2 | 15 | **17** |
| 7. | Skill Enhancement Course | – | 01 | – | 03 | 03 | – | – | – | **07** |
| 8. | Ability Enhancement Courses (AECC) | 03 | – | – | – | – | – | – | – | **03** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **9.** | **Value-Added Course** | 01 | 02 | 01 | – | – | – | – | – | **04** |
| **Total** | | **20** | **21** | **21** | **20** | **24** | **20** | **20** | **21** | **167** |

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## School of Computational Intelligence

## B.Tech CSE (Artificial Intelligence & IoT) BTAT

### Semester – I

### (Total Credits: 20)

| SI.No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT111 | **Core Course** Fundamentals of Computing | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT112 | **Core Course** Introduction to Programming | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT113 | **Applied Science** Mathematics – I | 3 | 1 | 0 | 4 | 4 |
| 4. | 25BTAT114 | **Applied Science** Physics I | 3 | 1 | 0 | 4 | 4 |
| 5. | 25AEEN911 | **Ability Enhancement Compulsory Course (AECC)** Effective Communication | 3 | 0 | 0 | 3 | 3 |
| 6. | 25BTAT911 | **Value-Added Course** Performing Arts/Sports (Non-Graded) | 3 | 0 | 0 | 3 | 1 |
| 7. | 25BTAT211 | **Core Course** Fundamentals of Computing Lab | 0 | 0 | 2 | 2 | 1 |
| 8. | 25BTAT212 | **Core Course** Introduction to Programming Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **18** | **2** | **4** | **24** | **20** |

**Semester – II**

**(Total Credits: 21)**

| Sl.No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT121 | **Core Course** Python Programming | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT122 | **Applied Science** Probability, Statistics and Stochastic Processes | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT123 | **Applied Science** Mathematics II | 3 | 1 | 0 | 4 | 4 |
| 4. | 25BTAT124 | **Applied Science** Physics II | 3 | 0 | 0 | 3 | 3 |
| 5 | 25BTAT125 | **Core Course** Discrete Structures for Computer Science | 3 | 0 | 0 | 3 | 3 |
| 6 | 25EVST921 | **Value Added Course** Environmental Science | 2 | 0 | 0 | 2 | 2 |
| 7 | 25BTAT221 | **Core Course** Python Programming Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | 25BTAT222 | **Applied Science** Physics Lab | 0 | 0 | 2 | 2 | 1 |
| 9 | 25BTAT223 | **Skill Enhancement Course** Extended Reality and its Applications Lab (TANSAM) | 0 | 0 | 2 | 2 | 1 |
| | | **TOTAL** | **17** | **1** | **6** | **24** | **21** |

**Semester – III**
**(Total Credits: 21)**

| SI.No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT131 | **Core Course** Introduction to Artificial Intelligence | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT132 | **Core Course** Signals and Systems | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT133 | **Core Course** Digital Design | 3 | 0 | 0 | 3 | 3 |
| 4. | 25BTAT134 | **Core Course** Data Structures and Algorithms | 3 | 0 | 0 | 3 | 3 |
| 5. | 25BTAT135 | **Core Course** Object-Oriented Programming with Java | 3 | 0 | 0 | 3 | 3 |
| 6. | 25BTAT136 | **Core Course** Professional Ethics | 2 | 0 | 0 | 2 | 2 |
| 7. | 25BTAT931 | **Value Added Course** Indian Constitution | 1 | 0 | 0 | 1 | 1 |
| 8. | 25BTAT231 | **Core Course** Digital Design Lab | 0 | 0 | 2 | 2 | 1 |
| 9. | 25BTAT232 | **Core Course** Data Structures and Algorithms Lab | 0 | 0 | 2 | 2 | 1 |
| 10. | 25BTAT233 | **Core Course** Object-Oriented Programming with Java Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **18** | **0** | **06** | **24** | **21** |

**Semester – IV**
**(Total Credits: 20)**

| SI.No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT141 | **Core Course**<br>Machine Learning | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT142 | **Core Course**<br>Introduction to Internet of Things | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT143 | **Core Course**<br>Computer Organization and Architecture | 3 | 0 | 0 | 3 | 3 |
| 4. | 25BTAT841 | **Skill Enhancement Course**<br>Engineering Economics and Foreign Trade | 3 | 0 | 0 | 3 | 3 |
| 5 | 25BTAT341<br>25BTAT342<br>25BTAT343 | **Discipline Specific Elective (DSE) I**<br>Human-Computer Interaction<br>Optical Fiber Communication<br>MIMO and 5G Technologies | 3 | 0 | 0 | 3 | 3 |
| 6 | 25BTAT344<br>25BTAT345<br>25BTAT346 | **Discipline Specific Elective (DSE) II**<br>Explainable AI<br>Software Defined Radio<br>Cognitive Radio and AI-Enabled Wireless Networks | 3 | 0 | 0 | 3 | 3 |
| 7 | 25BTAT241 | **Core Course**<br>Machine Learning Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | 25BTAT242 | **Core Course**<br>Introduction to Internet of Things Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **18** | **0** | **04** | **22** | **20** |

**Semester – V**
**(Total Credits: 24)**

| SI. No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT151 | **Core Course**<br>Deep Learning | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT152 | **Core Course**<br>Microcontrollers & IoT Devices | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT153 | **Core Course**<br>Theory of Computation | 3 | 1 | 0 | 4 | 4 |
| 4 | 25BTAT851 | **Skill Enhancement Course**<br>Principles of Management | 3 | 0 | 0 | 3 | 3 |
| 5 | 25BTAT351<br>25BTAT352<br>25BTAT353 | **Discipline Specific Elective (DSE) III**<br>Natural Language Processing(NLP)<br>Reinforcement Learning<br>Edge AI and Tiny ML | 3 | 0 | 0 | 3 | 3 |
| 6 | 25BTAT354<br>25BTAT355<br>25BTAT356 | **Discipline Specific Elective (DSE) IV**<br>Mobile Ad-hoc Networks (MANETs)<br>AI for Network Security and Intrusion Detection<br>Quantum Computing | 3 | 0 | 0 | 3 | 3 |
| 7 | 25BTAT051<br>25BTAT052<br>25BTAT053 | **Open Elective I**<br>Artificial Intelligence<br>Python Programming<br>Computer Networks | 3 | 0 | 0 | 3 | 3 |
| 8 | 25BTAT251 | **Core Course**<br>Deep Learning Lab | 0 | 0 | 2 | 2 | 1 |
| 9 | 25BTAT252 | **Core Course**<br>Microcontrollers & IoT Devices Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **21** | **01** | **04** | **26** | **24** |

**Semester – VI**

**(Total Credits: 20)**

| SI. No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT161 | **Core Course**<br>Reinforcement Learning | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT162 | **Core Course**<br>Cloud & Edge Computing for IoT | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT163 | **Core Course**<br>Industrial Electronics and Power Convertors | 3 | 0 | 0 | 3 | 3 |
| 4. | 25BTAT361<br>25BTAT362<br>25BTAT363 | **Discipline Specific Elective (DSE) V**<br>AI for Signal and Image Processing<br>Network Function Virtualization (NFV)/<br>Internet of Things (IoT) Protocols | 3 | 0 | 0 | 3 | 3 |
| 5. | 25BTAT364<br>25BTAT365<br>25BTAT366 | **Discipline Specific Elective (DSE) VI**<br>AI in Optical and Satellite Communication<br>Network Management and Monitoring<br>Advanced Computer Networks | 3 | 0 | 0 | 3 | 3 |
| 6 | 25BTAT061<br>25BTAT062<br>25BTAT063 | **Open Elective II**<br>AI Tools<br>Internet of Things (IoT)<br>Cyber Security | 3 | 0 | 0 | 3 | 3 |
| 7. | 25BTAT261 | **Core Course**<br>Reinforcement Learning Lab | 0 | 0 | 2 | 2 | 1 |
| 8 | 25BTAT262 | **Core Course**<br>Cloud & Edge Computing for IoT Lab | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **18** | **0** | **04** | **22** | **20** |

**Semester – VII**
**(Total Credits: 20)**

| SI.No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT171 | **Core Course**<br>High performance Computing | 3 | 0 | 0 | 3 | 3 |
| 2. | 25BTAT172 | **Core Course**<br>IoT with 5G Technology | 3 | 0 | 0 | 3 | 3 |
| 3. | 25BTAT371<br>25BTAT372<br>25BTAT373 | **Discipline Specific Elective (DSE) VII**<br>Real-Time Operating Systems (RTOS)<br>Neuro-Symbolic AI<br>ARM and RISC Architectures | 3 | 0 | 0 | 3 | 3 |
| 4. | 25BTAT374<br>25BTAT375<br>25BTAT376 | **Discipline Specific Elective (DSE) VIII**<br>Advanced Digital Signal Processing with AI<br>Ethics, Policy, Law and Standards in AI<br>Sensor Networks and Actuators | 3 | 0 | 0 | 3 | 3 |
| 5 | 25BTAT071<br>25BTAT072<br>25BTAT073 | **Open Elective III**<br>Advanced Python Programming<br>Optimisation Algorithms<br>Computing (Latest) | 3 | 0 | 0 | 3 | 3 |
| 6 | 25BTAT271 | **Core Course**<br>Cybersecurity for IoT Lab | 0 | 0 | 2 | 2 | 1 |
| 7 | 25BTAT471 | Industrial Internship | 0 | 0 | 0 | 0 | 2 |
| 8 | 25BTAT571 | Mini project | 0 | 0 | 0 | 0 | 2 |
| | | **Total** | **15** | **0** | **02** | **17** | **20** |

**Semester – VIII**
**(Total Credits: 21)**

| SI.No | Course Code | Course Title | L | T | P | Contact Hrs / Wk | Credits |
|---|---|---|---|---|---|---|---|
| 1. | 25BTAT581 | Capstone Project | 0 | 0 | 0 | 0 | 15 |
| 2. | | **Discipline Specific Elective (DSE) IX** | 3 | 0 | 0 | 3 | 3 |
| | 25BTAT381 | AI for Society, Innovation and Entrepreneurship | | | | | |
| | 25BTAT382 | Distributed Systems | | | | | |
| | 25BTAT383 | Data Warehousing & Data Mining | | | | | |
| 3. | | **Discipline Specific Elective (DSE) X** | 3 | 0 | 0 | 3 | 3 |
| | 25BTAT384 | Network Security | | | | | |
| | 25BTAT385 | Bioinformatics & Computational Biology | | | | | |
| | 25BTAT386 | Analog and Mixed Signal Design | | | | | |
| | | **Total** | **06** | **0** | **0** | **06** | **21** |

# Semester - I

| | | | | | |
|---|---|---|---|---|---|
| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT | | |
| Course Code | 25BTAT111 | Number of Hours/ Week | 3 | | |
| Semester | I | Max. Marks | 100 | | |
| Year | I | Credits | 3 | | |
| Core Course | | | | | |
| Course Title | FUNDAMENTALS OF COMPUTING | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours | T-Tutorial Hours | P-Practical Hours | | | |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To introduce the fundamental concepts of computers and computing systems.
2. To understand the working principles of hardware, software, and operating systems.
3. To learn problem-solving techniques using algorithms and flowcharts.
4. To familiarize with programming basics and logic using C/Python.
5. To build awareness of current trends in computing and emerging technologies.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Computer**<br>Evolution of Computers, Generations of Computers, Classification of Computers, The Computer System, Computing Concepts, Applications of Computers.<br>**Memory and storage systems**<br>Computer Software and Hardware components and its requirements- Storage Devices,<br>**Computer Viruses**<br>Types Of Viruses – Spreading of Virus, Prevention of Computer Virus, Virus Detection, Computer Security, Maintenance, Desktop functions, Dialog boxes, Single Document Interface (SDI), Multiple Document Interface (MDI), Windows Controls, Main Menu Display, Categories of Menus, Main and Context Sensitive Menus, Booting/Shutting Down. | 10 |

| | | |
|---|---|---|
| **II** | **Microsoft software**<br>MS DOS, MS Word System, MS Excel System, MS Power point System, MS Access System, MS Publisher. Number System Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System, BCD, XS,3, Gray Code, Alphanumeric Codes,(ASCII, EBCDIC). | **9** |
| **III** | **Computer Software**<br>Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, System Management Programs , Standard Application Programs , Unique Application Programs, Problem Solving, Structuring the Logic | **9** |

| | | |
|---|---|---|
| **IV** | **Memory management**<br>Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems. | **9** |
| **V** | **THE INTERNET AND WORLD WIDE WEB**<br>History of the Internet-The Internet Applications-Understanding World Wide Web-Web Browsers-Browsing the Internet-Using a Search Engine- Email Service-Protocols used in the Internet.<br>**DATA COMMUNICATIONS AND NETWORKS**<br>Introduction-Data Communication Using Modem-Computer Networks- Network Topologies-Network Protocols and Software-Applications of Network. | **10** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Understand the basic concepts of computers.

**CO2:** Analyze the basics of number systems.

**CO3:** Apply system development programs to create and manage simple software projects.

**CO4:** Analyze the performance of different memory management techniques and their impact on system efficiency.

**CO5:** Evaluate the knowledge of Internet history to understand current Internet technologiesand to solve problems in communication and information access.

**Text Books:**

1. Fundamentals of Computers, E. Balagurusamy, Tata McGraw Hill Education Private Limited, 2009.

**Reference Books:**

1. Introduction to Computer Fundamentals, Bright Siaw Afriyie, Second edition, Trafford Publishing, Canada, 2003-2006.
2. Computer Fundamentals, P. K. Sinha, BPB Publications, Sixth Edition, 2004.
3. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Nineth edition, 2013.
4. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth edition, Prentice Hall, 2011.
5. Computing Fundamentals: Introduction to Computers, Faithe Wempen, Wiley 2014.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 |
| CO 2 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 1 | 1 |
| CO 4 | 2 | 3 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 1 | 1 |
| CO 5 | 3 | 3 | 2 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 1 | 1 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT211** | **Number of Hours/Week** | **2** | | |
| **Semester** | **I** | **Max. Marks** | **100** | | |
| **Year** | **I** | **Credits** | 1 | | |
| **Core Course** | | | | | |
| **Course Title** | **FUNDAMENTALS OF COMPUTING LAB** | | **L** | **T** | **P** |
| | | | **0** | **0** | **2** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**LIST OF PROGRAMS**

1. Basics of Microsoft Word.
2. Insert Table and Generating Chart.
3. Mail Merging.
4. Study on features of Microsoft Excel.
5. Incorporating the predefined functions in Excel.
6. Inserting table and generating chart in Excel.
7. Pivot chart, table and slicing in Excel.
8. Study on features in Microsoft PowerPoint.
9. Creating presentation incorporating the features of PowerPoint.
10. Study on HTML.
11. Basic web page design, formatting, inclusion of image and video.
12. Creation of Table.
13. Designing own web page.

On successful completion of this course, the student will be able to

**CO1:** Understand the basic functionalities of Microsoft Word

**CO2:** Apply advanced Excel features for data management.

**CO3:** Create complex data presentations using Excel pivot tables, charts, and slicers.

**CO4:** Develop professional presentations using advanced PowerPoint features.

**CO5:** Design and develop basic web pages using HTML

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 |
| CO 2 | 3 | 3 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 1 | 1 |
| CO 4 | 2 | 3 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 1 | 1 |
| CO 5 | 3 | 3 | 2 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 1 | 1 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT112 | Number of Hours/Week | 3 |
| Semester | I | Max. Marks | 100 |
| Year | I | Credits | 3 |
| Core Course | | | |
| Course Title | INTRODUCTION TO PROGRAMMING | L T P | 3 0 0 |

**COURSE OBJECTIVES:**

The main aim of this course is to prepare the students,

1. To learn the fundamental concepts of programming, including algorithms, flowcharts, and the logical approach to problem solving that is applicable to any programming language.
2. To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language
3. Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management .
4. Build a foundation for advanced programming and software development.
5. To develop skills to handle complex programming challenges such as file handling, Debugging.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to programming** Algorithm, Formalism, Flow chart, Assembly language, Introduction to program, Program components, structure, Execution path, Programming paradigms introdution, Syntax and Semantics | 9 |
| II | **Introduction to C language** History of C, Prerequisites of C, Features and its applications, Structure of C, Preprocessor directives, Data types and constants, variables and its types, Tokens, Identifiers and format specifiers, Operators and Enums, Data I/O, Decision making and Branching, Loop Introdcution, programs with looping structure, Control Flow programs with control flow | 10 |
| III | **Array and Strings** Introduction to Array, Initialization, Single dimensional array, Multidimensional array, String, Functions with string: Read, Display string and string functions, String Arrays. | 9 |

| | | |
|---|---|---|
| **IV** | **Functions and Pointers** Function Introduction, Function calling, Return type, Function types, Recursion, Types of Recursion, Introduction to Pointers, Types Pointers, Programming exercises with pointers. | **9** |
| **V** | **Structures and Unions** Introduction to structure and simple programusing structure concepts, Introduction to Union and programs with union, Storage Classes- Introduction to DMA, Introdcution to Pre- processor | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1 :** Acquiring foundational knowledge of programming including Algorithm, Flowcharts,assembly language basics, Program structure.

**CO2 :** Understanding C language fundamentals

**CO3 :** Applying various types of arrays and string manipulation technique to manage andprocess data in programming scenarios

**CO4 :** Analyze and experiment with functions, develop recursive solutions, and apply pointers to solve complex problems.

**CO5:** Develop modular programs using control structures, Unions.

**Text Books**


1. Introduction to Programming Languages 1st Edition by Arvind Kumar Bansal, CRC Press, Taylor and Francis group, 2014.
2. C Programming Language by Brian Kernighan and Dennis Ritchie, Prentice Hall Software, 1988.
3. Programming with C 2 nd Edition Byron Gottfried Schaum's outlines, Tata McGraw-Hill, 1998.


**Reference Books**


**1.** E. Balagurusamy, 'Programming in ANSI C', third edition, Tata McGraw-Hill Publishers,2004.

**2.** Eric C.R.Hehner, 'The Logic of Programming', Prentice hall of India, 1991.

**3.** C: Herbert Schildt, 'The Complete Reference', McGraw Hill, 4 th edition , 2017.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 2 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 |
| CO 2 | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 |
| CO 3 | 3 | 2 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 |
| CO 4 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 1 |
| CO 5 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 1 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | |
|---|---|---|---|
| **Programm** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT212** | **Number of Hours/Week** | **2** |
| **Semester** | **I** | **Max. Marks** | **100** |
| **Year** | **I** | **Credits** | **1** |

| **INTRODUCTION TO PROGRAMMING LAB** | **L** | **T** | **P** |
|---|---|---|---|
| | **0** | **0** | **2** |

**LIST OF PROGRAMS**

1. Write a C program to print Integer, Float, Character values
2. a) Write a c program to demonstrate use of arithmetic operators
2. b) Write a C program using increment and decrement operators
3. a) Write a C program using Decision making constructs (Switch case statement)
3. b) Program to find if a number is Negative, Positive, or zero(using if..elseif..else statement)
4. C program to perform factorial of a number
5. a) Write a C program to print a message 5 times using"while" statement

5. b) Illustrate the Do-while statement using C program

5. c ) Program using for loop statement
6. a) Program to implement break statement
6. b) write a program to demonstrate continue statement
7. Program to insert elements into an array and display the array elements using C language
8. Program to solve multiplication of 2 matrices
9. String
   a) Program to accept a string and display it as reverse using C language
   b) program to concatenate 2 string using C
10. Array
    a) Program to illustrate the concepts of arrays
    b) Program to illustrate pointer to 2-dimensional array
11. Program to take mark details of students and display the name of the students with highest marks using Structure concept
12. Program to implement union concept

## COURSE OUTCOMES:

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Acquire foundational knowledge of programming including Algorithm, Flowcharts, assembly language basics, Program structure. |
| **CO2** | Understand C language fundamentals |
| **CO3** | Apply various types of arrays and string manipulation technique to manage andprocess data in programming scenarios |
| **CO4** | Analyze and experiment with functions, develop recursive solutions and pointers to solve complex problems. |
| **CO5** | Develop modular programs using control structures, unions |

### Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 2 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 |
| CO 2 | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 1 | 0 | 3 | 1 | 0 | 0 |
| CO 3 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 3 | 0 | 2 | 2 | 3 | 0 | 1 | 1 |
| CO 4 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 3 | 1 | 0 | 1 |
| CO 5 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 3 | 3 | 0 | 1 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B. Tech CSE-AI&IoT | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT113 | Number of Hours/ Week | 4 |
| Semester | I | Max. Marks | 100 |
| Year | I | Credits | 4 |

**Applied Science Course**

| Course Title | MATHEMATICS - I | L | T | P |
|---|---|---|---|---|
| | | 3 | 1 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To recall and remember basics of matrices, complex numbers, and differential calculus.
2. To understand the concepts of basic mathematical methods for matrices, complex numbers and differential calculus.
3. To apply methods to solve engineering problems.
4. To analyze engineering problems and evaluate.
5. To solve and evaluate the problems using matrices, complex numbers, and differential calculus.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Differentiation and its applications:** Fundamentals of Differentiation, Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders, Indeterminate forms and L'Hopital's rule, Maxima and Minima | 10 |
| II | **Integration and its applications:** Double integral, Triple integral, Change of order of integration, Change of variables, Beta and Gamma functions and their properties, Dirichlet's integral and its applications to area and volume, Liouville's extensions of Dirichlet's integral. | 9 |
| III | **Sequence and Series:** Real number system, Convergence of sequence and series, Tests for convergence, Power series, Taylor's series, Series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem. | 10 |
| IV | **Advanced Multivariable Calculus:** Limit, continuity and partial derivatives, Directional derivatives, Total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers, Gradient,curl and divergence | 9 |

| | | |
|---|---|---|
| **V** | **Advanced Matrix Theory**: Introduction, types of matrices-symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, unitary matrices, Rank of a matrix - echelon form, normal form, consistency of system of linear equations (Homogeneous and Non-Homogeneous).Inverse and rank of a matrix, rank-nullity theorem | 9 |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| CO1: | Understand the concepts of mean value theorems, higher order derivative, series expansion and associated problems |
| CO2 : | Acquire problem solving skills for finding area and volume using multiple integrals |
| CO3 | Analyze sequences and series, including Fourier series |
| CO4 | Apply the differentiation of functions of two variables for maximization and minimization |
| CO5 | Evaluate basic matrix operations, linear systems of equations |

**Text Books**


1: Advanced Engineering Mathematics, 10 th edition, Erwin Kreyszig, 1998.

2: Calculus and Analytical Geometry, Thomas and Finney, 1996.

3: Engineering Mathematics-I, Veerarajan T., , Tata McGraw-Hill, New Delhi, 2008.

4: Higher Engineering Mathematics, Ramana B.V., , Tata McGraw Hill New Delhi, 11 th Reprint, 2010.


**Reference Books**


1: Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 36th Edition, 2010.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 1 | 1 |
| CO 2 | 3 | 2 | 1 | 1 | 2 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 1 |
| CO 3 | 2 | 3 | 2 | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 1 | 0 | 1 | 2 |
| CO 4 | 3 | 2 | 2 | 2 | 2 | 0 | 3 | 0 | 1 | 0 | 0 | 3 | 1 | 1 | 2 |
| CO 5 | 3 | 2 | 1 | 1 | 2 | 0 | 1 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 1 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE- AI & IoT | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT114 | Number of Hours/Week | 4 |
| Semester | I | Max. Marks | 100 |
| Year | I | Credits | 4 |

**Applied Science Course**

| Course Title | PHYSICS I | L | T | P |
|---|---|---|---|---|
| | | 3 | 1 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

1. To impart knowledge on the basics of the vector and scalar representation of forces and moments with Special reference to differentiation and integration methods
2. To acquire knowledge on moment of inertia and angular momentum
3. To impart knowledge on the concept of central force problems and uniformly accelerating systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Algebra of vectors-Describing motion:** displacement, velocity, speed, acceleration; Cartesian, polar,spherical, and cylindrical polar coordinates; Mathematical tools-differentiation and integration methods, Taylor's series | 12 |
| II | **Concept of inertia**; concept of inertial and non-inertial frames; Newton's laws of motion; Application of Newton's laws: particles in gravitational field, simple harmonic motion, tension in a string, frictional force, viscous force, damped harmonic oscillator, forced harmonic oscillator and resonance. Concept of momentum- center of mass, conservation of momentum, momentum and flow of mass, work-energy theorem, conservative and non-conservative forces, conservation of energy, concept of power, conservation laws and particle collisions | 12 |
| III | **Concept of moment of inertia:** fixed axis rotation; angular displacement, angular velocity, and angular acceleration; vector nature of angular velocity; angular momentum; torque; conservation of angular momentum; gyroscope motion | 12 |
| IV | Central forces; central force motion as one-body problem; conservation laws in central forcemotion; Kepler's laws | 12 |

| | | |
|---|---|---|
| **V** | Galilean transformations; uniformly accelerating systems; principle of equivalence; Physics in rotating coordinate systems | **12** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Apply the concepts of polar, rectangular, cylindrical and spherical coordinatesystems.

**CO2:** Ability to differentiate statics and kinematics.

**CO3:** Demonstrate the ability to solve the problems in Newton's laws.

**CO4:** Appreciate to understand rotational kinetic energy & angular momentum.

**CO5:** Acquire adequate knowledge on conservation laws.

**Text Books:**

1. An Introduction to Mechanics by Daniel Kleppner, Robert Kolenkow, 2 nd edition, 2006.

**Reference Books:**

1. Mechanics: Course of Theoretical Physics - Vol. 1, L.D. Landau and E.M. Lifshitz, ThirdEdition, CBS Publishers,2002.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 2 |
| CO2 | 2 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 2 |
| CO3 | 0 | 1 | 0 | 0 | 3 | 2 | 0 | 3 | 3 | 0 | 2 | 2 | 2 | 0 | 2 |
| CO4 | 2 | 1 | 0 | 1 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 1 | 0 |
| CO5 | 2 | 2 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 0 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25AEEN911 | Number of Hours/Week | 3 | | |
| Semester | I | Max. Marks | 100 | | |
| Year | I | Credits | 3 | | |
| Ability Enhancement Compulsory Course (AECC) | | | | | |
| Course Title | EFFECTIVE COMMUNICATION | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To define and explain the fundamental concepts, types, and processes of communication.
2. To develop active listening and effective speaking skills to enhance interpersonal communications.
3. To improve reading comprehension skills through different techniques.
4. To apply grammar and vocabulary rules and public communication for accurate sentence structure and effective written communication.
5. To prepare and deliver effective presentations by planning, structuring, and overcoming stage fright.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Communication**<br>Definition of Communication, Types of Communication: Formal, Informal, Oral, Written, Verbal, non-verbal, interpersonal, intrapersonal Process of Communication: Sender, Message, Channel, Receiver, Feedback Barriers: Intrapersonal, Interpersonal, Organizational<br>Overcoming Barriers | 10 |
| II | **Listening and Speaking:**<br>Active Listening: Types of Listening, Reasons for poor listening Traits of the good listener, Effective Speaking: Achieving Confidence, Clarity, and Fluency, Public Speaking, Drafting the Speech | 11 |

| | | |
|---|---|---|
| **III** | **Reading and Writing:**<br>Reading Comprehension**:** Improving Comprehension Skills, Scanning and Skimming, Predicting the Content, Understanding the Gist, PQRST Technique Grammar and Vocabulary**:** Sentence Structure, Preposition, Punctuation, Articles, Common errors and Correct Usage, Word formation: Affixes, Active and Passive Vocabulary | **11** |
| **IV** | **Presentation Skills**<br>Planning: Occasion, Audience, Purpose, Thesis Statement, Material, Outlining and Structuring, Guidelines for Effective Delivery, Strategies for Reducing Stage Fright | **8** |
| **V** | **Practice:**<br>Grammar Bites, English Fluency Drills | **4** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Analyze different types and processes of communication and the barriers that may arise.

**CO2:** Demonstrate active listening skills and strategies for confident and fluent public speaking.

**CO3:** Improve reading comprehension through effective reading techniques.

**CO4:** Apply proper grammar, sentence structures, and vocabulary for clear and correct writtencommunication.

**CO5:** Create structured presentations, incorporating techniques to manage stage fright and engage theaudience effectively.

**Text Books**


1. Kumar, Sanjay and Pushp Lata. *Communication Skills*. 2 nd ed., Oxford University Press, 2015.
2. Raman, Meenakshi and Sangeetha Sharma. *Technical Communication: Principles and Practice*, 4th ed., Oxford University Press, 2022.


**Reference Books**


1. Adair, John. Effective Communication: The Most Important Management Skill of All. Pan Books Publishers, 1997.
2. Gorrell, Robert M and Charlton Laird. *Modern English Handbook. 6 th* ed., Pentice Hall Publications, 1976.

3. Rose, William. *GNVQ Core Skills Communication*. 2 nd ed., Pitman Publishing, 1995.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| CO 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 |
| CO 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| CO 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| CO 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

# Semester II

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT121 | Number of Hours/Week | 3 |
| Semester | II | Max. Marks | 100 |
| Year | I | Credits | 3 |
| Core Course | | | |

| Course Title | PYTHON PROGRAMMING | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To Understand the fundamentals of the Python programming language and its historical development
2. To Master Python basics, including data types, operators, tuples, dictionaries, and string manipulation.
3. To demonstrate object oriented concept in python
4. To familiarize with machine learning tools in python

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to python programming**<br>Introduction to python ; setting up python programming environment; variables; strings and its operations; special characters; striping whitespace; numbers; comments; list and its operations; indexing; looping through lists; indentation; range function; slicing a list; copying list; looping through slice; | 8 |
| II | **Python datatypes**<br>Tuples and its operations; relational operators; conditional statements – if, if-else, if-elif-else; multiple conditional blocks; dictionaries; key- value pairs – adding, modifying, removing; looping through dictionary; list of dictionaries; dictionary in a dictionary; user input function; type casting; | 8 |
| III | **Loop and function**<br>While loop; break and continue; functions; arguments; passing arguments – positional arguments, keyword arguments, default values; optional arguments; returning from function; passing arbitrary number of arguments; storing functions in modules; import specific function or module; | 8 |

| | | |
|---|---|---|
| **IV** | **OOPs in python**<br>Classes; init() method; instance of a class; accessing attributes; calling methods; creating multiple instances; inheritance – parent class, child class; importing classes; files – reading a file, writing to a file, appending to a file; exceptions – try-except block, else block; | **8** |
| **V** | **Python machine learning tools**<br>Python tools for machine learning; python modules – numpy, pandas, matplotlib, scipy; python based machine learning libraries – pytorch, tensorflow; virtual environment; machine learning application using python tools; | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1 :** Comprehend the holistic view of programming language design and behavior

**CO2 :** Understand the programming concepts in abstract and paradigm level

**CO3 :** Structure python programs for solving problems

**CO4 :** Develop python programs using OOP concept

**CO5 :** Execute ML project using python tools

**Text Books:**

1. A Hands-On, Project-Based Introduction to Programming, Eric Matthes. Python Crash Course, 2nd Edition: No Starch Press, Inc., 2019.

**Reference Books:**

1. Boring Stuff with Python by Al Sweigart. AutomA ,William Pollock, 2015.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 1 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 1 |
| CO 2 | 3 | 3 | 2 | 3 | 1 | 2 | 0 | 2 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| CO 3 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 2 | 2 | 2 |
| CO 4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 3 |
| CO 5 | 2 | 2 | 3 | 3 | 3 | 0 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT221 | Number of Hours/WK | 2 |
| Semester | II | Max. Marks | 100 |
| Year | I | Credit | 1 |
| Core Course | | | |

| Course Title | PYTHON PROGRAMMING LABORATORY | L | T | P |
|---|---|---|---|---|
| | | 0 | 0 | 2 |

**Course Objective:**

The main learning objective of this course is to prepare the students,

1. To learn fundamentals in python programming language
2. To introduce python modules for application
3. To familiarize python framework for machine learning applications
4. To develop machine learning application using python
5. To implement research topic as part of python project.

**List of experiments:**

| S.NO | TITLE |
|---|---|
| 1 | Implement basic algebraic problems to get into python programming |
| 2 | Implement string manipulations problems using python |
| 3 | Implement problems using python datatypes such as tuple, list, dictionary etc. |
| 4 | Implement problems for python loops, conditional statements and functions |
| 5 | Implement object oriented programming concepts in python to solve different problems |
| 6 | Implement problems for python file manipulations |
| 7 | Implement standard machine learning algorithms using python frameworks such as TensorFlow, PyTorch etc. |
| 8 | Implement adavanced problems using python tools in a virtual environment as part of python project |

## Course outcome:

On successful completion of this course, the student will be able to

CO1 : Develop basic coding skills in python
CO2 : Understand python datatypes, modules, frameworks etc.
CO3 : Implement standard ML algorithms using python tools
CO4 : Apply python frameworks for ML applications
CO5 : Create ML model for existing problems

### Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 1 | 2 | 0 | 2 | 1 | 1 | 0 | 2 | 0 | 1 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 2 | 2 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 0 | 1 | 1 | 0 | 1 | 2 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 3 | 3 | 0 | 1 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT122 | Number of Hours/Week | 3 | | |
| Semester | II | Max. Marks | 100 | | |
| Year | I | Credits | 3 | | |
| Applied Science Course | | | | | |
| Course Title | PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES | | L | T | P |
| | | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To Understand fundamental probability concepts and their applications in real-world scenarios.
2. To Analyze data using descriptive statistics such as mean, variance, and standard deviation.
3. To Apply probability distributions (e.g., binomial, normal) to model and solve problems.
4. To Conduct hypothesis testing and confidence intervals to make informed statistical inferences.
5. To Utilize statistical tools and software for data analysis and decision-making in various fields.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Probability:** Introduction to set algebra-sigma algebra- Borel sigma algebra-sequence of sets and its limits-lim-sup and lim-inf of sequence of sets; Axiomatic definition of probability-probability space-properties of probability functions-conditional probability-Bayes' rule-independence of events-continuity of probability functions-Borel Cantelli lemmas. | 10 |
| II | **Random variables**-distribution function and its property probability mass and density functions-symmetric distribution and its properties- expectation-moments moment generating function-Markov inequality-Chebyshev's inequality. | 6 |
| III | **Joint distributions**-marginal and conditional distributions-moments- independence of random variables-covariance, and correlation joint moment generating functions-additive properties of random variables-functions of random variables-ordered Statistics. | 8 |

| | | |
|---|---|---|
| **IV** | **Special distributions**: Discrete uniform-Bernoulli-binomial-geometric negative binomial-hypergeometric-Poisson-exponential-gamma-normal- bivariate normal distribution; Population- sample-parameters- distributions of the sample mean and the sample variance for a normal population-Chi-Square-t, F distributions-law of large numbers–central limit theorem-point estimation-method of moments-maximum likelihood estimator-unbiasedness. | **8** |
| **V** | **Testing of hypothesis**: Null and alternate hypothesis-Neyman Pearson fundamental lemma and its applications-tests for one sample and two sample problems for normal populations-tests for proportions- confidence interval estimation-confidence interval for parameters of normal population | **10** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

- CO1: Understand Basic Probability Concepts
- CO2: Analyze Random Variables and Probability Distributions, Joint Distributions and Conditional Probability
- CO3: Implement the Central Limit Theorem and Law of Large Numbers
- CO4: Perform Hypothesis Testing and Statistical Inference, Regression and Correlation for Data Analysis
- CO5: Employ Statistical Tools in Engineering Applications

**Text Books:**


1. First Course in Probability, Sheldon Ross, 2022.
2. An Introduction to Probability and Statistics, V.K. Rohatgi and A.K. Md. E. Saleh, 2015.


**Reference Books:**


1. Introduction to Probability and Statistics, S. Milton and J.C. Arnold, 2003.
2. Introduction to Mathematical Statistics, R V Hogg, A Craig and J W McKean, 2019


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 |
| **CO 2** | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| **CO 3** | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 2 | 0 | 2 |
| **CO 4** | 2 | 2 | 1 | 2 | 0 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 2 | 2 |
| **CO 5** | 2 | 2 | 0 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 0 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT123 | Number of Hours/Week | 4 |
| Semester | II | Max. Marks | 100 |
| Year | I | Credits | 4 |

**Applied Science Course**

| Course Title | MATHEMATICS II | L | T | P |
|---|---|---|---|---|
| | | 3 | 1 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To develop a strong understanding of vector spaces, subspaces, basis, and dimension, as well as how linear transformations relate to matrices and their properties.
2. To gain proficiency in solving systems of linear equations using techniques like Gaussian elimination, matrix operations, and determinants.
3. To compute eigenvalues and eigenvectors, and apply them to diagonalize matrices, a critical tool for solving differential equations.
4. To solve first-order and second-order ordinary differential equations (ODEs) with applications to physical, biological, and engineering problems.
5. To understand the interplay between linear algebra and differential equations, especially in systems of linear differential equations, using matrix methods such as the Laplace transform and matrix exponentials.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Advanced Matrix Theory: Systems of linear equations**: Elementary operations-row-reduced echelon matrices-Gauss elimination LU factorization-linear independence-rank of a matrix-solutions of linear systems-existence and uniqueness. | 10 |
| II | **Vector spaces**: Vector space-subspaces-spanning space-bases and dimensions. Linear transformation-matrix representations of linear transformations-range space and rank-null space and nullity-the rank and nullity theorem-invertibility. | 10 |
| III | **Eigenvalues and eigenvectors**: Eigen values-eigenvectors and some applications of eigenvalue problems-Hermitian, skew-Hermitian, unitary matrices and their eigenvalues-eigen bases. | 9 |

| | | |
|---|---|---|
| **IV** | **Elementary Canonical Forms:** Diagonalization: Annihilating polynomial-the minimal polynomial and the characteristic polynomial- Cayley-Hamilton theorem-real quadratic form; Inner product spaces: Inner product spaces-orthonormal bases- Gram-Schmidt process. | **9** |
| **V** | **Ordinary Differential Equations**: Review of First Order ODE- Lipschitz condition-Picard`s theorem; Linear differential equations: Linear dependence and Wronskian-linear ODE with constant coefficients of higher order characteristic equations- Cauchy-Euler equations-method of undetermined coefficients-method of variation of parameters- solutions methods using Laplace Transform | **10** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

- Learn different types of matrices, concept of rank, methods of matrix inversion and their applications, systems of linear equations, and manipulate vectors in various dimensions.
- Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
- Apply the concept of eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces for understanding physical and engineering problems.
- Understand the first- and second-order ordinary differential equations (ODEs), both analytically and numerically, with applications to real-world phenomena.
- Develop the skills to model physical systems using differential equations and linear algebra.

**Text Books:**


- Linear Algebra, Hoffman Kunze, 2015.
- Differential Equations, S. L Ross, 2007.


**Reference Books:**


- Introduction to Linear Algebra, Gilbert Strang, 2016.
- Advanced Engineering Mathematics, Erwin Kreyszig, 2010.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 |
| **CO 2** | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| **CO 3** | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 2 | 0 | 2 |
| **CO 4** | 2 | 2 | 1 | 2 | 0 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 2 | 2 |
| **CO 5** | 2 | 2 | 0 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 0 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT124** | **Number of Hours/Week** | **3** | | |
| **Semester** | **II** | **Max. Marks** | **100** | | |
| **Year** | **I** | **Credits** | **3** | | |
| **Applied Science Course** | | | | | |
| **Course Title** | **PHYSICS II** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

1. To understand the working principle of various lasers, fibre optics and its applications.
2. To impart knowledge on acoustics and ultrasonics and its applications.
3. To provide knowledge on magnetism and superconducting phenomenon.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | Introduction – Components of laser – Principle of laser action – Properties of laser – Spontaneous emission and stimulated emission – Einstein's coefficients – Population inversion – Types of lasers – He-Ne laser – Nd- YAG laser – Semiconductor laser – Industrial applications of laser – Medical applications of laser – Holography | **12** |
| **II** | Introduction – Propagation of light in optical fiber – Total internal reflection – Principle of optical fiber – Fractional Refractive index - Numerical aperture and acceptance angle – Types of optical fibers based on materials, modes of propagation and refractive index profile – Power losses in optical fibers – Fiber optic communication system – Fiber optic sensors – Temperature and Displacement – Fibre endoscope | **12** |
| **III** | Introduction – Classification of sound – Characteristics of musical sound – Pitch – Loudness – Quality – Intensity of sound – Weber Fechner Law – Reverberation – Reverberation Time – Sabine's Formula – Factors affecting the acoustics of a building – Absorption Coefficient – Measurement of Absorption coefficient | **11** |

| | | |
|---|---|---|
| **IV** | Introduction – Production of ultrasonic waves – Magnetostriction Effect – Magnetostriction generator – Piezoelectric Effect – Properties of ultrasonics - Acoustic grating – Applications of ultrasonics – Industrial applications – SONAR – NDT –– Medical Applications | **11** |
| **V** | Types of electronic materials: metals, semiconductors, and insulators, Dia, Para, Ferro magnetic materials properties, Temperature effects - Hysteresis curve, Hard and soft magnetic engineering materials - Applications: Magnetic recording and reading – Hard disc. Superconductors: Properties of superconducting materials - Type I and Type II superconductors- Applications: Maglev. | **10** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Understand the concept of lasers and apply laser action in industries.

**CO2:** Explain and interpret the principle of fiber optics for different types of industrialsensors.

**CO3:** Discern the laws governing acoustics and implement the same in acoustic quieting.

**CO4:** Apply the fundamentals of ultrasonics in non-destructive testing.

**CO5:** Evaluate and perceive various laws governing magnetism with special reference to magnetic confinement for future power generation

**Text Books:**


1. Engineering Physics, D.K. Bhattacharya and Poonam Tandon, New Delhi: Oxford University Press (2017)
2. Engineering Physics, S.Mani Naidu, New Delhi: Pearson India Education Services Pvt. Ltd., (2014)


**Reference Books:**


1. Engineering Physics, R.K. Gaur and S.L.Gupta, New Delhi: Dhanpat Rai Publications (P) Ltd. (2008)
2. Engineering Physics, Shatendra Sharma and Jyotsna Sharma, New Delhi: Pearson India Education Services Pvt. Ltd., (2019)
3. Engineering Physics, Dattu R. Joshi, New Delhi: Tata McGraw Hill Education Private Ltd., (2010)
4. A Textbook of Engineering Physics, M. N. Avadhanulu and P. G. Kshirsagar, New Delhi: S.Chand and Company Ltd., (2009)
5. Principles of Physics, Jearl Walker, David Halliday and Robert Resnick, Wiley India Pvt. Ltd., New Delhi (2014), Tenth Edition
6. Sears and Zemansky's University Physics with Modern Physics, Hugh D. Young

and Roger A. Freedman, Pearson Education, New Delhi (2018), Fourteenth Edition.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| **CO 2** | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **CO 3** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **CO 4** | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **CO 5** | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT222** | **Number of Hours/Week** | **2** | | |
| **Semester** | **II** | **Max. Marks** | **100** | | |
| **Year** | **I** | **Credits** | 1 | | |
| **Applied Science Course** | | | | | |
| **Course Title** | **PHYSICS II LAB** | | **L** | **T** | **P** |
| | | | **0** | **0** | **2** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

At the end of the courses, the student will be able to

1. Understand the concept of lasers and its action in industries.
2. Explain the principle of fiber optics for different types of industrial sensors.
3. Apply the basics of Lasers and Optical fibers.
4. Study the principles and applications of acoustics.
5. Discern the laws governing acoustics and its applications in acoustic quieting.
6. Relate the application of light in optical devices.

**List of experiments**

| | |
|---|---|
| **1** | Wavelength Determination – LASER diffraction |
| **2** | Particle size Determination – LASER diffraction |
| **3** | Attenuation of an Optical fibre– Fibre Optic Cable |
| **4** | Numerical Aperture measurement of an Optical Fibre– Fibre Optic Cable |
| **5** | Determination of Planck's constant – LED |
| **6** | Reverberation Time of a hall - Acoustics |
| **7** | Refractive index of a prism – Spectrometer |
| **8** | Wavelength of Mercury spectrum – Diffraction grating – Spectrometer |

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| **CO 2** | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| **CO 3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| **CO 4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| **CO 5** | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT125 | Number of Hours/ Week | 3 |
| Semester | II | Max. Marks | 100 |
| Year | I | Credits | 3 |

**Core Course**

| Course Title | DISCRETE STRUCTURES FOR COMPUTER SCIENCE | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

1. To get familiar and understand the fundamental notions in discrete structures focusing on aspects of computer science
2. To describe binary relations between two sets, combine relations using set operations and composition.
3. To understand and demonstrate the basic concept of algorithm and its application in combinatorial mathematics.
4. To identify the base step and the recursive or inductive step in applied problems and give a recursive and a non-recursive definition for an iterative algorithm.
5. To classify the basic properties of graphs and trees and model simple applications.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Set Theory and Logic**<br>Sets – Functions – Relations - Equivalence Relation – Poset - Functions Logic: Propositional logic - Truth Tables – Tautologies - Resolution Proof System - Predicate Logic | 8 |
| II | **Induction and Combinatorics**<br>Peano's Axioms - Mathematical Induction - Pigeon-Hole Principle - Principle of Inclusion and Exclusion - Review of Permutations and Combinations - Distribution Problems - Derangements - Bijection Principle. | 8 |
| III | **Algebraic Structures**<br>Semi-Groups – Monoids – Groups - Subgroups and Their Properties - Cyclic Groups - Cosets - Permutation Groups - Lagrange's Theorem - Cayley's Theorem - Normal Subgroups - Homomorphism of Groups - Quotient Groups –Introduction to Rings and Fields | 9 |
| IV | **Linear Algebra and Recurrence Relations**<br>Linear Algebra: Vector Space – Basis, Dimension, Orthogonality - Recurrence Relations: Homogeneous and Inhomogeneous Recurrences and their Solutions - Solving Recurrences Using Generating Functions. | 9 |

| | | |
|---|---|---|
| **V** | **Graph Theory**<br>Definitions and Basic Results - Representation of a Graph by a Matrix and Adjacency List - Trees - Cycles - Properties - Paths and Connectedness - Subgraphs - Graph Isomorphism - Operations on Graphs - Vertex and Edge Cuts - Vertex and Edge Connectivity. | **9** |

## COURSE OUTCOMES:

- On successful completion of this course, the student will be able to
- Understand the fundamental aspects of discrete and continuous mathematical structures.
- Demonstrate the principles of mathematical induction to prove statements.
- Differentiate between various algebraic structures and analyze their properties.
- Apply logical reasoning and mathematical techniques to solve problems in set theory, algebra and graph theory.
- Construct new mathematical models thereby generating solutions to complex recurrence relations and graph problems.

## Text Books


1. "Elements of Discrete Mathematics: A Computer Oriented Approach", C. L. Liu, D. P. Mohapatra, McGraw Hill, Third Edition, 2012.
2. "Applied Discrete Structures", Al Doerr, Ken Levasseur, LibreTexts, Third Edition, 2023


## Reference Books


1. "Discrete Mathematical Structures with applications to Computer Science", Tremblay J.P. and Manohar R., McGraw Hill International Edition, 1987.
2. "Discrete Mathematics and Its Applications", Kenneth H. Rosen, Sixth Edition, Tata McGraw Hill, 2012.


### Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 3 |
| **CO 2** | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 3 |
| **CO 3** | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| **CO 4** | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 1 |
| **CO 5** | 3 | 2 | 1 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25EVST921** | **Number of Hours/Week** | 2 | | |
| **Semester** | **II** | **Max. Marks** | **100** | | |
| **Year** | **I** | **Credits** | **2** | | |
| **Value Added Course** | | | | | |
| **Course Title** | **ENVIRONMENTAL SCIENCE** | | **L** | **T** | **P** |
| | | | **2** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To understand the Environmental Foundations
2. To differentiate between renewable and non-renewable resources and assess the impacts of land use changes, land degradation, and water resource exploitation.
3. To study the causes and effects of pollution and its impacts on earth
4. To analyse the population causes, its effects and control measures.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | **Introduction to Environmental studies**<br>Definition and Scope of Environmental Studies - Interdisciplinary Nature of Environmental Science- Historical Perspectives on Environmental Issues- Principles of Sustainability and Sustainable Development, Ecosystem- Structure and functions of ecosystem--Aquatic ecosystems | **6** |
| **II** | **Natural Resources- Renewable and Non-renewable Resources**<br>Land resources and land use change, Land degradation, soil erosion, Desertification- Deforestation- exploitation of surface and ground water, floods, droughts, conflicts over water Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing | **6** |
| **III** | **Biodiversity and Conservation**<br>Levels of biological diversity- genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity patternsand global biodiversity hot spots. | **6** |

| | | |
|---|---|---|
| **IV** | **Environmental Pollution**<br>Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution - Nuclear hazards and human health risks-Solid waste management: Control measures of urban and industrial waste. Pollution case studies, Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment Laws: Environment Protection Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD), Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. | **12** |
| **V** | **Human Communities and the Environment**<br>Human population growth: Impacts on environment, human health and welfare- Resettlement and rehabilitation of project affected persons, Disaster management: floods, earthquake, cyclones and landslides,<br>Environmental movements- Chipko, Silent valley, Bishnoi's of Rajasthan | **10** |

**Andragogy**
Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz,Formative Assessments, Brain storming, Activity.

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1:** | Define environmental studies and its interdisciplinary nature |
| **CO2:** | Analyze the structure and functions of various ecosystems, including aquatic ecosystems. |
| **CO3:** | Evaluate the growing energy needs and the role of alternative energy sources |
| **CO4:** | Understand levels of biodiversity (genetic, species, and ecosystem) and identify<br>biodiversity hotspots, with a focus on conservation strategies. |
| **CO5:** | Evaluate the effects of human population growth on the environment and the importance of disaster management, resettlement, and environmental movements |

**Textbooks**


1. Environmental and Sustainable Development, Keiji Ujikawa, Mikio Ishiwatari, Eric van Hullebusch, 1st Edition springer publishers Singapore, 2022.
2. Environmental Science: Toward A Sustainable Future, Dorothy F. Bourse and Richard T. Wright, 13th edition,Pearson publishers, 2017.
3. Social Learning in Environmental Management: Towards a Sustainable Future, Meg Keen, Valerie A. Brown, Rob Dyball, 2012.

4. Principles of Environmental Science, William P. Cunningham and Mary Ann Cunningham, 10th edition, Mc graw hill publishers, 2004.
5. Visualizing Environmental Science, Linda R. Berg, Mary Catherine Hager and David M. Hassenzahl, 2017.

**Reference Books:**

1. Waste Water Treatment, Rao, M.N., Datta, A.K.,Oxford and IBH Publishing Co. Pvt. Ltd, 1987.
2. Fundamentals of Ecology, Odum, E.P., Odum, H.T., and Andrews, J., , Saunders, Philadelphia, 1971, USA.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO 2** | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO 3** | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO 4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **CO 5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

3 – High, 2 – Average, 1 – Low , 0-Null

# Semester III

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT131 | Number of Hours/ Week | 3 |
| Semester | III | Max. Marks | 100 |
| Year | II | Credits | 3 |
| Core Course | | | |
| Course Title | INTRODUCTION TO ARTIFICIAL INTELLIGENCE | L T P | 3 0 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To explore history and revolution of artificial intelligence
2. To formulate artificial intelligence problem by defining intelligent agent and its environment
3. To learn problem solving approaches through state space search and its different algorithms.
4. To develop an AI model with the help of concepts such as state space search, adversarial search, knowledge representation, inference etc.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to AI**<br>Introducing the structure and scope of the course; Introduction and History of AI; Turing Test; Chinese Room Argument; Milestones in AI; AI Project Discussion – Problem finding, Project resources, Report writing; Intelligent agent – Sensors and Actuators; Examples of Agents; Rationality – perfect and bounded rationality; | 8 |
| II | **Intelligent agent and state space search**<br>Intelligent agent and its environment; Types of environments; Multi- agent environment; Structure of the agent – table based agent, percept based agent, state based agent, goal based agent, utility based agent; Subsumption architecture; Learning agent; State and State space definition; State space search; Problem formulation; 8 Queens problem; 8 Puzzle problem; Problem formulation examples; | 8 |
| III | **Uninformed and Informed Searches**<br>Uninformed search – Breadth first search, Depth first search, Depth limited search, Iterative deepening search, Bidirectional search, Uniform cost search; Informed Search – Greedy best first search, A* search, Memory-bounded search; Heuristic function; | 8 |

| | | |
|---|---|---|
| **IV** | **Local search and adversarial search**<br>Search in complex environment; Local search and optimizations problems; Hill-climbing search; Simulated annealing; Local beam search; Adversarial search; Game theory – Two-player zero-sum games– max and min, utility function, state space graph, game tree, tic-tac-toe example; Minimax search; Alpha-Beta pruning; | **8** |
| **V** | **Constraint satisfaction and Knowledge representation**<br>Constraint satisfaction problem; satisfiability; propagating constraints; forward checking; backward checking; Knowledge representation – Logic, Propositional logic, Reasoning, Modus Ponens; First order logic; quantifiers; Mathematics behind machine learning – Linear algebra basics | **8** |

## COURSE OUTCOMES:

On successful completion of this course, the student will be able to

**CO1 :** Describe the history behind artificial intelligence

**CO2 :** Illustrate fundamental AI concepts

**CO3 :** Demonstrate problem formulation in state space search

**CO4 :** Infers adversarial search with alpha-beta pruning

**CO5 :** Develop an AI model for existing problems

## Text Books:


1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009


## Reference Books:


1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
2. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.


### Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 2 | 0 | 0 |
| **CO2** | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 3 | 3 |
| **CO3** | 3 | 1 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 3 |
| **CO4** | 3 | 1 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 1 | 2 |
| **CO5** | 2 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT132 | Number of Hours/Week | 3 | | |
| Semester | III | Max. Marks | 100 | | |
| Year | II | Credits | 3 | | |
| Core Course | | | | | |
| Course Title | SIGNALS AND SYSTEMS | | L | T | P |
| | | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main aim of learning this course is to

1. Understand the fundamental characteristics of signals and systems.
2. Understand the concepts of vector space, inner product space and orthogonal series.
3. Understand the signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
4. Develop the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Classification of Signals:** Continuous-time vs discrete-time signals, analog vs digital signals, energy and power signals, deterministic vs random signals. Signal Operations: Scaling, time shifting, time inversion, and time scaling of signals. Signal Properties: Symmetry (even and odd signals), periodicity of signals, and absolute integrability. Elementary Signals: Unit step, unit impulse, ramp, exponential, sinusoidal signals. | 9 |

| | | |
|---|---|---|
| **II** | **Systems:** Classification of Systems: Continuous-time vs discrete-time systems, linear vs nonlinear systems, causal vs non-causal systems, time-invariant vs time-varying systems, stable vs unstable systems. System Properties: Linearity, time/shift invariance, causality, and stability. LTI and LSI Systems: Continuous-time linear time-invariant (LTI) systems, discrete-time linear shift-invariant (LSI) systems. Impulse and Step Response: Impulse response and step response of systems. Response to Arbitrary Input: Convolution in continuous and discrete time domains. System Representation: Representation of systems using differential equations for continuous-time systems and difference equations for discrete-time systems. | **9** |
| **III** | **Fourier Series and Transforms:**Fourier Series Representation: Fourier series representation of continuous-time periodic signals, Fourier series of discrete-time periodic signals, properties of Fourier series. Continuous-Time Fourier Transform (CTFT): Fourier transform of continuous-time signals, properties of CTFT (linearity, time shifting, time scaling, etc.), Parseval's theorem, and time-bandwidth product. Discrete-Time Fourier Transform (DTFT): Fourier transform of discrete-time signals, properties of DTFT (linearity, time shifting, time scaling, etc.). Relationships among Fourier Representations: Relationship between Fourier series, CTFT, and DTFT. | **9** |
| **IV** | **Laplace Transform and Sampling:** Laplace Transform: Definition of the Laplace transform, region of convergence (ROC), properties of Laplace transforms (linearity, time shifting, scaling, initial value theorem, final value theorem, etc.), inverse Laplace transform. Sampling: Sampling theorem for bandlimited signals, aliasing in the sampling process, and Nyquist rate. Signal Reconstruction: Ideal signal reconstruction using interpolators, zero-order hold, and first-order hold methods. | **9** |
| **V** | **Z-Transform and Discrete Fourier Transform:**Z-Transform: Definition of the z-transform, region of convergence (ROC) for z-transform, properties of the z-transform (linearity, time shifting, scaling, etc.), inverse z-transform (using partial fraction expansion and power series methods). Discrete Fourier Transform (DFT): Definition and properties of the DFT, relationship between DFT and DTFT, computation of DFT, inverse DFT. | |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1 : U**nderstand different types of signals-continuous and discrete, odd and ever,periodic and aperiodic etc
**CO2 :** to classify systems based on their properties
**CO3 :** familiarize the concepts of transform based continuous time and discrete time
**CO4 : A**nalyze continuous time and discreet time signals and systems by using appropriate mathematical tools
**CO5 : d**etermine Fourier transforms for continuous-time and discrete-time signals (or impulse response functions), and understand how to interpret and plot Fourier transform magnitude and phase functions

**Text Books:**

1. "Signals and Systems" by Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, 1997.
2. D.C. Lay, Linear Algebra and its Applications (2/e), Pearson, 2016.
3. "Digital Signal Processing" by John G. Proakis, Dimitris G. Manolakis, 2007.

**Reference Books:**

1. "Signal Processing and Linear Systems" by B.P. Lathi, 1998.
2. "Signals and Systems: Continuous and Discrete" by Roger E. Ziemer, William H. Tranter, 1998

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| CO 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 0 | 2 | 2 | 1 | 1 |
| CO 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 2 | 2 |
| CO 4 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 0 | 1 |
| CO 5 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT133 | Number of Hours/Week | 3 |
| Semester | III | Max. Marks | 100 |
| Year | II | Credits | 3 |

**Core Course**

| Course Title | DIGITAL DESIGN | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main aim of this course is to prepare the students for:

- To teach various number systems, binary codes and their applications
- To familiarize the students the importance of error detection and error correction codes.
- To inculcate concepts of K-MAP to simplify a Boolean expression
- To facilitate students in designing a logic circuit

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Number Representations:** Binary numbers: binary, octal, and hexadecimal number systems; conversion between different number systems; signed and unsigned numbers; representation of negative numbers using 1's complement and 2's complement. Integer representation: fixed-point number representation; range and precision of fixed-point numbers; overflow and underflow conditions. Floating-point representation, Arithmetic operations in binary: binary addition, subtraction, multiplication, and division; overflow detection and handling. | 7 |
| II | **Combinatorial Circuits:** Boolean Algebra: fundamental theorems and postulates; simplification of Boolean expressions using algebraic techniques. Logic Gates: basic gates (AND, OR, NOT), universal gates (NAND, NOR), XOR and XNOR gates. Minimization of Boolean functions: simplification using Boolean identities; Karnaugh map (K- map) technique for 2, 3, 4, and 5 variables; don't care conditions in K- maps. Combinational Circuits: design and analysis of arithmetic circuits (adders, subtractors); code converters (Binary to Gray, Gray to Binary, BCD to Binary, etc.); multiplexers, demultiplexers, encoders, decoders. | 10 |

| | | |
|---|---|---|
| **III** | **Sequential Circuits:** Introduction to sequential circuits: difference between combinational and sequential circuits; clock signals and timing diagrams. Latches and Flip-Flops: SR Latch, D Latch, JK Flip-Flop, D Flip-Flop, T Flip-Flop; timing constraints: setup time, hold time, propagation delay. Counters: asynchronous (ripple) counters and synchronous counters; modulus of counters; design of up-down counters, ring counters, Johnson counters. Shift Registers: serial-in serial-out (SISO) registers, serial-in parallel-out (SIPO) registers,<br>parallel-in serial-out (PISO) registers; applications of shift registers. | 10 |
| **IV** | **Data Converters:** purpose of sample and hold circuits in digital signal processing; working principle and block diagram. Analog to Digital Converters (ADCs): working principle of ADCs and Digital to Analog<br>Converters (DACs): working principle of DACs | 7 |
| **V** | **Memory and Programmable Logic:** Introduction to memory: classification of memory: volatile vs non-volatile, primary vs secondary; characteristics of memory: access time, memory cycle time, and bandwidth. Random Access Memory (RAM): types of RAM: Static | 7 |

| | | |
|---|---|---|
| | RAM (SRAM) and Dynamic RAM (DRAM); memory cell architecture and organization. Memory decoding: address decoding techniques for RAM; row and column address selection. Read Only Memory (ROM): types of ROM: PROM, EPROM, EEPROM, Programmable Logic Array (PLA) architecture; Programmable Array Logic (PAL) structure | |

## COURSE OUTCOMES:

On successful completion of this course, the student will be able to

**CO1 :** Understand various number systems and their arithmetic operations.

**CO2 :** Design and analyze combinatorial circuits using Boolean algebra, K-maps, and logicgates.

**CO3 :** Work with sequential circuits like latches, flip-flops, counters, and shift registers.

**CO4 :** Interface and design systems using data converters like ADCs and DACs.

**CO5 :** Explore different types of memory and programmable logic devices and apply them indigital systems.

## Text Book


1. "Digital Design" by M. Morris Mano, Michael D. Ciletti, 2013.
2. Digital Systems: Principles and Applications" by Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, 2004.
3. "Microelectronics: Digital and Analog Circuits and Systems" by Jacob Millman and Arvin Grabel, 1987.


## Reference Books


1.Roth (2004), Fundamentals of Logic Design, 5th Edition, Thomson, India, 2018.

2.S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis,Pearson, 2nd Ed, 2003.

3.F. Vahid, Digital Design, 1st Ed., Wiley India, 2011.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 |
| CO 2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 0 | 1 | 2 | 1 | 2 | 3 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 2 | 0 | 2 |
| CO 4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 2 | 2 |
| CO 5 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT134** | **Number of Hours/Week** | **3** |
| **Semester** | **III** | **Max. Marks** | **100** |
| **Year** | **II** | **Credits** | **3** |

**Core Course**

| **Course Title** | **DATA STRUCTURE AND ALGORITHMS** | **L** | **T** | **P** |
|---|---|---|---|---|
| | | **3** | **0** | **0** |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students for,

1. Comprehensive understanding of fundamental data structures and algorithms.
2. Equipping algorithms with the skills to analyze and implement various computational techniques.
3. Learning to select appropriate data structures for solving complex problems, optimize algorithm performance, and gain insight into advanced topics such as dynamic programming and NP- completeness.

| **UNITS** | **TOPICS** | **HOURS** |
|---|---|---|
| **I** | **Introduction to Data Structures**Algorithms- asymptotic notations and analysis- Analysing Algorithms - Insertion sort, Divide and Conquer approach, Sorting, Building Heaps, Heap sort, Quick sort, Analysis of sorting algorithms, | **8** |
| **II** | **Elementary data structures** Stacks and Queues, linked lists and its operations, Hash Tables - Direct and Open addressing.<br>**Tree data structure**<br>Tree- Tree Traversals-Binary Search Trees-Red Black Trees - Red-black trees and its operations. B-Tree-Insertion-Deletion. | **8** |
| **III** | **Dynamic programming**Memoization, Tabulation, Rod Cutting, Matrix Chain Multiplication, Longest common subsequence, Greedy Algorithms- Introducing greedy approach, activity selection problem, Huffman codes, Graphs, Trees and Algorithms | **8** |
| **IV** | **Introducing spanning trees**,<br>Minimum spanning tree, algorithms,Kruskal, Prims, Bellman-Ford algorithm, Single source shortest path in directed acyclic graphs, Dijkstra's algorithms, Floyd-Warshall algorithm | **8** |

| | | |
|---|---|---|
| **V** | **NP-Completeness**<br>Polynomial time, Verification algorithms, NP-Complete, NP-Hard | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Understand the Fundamental Data Structures.

**CO2:** Applying the concept of stack, queue, list, binary search tree andRed black tree.

**CO3:** Analyzing the dynamic programming , greedy algorithms and binary search trees, including performing tree traversals, insertions, and deletions.

**CO4:** Utilize graph representations and perform operations.

**CO5:** Evaluating the implications of computational complexity for algorithm design and problem-solving strategies, including approaches for handling NP-Complete and NP- Hard problems.

**Text Books:**


1. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022.
2. Data Structures And Algorithms In C++, 2nd Edition by Michael T. Goodrich, 2014.
3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 20323.
4. Fundamentals of Data Structures by Ellis Horowitz and Sartaj Sahni, 1978.


**ReferenceBooks:**


1. Chitra.A, Rajan.P.T , (2016*), Data Structures*, Vijay Nicol Imprints Pvt Ltd, McGraw-Hill Education of India Pvt Ltd, India, SecondEdition.
2. Pai.G.A.V,( 2009), *Data Structures andAlgorithms*,TMH.
3. Samanta.D , (2006), *Classic Data Structures*, Prentice Hall of India Pvt Ltd, NewDelhi


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 2 | 3 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | 2 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT135 | Number of Hours/ Week | 3 |
| Semester | III | Max. Marks | 100 |
| Year | II | Credits | 3 |

**Core Course**

| Course Title | OBJECT ORIENTED PROGRAMMING WITH JAVA | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students for:**

1. To introduce the fundamentals of Java programming language.
2. To enable students to write object-oriented programs.
3. To familiarize students with advanced Java concepts like multithreading, exception handling, and collections.
4. To provide hands-on experience in developing real-world applications using Java.

| UNITS | TOPICS | HOURS |
|---|---|---|
| I | **Basics of Java Programming** Introduction to Java: Features, JVM, JDK, and JRE.-Writing, compiling, and executing Java programs.-Data types, variables, and operators.-Control structures: Decision-making , loops .-Arrays and Strings: Declaration, initialization, and operations. | 9 |
| II | **Object-Oriented Programming in Java** Classes and Objects: Declaration, instantiation, and initialization.-Methods: Static, instance, and parameterized methods -Constructors and destructors.-Inheritance: Single, multilevel, hierarchical, and overriding.Polymorphism: Compile-time and runtime,Encapsulation and abstraction.Interfaces and abstract classes**.** | 9 |
| III | **Exception Handling and Multithreading** Exception handling: Try-catch block, multiple catch, finally, throw, and throws. Built-in exceptions and user-defined exceptions. Multithreading: Thread lifecycle, creating threads -Thread class, Runnable interface. Thread synchronization and inter-thread communication. | 9 |

| | | |
|---|---|---|
| **IV** | **File I/O and Streams**<br>Reading and writing files using FileReader, FileWriter, BufferedReader, and BufferedWriter. Byte and character streams. Serialization and deserialization. | **9** |
| **V** | **GUI Programming and Event Handling**<br>Introduction to AWT and Swing-Layout managers -FlowLayout, GridLayout, BorderLayout.Event handling: ActionListener, MouseListener, KeyListener. Creating simple GUI applications. | **9** |

**Andragogy:**

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1:** | Understand and apply Java syntax and semantics. |
| **CO2:** | Implement object-oriented programming concepts in Java. |
| **CO3:** | Develop Java applications with exception handling and multithreading. |
| **CO4:** | Use Java frameworks and APIs for GUI and database integration. |
| **CO5:** | Solve real-world problems using Java programming. |

**Text Books:**

1. "Programming in Java" by K. Somasundaram, by **PHI Learning Pvt. Ltd.**
2. "Java: The Complete Reference" by Herbert Schildt

**Reference Books:**

1. "Thinking in Java" by Bruce Eckel
2. "Effective Java" by Joshua Bloch
3. "Java Programming for Beginners" by Mark Lassoff

**Websites for Learning & Tools:**

1. **Oracle Java Tutorials**

Website: https://docs.oracle.com/javase/tutorial/

2. **GeeksforGeeks - Java Programming**

Website: https://www.geeksforgeeks.org/java/

3. **W3Schools - Java Tutorial**

Website: https://www.w3schools.com/java/

4. **JavaTpoint**

Website: https://www.javatpoint.com/

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO. 10 | PO 11 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 3 | - | - | 2 | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | 2 | 3 | - | - | 2 | - | - | - | - | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 1 | - | - | - | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | - | - | - | - | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT136** | **Number of Hours/Week** | **2** | | |
| **Semester** | **III** | **Max. Marks** | **100** | | |
| **Year** | **II** | **Credits** | **2** | | |
| **Core Course** | | | | | |
| **Course Title** | **PROFESSIONAL ETHICS** | | **L** | **T** | **P** |
| | | | **2** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To identify and understand key concepts of human values, including ethics, integrity, and professional responsibility.
2. To explore moral theories and frameworks related to engineering ethics, and analyze how these impact decision-making.
3. To evaluate the role of engineers in society through the lens of social experimentation, responsibility, and professional codes of conduct.
4. To assess safety and risk management principles, rights and responsibilities, including intellectual property and occupational ethics.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | **Human Values**<br>Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character - Spirituality – Introduction to Yoga and meditation for professional excellence and stress management. | **8** |
| **II** | **Engineering Ethics**<br>Senses of Engineering Ethics – Variety of moral issues – Types of inquiry<br>– Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest, Customs and Religion – Uses of Ethical Theories. | **8** |
| **III** | **Engineering as Social Experimentation**<br>Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law. | **8** |

| | | |
|---|---|---|
| **IV** | **Safety, Responsibilities and Rights**<br>Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination. | **8** |
| **V** | **Global issues**<br>Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Recognize the significance of human values and ethics in personal and professionallife.

**CO2:** Analyze various moral theories and ethical dilemmas in engineering practices.

**CO3:** Evaluate the responsibilities of engineers as experimenters and decision-makerswithin legal and ethical frameworks.

**CO4:** Assess risk and safety issues, including intellectual property and employee rights inengineering contexts.

**CO5:** Apply ethical theories and frameworks to make informed engineering decisions.

**Text Books:**

1. Naagarazan, R.S. A Textbook on Professional Ethics and Human Values, New Age InternationalLimited Publishers: New Delhi, 2006.

**Reference Books:**

1. Charles B. Fleddermann, ―Engineering Ethics , Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ―Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 1 | 0 | 0 |
| CO2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 |
| CO3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 |
| CO4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 |
| CO5 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 0 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Pogramme | B.Tech CSE (AI&IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT231 | Number of Hours/Week | 2 | | |
| Semester | III | Max. Marks | 100 | | |
| Year | II | Credits | 1 | | |
| Core Course | | | | | |
| Course Title | DIGITAL DESIGN LAB | | L | T | P |
| | | | 0 | 0 | 2 |

## Digital design lab list of experiments

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex- OR, Ex-NOR gates
2. Construction of half and full adder using XOR and NAND gates and verification of its operation
3. To Study and Verify Half and Full Subtractor
4. Realization of logic functions with the help of Universal Gates (NAND, NOR)
5. Construction of a NOR gate latch and verification of its operation
6. Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates
7. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers
8. Implementation and verification of decoder or de-multiplexer and encoder using logic gates
9. Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates
10. Design and verify the 4- Bit Synchronous or Asynchronous Counter using JK Flip Flop
11. Verify Binary to Gray and Gray to Binary conversion using NAND gates only
12. Verify the truth table of one bit and two bit comparator using logic gates.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 0 | 1 | 2 | 1 | 2 | 3 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 | 2 | 0 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT232** | **Number of Hours/Week** | **2** | | |
| **Semester** | **III** | **Max. Marks** | **100** | | |
| **Year** | **II** | **Credits** | 1 | | |
| **Core Course** | | | | | |
| **Course Title** | **DATA STRUCTURE AND ALGORITHMS LAB** | | **L** | **T** | **P** |
| | | | **0** | **0** | **2** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**COURSE OBJECTIVES:**

1. To implement basic data structures like arrays linked lists, stacks, and queues.
2. To develop skills in implementing algorithms for searching and sorting.
3. To gain hands-on experience with tree and graph data structures.
4. To apply recursion and dy`namic memory management in problem-solving.
5. To understand the practical implications of algorithm efficiency and optimization.

**Programs:**

1. Program for Insertion sort.
2. Program for Quick sort.
3. Program for Merge sort.
4. Program for Heap sort.
5. Implementation of a stack using an array with push and pop operations.
6. Implementation of swap () function using stack.
7. Implementation of swap () function using queue.
8. Singly linked list with basic operations.
9. Double linked list with basic operations.
10. Hash table using direct addressing.
11. Hash table using indirect addressing.
12. Binary search tree with insertion and traversal.
13. Graphs
    a. Depth First Search (DFS)
    b. Breadth First Search (BFS)
    c. Dijkstra's Algorithm (Shortest Path in Weighted Graph)
    d. Kruskal's Algorithm (Minimum Spanning Tree)
14. Tree Algorithms
    a. Binary Search Tree (BST) Operations
    b. AVL Tree (Balanced BST) Insertions
15. Verifying a Solution for the Knapsack Problem.

**Course Outcomes:**

By learning Data Structures and Algorithms, students will be able to

CO1 : Demonstrate the implementation of basic data structures in real-world problems.
CO2 : Apply various searching and sorting techniques in practical scenarios.
CO3 : Implement tree and graph algorithms effectively.
CO4 : Solve complex problems using recursion and dynamic memory management.
CO5 : Analyze and optimize algorithms for better performance in practical applications.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 2 | 3 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | 2 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT233** | **Number of Hours/Week** | **2** | | |
| **Semester** | **III** | **Max. Marks** | **100** | | |
| **Year** | **II** | **Credits** | **1** | | |
| **Core Course** | | | | | |
| **Course Title** | **PROGRAMMING WITH JAVA LAB** | | **L** | **T** | **P** |
| | | | **0** | **0** | **2** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P -Practical Hours** | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students,**

- To introduce the fundamentals of Java programming language.
- To enable students to write object-oriented programs.
- To familiarize students with advanced Java concepts like multithreading, exception handling, and collections.
- To provide hands-on experience in developing real-world applications using Java.

**PROGRAMS**

1. Write a Java program to calculate the factorial of a number using loops.
2. Implement a program to demonstrate the use of arrays and string operations (reverse, concatenate, length).
3. Create a program to find the largest and smallest numbers in an array.
4. Create a class Student with properties name, rollNumber, and marks. Write methods to calculate and display the grade.
5. Demonstrate single and multilevel inheritance using classes for Shape, Rectangle, and Square.
6. Implement polymorphism using method overloading and method overriding.
7. Write a program to handle ArrayIndexOutOfBoundsException and NumberFormatException.
8. Create a multithreaded program to calculate the sum of odd and even numbers in an array using two threads.
9. Demonstrate thread synchronization by simulating a producer-consumer problem.
10. Write a program to copy the contents of one text file to another using FileReader and FileWriter.
11. Implement a program to serialize and deserialize an object of a class Employee.
12. Create a program to count the number of words and characters in a text file.
13. Create a simple calculator using AWT/Swing with basic arithmetic operations.
14. Develop a GUI application to accept student details and display them in a table format.
15. Create a Java Swing application to simulate a login screen with username and password validation.

# Semester IV

| Programme | B.Tech CSE (AI&IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT141 | Number of Hours/Week | 3 | | |
| Semester | IV | Max. Marks | 100 | | |
| Year | II | Credits | 3 | | |
| Core Course | | | | | |
| Course Title | MACHINE LEARNING | | L | T | P |
| | | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students for:

- To explore fundamental concepts in machine learning
- To equip different concepts in machine learning with mathematical intuition
- To construct an existing problem into standard machine learning paradigm
- To develop an innovative ML model for research problems using different ML tools and standard datasets

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to machine learning**<br>Introduction to machine learning; Mathematics behind machine learning; Linear algebra - Vector space, system of linear equations, projection, Solving Ax=b, projection, least square problem, eigen values and vectors, eigen decomposition, singular value decomposition; Probability – expectation, variance, covariance; Multivariable calculus basics; | 8 |
| II | **Linear and Logistic Regression**<br>Linear Regression – cost function, optimization function; gradient descent – batch, mini-batch, stochastic; normal equation; regularization - ridge regression; feature scaling; logistic regression – sigmoid function, solving cost function; maximum likelihood estimation; gaussian discriminant analysis; naïve bayes; | 8 |
| III | **SVM and Bayesian learning**<br>Support vector machine – linear discriminant analysis, KKT theorem, primal-dual problem; Kernels – polynomial, gaussian; decision trees – information gain, gini index; Bayesian learning – bayes minimum risk classifier; multivariate normal distribution; softmax classifier; Non-linear functions – threshold, sigmoid, ReLU, tanh; | 8 |

| | | |
|---|---|---|
| **IV** | **Neural Networks and CNN**<br>Neural networks; perceptron; multilayer perceptron; backpropagation algorithm; autoencoder – deep autoencoder, sparse auto encoder, denoising autoencoder; convolution; convolutional neural network – pooling, padding, strided convolution; CNN example – LeNet, AlexNet, VGGNet, ResNet, GoogleNet; | **8** |
| **V** | **Clustering and Dictionary learning**<br>Clustering – K-means, K-medoids; issues in deep learning – vanishing/exploding gradient problem, overfitting, covariate shift; momentum optimizer; Nesterov accelerated gradient; adagrad; RMS prob; ada delta; underdetermined system of linear equations; pursuit algorithms; sparse coding; dictionary learning; | **8** |

## COURSE OUTCOMES:

On successful completion of this course, the student will be able to

**CO1 :** Infer mathematical concepts behind machine learning

**CO2 :** Distinguish different ML concepts in terms of applications

**CO3 :** Implement standard ML algorithms for applications

**CO4 :** Validate the ML models to improve the performance

**CO5 :** Develop an ML model for existing problems

## Text Books:


1. Gilbert Strang. Introduction to Linear Algebra. Wellesley-Cambridge Press, USA, 5th edition, 2016.
2. Andrew Ng. Machine Learning Yearning. deeplearning.ai, 2018.


## Reference Books:


1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
2. M. Elad, Sparse and Redundant Representations: From Theory to Applications in Signal and Image Processing, Springer, 2010.


### Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 1 | 2 |
| **CO 2** | 3 | 2 | 1 | 3 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 3 |
| **CO 3** | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 2 | 3 |
| **CO 4** | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE-(AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT241 | Number of Hours/WK | 2 | | |
| Semester | IV | Max. Marks | 100 | | |
| Part | | Credit | 1 | | |
| Core Course | | | | | |
| Course Title | MACHINE LEARNING LABORATORY | | L | T | P |
| | | | 0 | 0 | 2 |

**Course Objective:**

The main learning objective of this course is to prepare the students,

1. To practice fundamental concepts in machine learning
2. To introduce mathematical tools in machine learning
3. To introduce various framework for machine learning
4. To implement neural networks, CNN for applications
5. To implement research topic as part of ML project

**List of experiments:**

| S.NO | TITLE |
|---|---|
| 1 | Implement Least square problem, eigen value decomposition, singular value decomposition |
| 2 | Implement Linear regression and ridge regression using gradient descent and normal equation |
| 3 | Implement logistic regression with sigmoid function |
| 4 | Implement support vector machine and kernel function with KKT tools |
| 5 | Implement guassian discriminant analysis and naïve bayes and compare the performance with different datasets |
| 6 | Implement non-linear functions such as Threshold, Sigmoid, Tanh, ReLU |
| 7 | Implement multi-layer fully connected feed forward and backpropagation algorithm for training |
| 8 | Implement convolutional neural network for computer vision tasks |
| 9 | Implement research topic as part of ML project |

**Course outcomes:**

CO1 : Execute mathematical concepts with and without tools

CO2 : Implement standard ML algorithms for applications

CO3 : Utilize the ML tools for applications

CO4 : Simulate ML research problems

CO5 : Develop an ML model for existing problems

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 2 |
| **CO 2** | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 2 | 0 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 2 | 0 | 2 | 2 | 2 | 3 |
| **CO 4** | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT142** | **Number of Hours/Week** | **3** |
| **Semester** | **IV** | **Max. Marks** | 100 |
| **Year** | **II** | **Credits** | **3** |

**Core Course**

| | | | | |
|---|---|---|---|---|
| **Course Title** | **Introduction to Internet of Things** | **L** | **T** | **P** |
| | | **3** | **0** | **0** |

**L-Lecture Hours** **T-Tutorial Hours** **P-Practical Hours**

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students for:

1. Introduce the fundamental concepts, architecture, and components of the Internet of Things (IoT).

2. Familiarize students with various communication technologies, protocols, and networking standards used in IoT.

3. Provide an understanding of IoT system design—both hardware and software components.

4. Expose students to IoT data management, cloud connectivity, and security mechanisms.

5. Enable students to develop small-scale IoT applications and understand emerging IoT trends and challenges.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | **Unit I-Definition, characteristics, and evolution of IoT**<br><br>IoT functional blocks and reference architecture- IoT enabling technologies: sensors, actuators, embedded systems, wireless communication- IoT vs M2M vs CPS (Cyber Physical Systems)- Application domains: Smart home, smart city, industrial IoT, healthcare, agriculture- Challenges and design considerations (energy, scalability, interoperability). | **9** |

| | | |
|---|---|---|
| **II** | **UNIT II – IoT Devices, Sensors, and Communication**<br><br>Hardware platforms: Arduino, Raspberry Pi, ESP32- Interfacing sensors and actuators: analog/digital input-output, ADC/DAC basics- Communication models: device-to-device, device-to-cloud, device-to-gateway- Networking technologies: RFID, Wi-Fi, Bluetooth Low Energy (BLE), ZigBee, LoRaWAN, 6LoWPAN, NB-IoT- Data transmission models and addressing schemes (IPv4, IPv6) | **9** |
| **III** | **UNIT III – IoT Protocols and Cloud Connectivity**<br><br>Overview of IoT communication protocols: MQTT, CoAP, HTTP/REST, AMQP- IoT data formats: JSON, XML- IoT gateways, message brokers, and edge devices- Cloud and fog computing for IoT: AWS IoT, Google IoT Core, Azure IoT Hub- IoT data analytics and visualization- Security and privacy aspects in data communication. | **9** |
| **IV** | **UNIT IV – IoT System Design and Applications**<br><br>Logical design: IoT device, gateway, cloud, and dashboard integration- Physical design: hardware setup, firmware, power management- Developing IoT applications: sensor data acquisition, control, and cloud interfacing- Tools and software: Node-RED, Blynk, ThingSpeak, Arduino IDE, Python libraries- Case studies: Smart irrigation, healthcare monitoring, home automation, industrial monitoring. | **9** |
| **V** | **UNIT V – IoT Security, Standards, and Future Trends**<br><br>Security requirements and challenges in IoT systems- Authentication, encryption, and secure firmware updates- Privacy and trust management- IoT standards and interoperability frameworks (oneM2M, IEEE, IETF)- Emerging trends: Industrial IoT (IIoT), 5G-enabled IoT, AI and Edge Analytics, Digital Twin, Smart Grid- Mini project / IoT prototype demonstration. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Explain the fundamentals, architecture, and characteristics of IoT systems.
**CO2:** Identify and describe sensors, actuators, and communication technologies for IoT.
**CO3:** Compare and implement different IoT communication protocols and cloud connectivity mechanisms.
**CO4:** Design simple IoT applications integrating hardware, software, and network components.
**CO5:** Evaluate IoT challenges such as security, scalability, and interoperability and identify future trends.

**Text Books**


[1] Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press, 2015.

[2] Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill, 2017.


**Reference Books:**


[3] Olivier Hersent, David Boswarthick, and Omar Elloumi, *The Internet of Things: Key Applications and Protocols*, Wiley, 2012.

[4] Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, Wiley, 2014.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 0 | 1 | 0 | 2 | 2 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI&IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT242** | **Number of Hours/Week** | **2** |
| **Semester** | **IV** | **Max. Marks** | **100** |
| **Year** | **II** | **Credits** | 1 |

**Core Course**

| **Course Title** | **Embedded Systems and IoT Protocols Laboratory** | **L** | **T** | **P** |
|---|---|---|---|---|
| | | **0** | **0** | **2** |

**L-Lecture Hours** **T-Tutorial Hours** **P-Practical Hours**

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students,

1. To introduce hands-on experience in working with microcontrollers and embedded systems.
2. To familiarize with various IoT communication protocols and interfacing sensors and actuators.
3. To enable to design, develop, and test IoT-based applications.
4. To demonstrate data acquisition, analysis, and communication between IoT devices and cloud platforms.
5. To understand real-time data monitoring and control in IoT environments.

**Programs**

1. Introduction to Arduino IDE and Raspberry Pi OS installation.
2. Writing simple programs – LED blinking, reading digital/analog pins.
3. Interfacing temperature, humidity, and light sensors with Arduino.
4. Interfacing ultrasonic and motion sensors for distance and object detection.
5. Interfacing Bluetooth (HC-05), Wi-Fi (ESP8266/ESP32), and GSM modules.
6. Data transmission using UART, I2C, and SPI communication protocols.
7. Implementation of MQTT protocol for IoT data transfer.
8. Implementation of CoAP and HTTP-based IoT data transmission.
9. Sending sensor data to cloud platforms like ThingSpeak, AWS IoT, or Google Firebase.
10. IoT-based mini-project — *Smart Home Automation, Smart Parking, or Health Monitoring System.*

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1:** Demonstrate the basic programming skills of microcontrollers such as Arduino and Raspberry Pi.

**CO2:** Interface various sensors, actuators, and communication modules with embedded devices.

**CO3:** Implement IoT communication protocols such as MQTT, CoAP, and HTTP for device communication.

**CO4:** Integrate IoT devices with cloud platforms like ThingSpeak, AWS IoT, or Blynk for data visualization.

**CO5:** Develop a complete IoT prototype addressing real-world problems.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **CO 2** | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| **CO 3** | 2 | 0 | 3 | 3 | 2 | 3 | 0 | 1 | 2 | 0 | 2 | 1 | 0 | 0 | 3 |
| **CO 4** | 2 | 2 | 2 | 2 | 2 | 3 | 0 | 1 | 2 | 0 | 2 | 1 | 2 | 0 | 1 |
| **CO 5** | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 2 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech. CSE- (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT143 | Number of Hours/ Week | 3 | | |
| Semester | IV | Max. Marks | 100 | | |
| Year | II | Credits | 3 | | |
| Core Course | | | | | |
| Course Title | COMPUTER ORGANIZATION AND ARCHITECTURE | | L | T | P |
| | | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students:

- To understand the architecture and basic components of a computer system.
- To learn data representation and perform arithmetic operations.
- To study control unit design and high-performance processor concepts.
- To explore memory systems and storage technologies.
- To examine I/O interfacing, communication, and bus systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Fundamentals of Computer Architecture and Organization**<br>Overview of Organization vs. Architecture - Functional components: Registers, Register files, Interconnection of components - IAS computer function, von Neumann & Harvard architectures - CISC vs. RISC architectures - Introduction to Instruction Sets - Instruction Set Architecture (ISA), instruction formats, instruction set categories - Addressing modes - Phases of instruction cycle | 9 |
| II | **Data Representation and Arithmetic Operations**<br>Representation of data: Binary, Hex, Character codes - Fixed-point arithmetic: Booth's Algorithm, Modified Booth's; Restoring and Non-restoring Division - Floating-point arithmetic: Addition, Subtraction, Multiplication, Division - ALU concepts - Performance Metrics: Execution time, MIPS, MFLOPS | 9 |
| III | **Control Unit and High Performance Processors**<br>Datapath and Control Unit: Hardwired Control; Microprogrammed Control - Pipelining: Two-stage, Multi-stage - Hazards: Structural, Data, Control - Hazard resolution techniques and limitations - Branch handling techniques - Flynn's taxonomy (SISD, SIMD, MISD, MIMD) - Superscalar and Super pipeline architectures - Amdahl's Law, Speed-up and Efficiency | 9 |

| | | |
|---|---|---|
| **IV** | **Memory System Organization and Storage Subsystems**<br>Memory hierarchy & types - Byte storage methods, conceptual view of memory cells - RAM and ROM, scalable memory design - Cache memory: Mapping techniques, Replacement policies, Management techniques, Mean access time evaluation - Memory Interleaving and Address mapping - External Storage: SSDs, Disk structure - RAID levels, ECC (Error detection & correction) - Reliability of memory systems | **9** |
| **V** | **Interfacing, Communication and I/O Systems**<br>I/O Fundamentals: Handshaking, Buffering, I/O Modules - I/O Techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access (DMA), Direct Cache Access - Interrupt structures: Vectored, Prioritized - Bus systems: Synchronous & Asynchronous - Bus Arbitration Techniques - I/O Performance considerations | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**CO1 :** Describe computer architecture, organization, and instruction formats

**CO2 :** Perform binary, fixed-point, and floating-point arithmetic operations.

**CO3:** Explain control unit design, pipelining, and parallel architectures

**CO4 :** Analyze memory hierarchy, cache systems, and storage reliability

**CO5 :** Evaluate I/O techniques, bus structures, and interfacing methods

**Text Books:**

1. David A. Patterson and John L. Hennessy, Computer Organization and Design – The Hardware / Software Interface, 6th Edition, Morgan Kaufmann, 2020.

**ReferenceBooks:**

1. Computer Architecture and Organization – Designing for Performance, William Stallings, 11th Edition, Pearson Education Series, 2022.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, Fifth Edition, Reprint 2011.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 0 | 2 | 3 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | 2 | 2 | 0 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI&ML) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT841 | Number of Hours/ Week | 3 | | |
| Semester | IV | Max. Marks | 100 | | |
| Year | II | Credits | 3 | | |
| Skill Enhancement Course | | | | | |
| Course Title | ENGINEERING ECONOMICS & FOREIGN TRADE | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

1. To understand basic economic principles relevant to engineering.
2. To analyze consumer and producer behavior using economic models.
3. To explore market structures and pricing mechanisms.
4. To apply cost estimation techniques in engineering decisions.
5. To gain awareness of foreign trade, globalization, and their impact.

| UNITS | TOPICS | HOURS |
|---|---|---|
| I | **Introduction**<br>The themes of economics – scarcity and efficiency – three fundamental economic problems – society's capability – Production possibility frontiers (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Micro economies and Macro economies – the role of markets and government – Positive Vs negative externalities. | 10 |
| II | **Consumer and Producer Behaviour**<br>Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behavior – consumer equilibrium – Approaches to consumer behavior – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short- run and long-run cost function – Relation between Production and cost function | 10 |
| III | **Product and Factor Market**<br>Product market – perfect and imperfect market – different market structures – Firm's equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and, efficiency of competitive markets. | 9 |

| | | |
|---|---|---|
| **IV** | **Engineering Costs & Estimation**<br>Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model. Inflation, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic, Analysis. | **10** |
| **V** | **Foreign Trade**<br>Introduction, Definition of Foreign Trade, balance of Trade, difference between international and domestic business, Advantages and Disadvantages of International Business, Globalization of Markets, Trends in Globalization, Effects and Benefits of Globalization, balance of payment and foreign exchange. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| **Course Outcomes** |
|---|
| **CO 1:** Understand the fundamental themes of economics |
| **CO 2:** Demonstrate market dynamics including demand and supply and their determinants. |
| **CO 3:** Appraise the firm equilibrium and supply in relation to market efficiency. |
| **CO 4:** Illustrate the different engineering cost concepts, including fixed, variable, and<br>opportunity costs, and apply these concepts to perform break-even analysis. |
| **CO 5:** Evaluate the globalization trends, balance of payments and foreign exchange dynamics. |

**Textbook:**

1. Karl E. Case and Ray C. fair, Principles of Economics, 7th edition, Pearson, Education Asia, NewDelhi, 2022.

**Reference Books:**

1. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, Economics, 19thedition, Tata McGraw Hill, New Delhi, 2021
2. William Boyes and Michael Melvin, Textbook of economics, Biztantra, 2022.
3. N. Gregory Mankiw, Principles of Economics, 8th edition, Thomson learning, New Delhi,2021

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| **CO 2** | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| **CO 3** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| **CO 4** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| **CO 5** | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |

3 – High, 2 – Average, 1 – Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT341 | Number of Hours/ Week | 3 |
| Semester | IV (DSE I) | Max. Marks | 100 |
| Year | II | Credits | 3 |

**Discipline Specific Elective I**

| Course Title | Human-Computer Interaction and Intelligent Interfaces | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the foundations of Human–Computer Interaction (HCI) and its design principles.
2. Develop understanding of cognitive models, user-centered design, and usability engineering.
3. Enable students to design and evaluate user interfaces using usability metrics.
4. Introduce intelligent interfaces incorporating AI, ML, and natural language interaction.
5. Explore future interaction paradigms including gesture, voice, and immersive systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Human–Computer Interaction:** The human, the computer, and the interaction. Goals of HCI, Human Information Processing Model, Cognitive Framework. Interaction styles: Command line, Menu selection, Form filling, Direct manipulation, Natural language. Usability goals and measures. Principles of good interface design. | 8 |
| II | **Design Process and User-Centered Design**<br><br>Design frameworks: Norman's model of interaction, Shneiderman's eight golden rules. User-centered design and participatory design methods. Task analysis: Hierarchical Task Analysis (HTA), GOMS model. Prototyping and iterative design process. Evaluation techniques: heuristic evaluation, cognitive walkthroughs. | 8 |

| | | |
|---|---|---|
| **III** | **Interface Design and Evaluation**<br><br>Visual design and typography. Color theory and graphical interface design principles. Input/output devices and interaction hardware. Usability testing and measurement. Accessibility and inclusive design: WCAG and assistive technologies. | **8** |
| **IV** | **Intelligent Interfaces:**<br><br>Introduction to intelligent user interfaces (IUIs). AI in HCI: adaptive and context-aware interfaces. Natural Language Interfaces and Conversational Agents. Affective computing and emotion recognition in interaction. Personalized systems and recommender interfaces. | **8** |
| **V** | **Advanced and Emerging Interaction Paradigms:**<br><br>Multimodal interfaces: speech, gesture, touch, eye tracking. Brain-Computer Interfaces (BCI). Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). Ethical and social implications of intelligent interfaces. Case studies and applications of intelligent HCI systems. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Describe the fundamental concepts and models of Human–Computer Interaction. |
| **CO2** | Apply design principles and user-centered design approaches to create usable interfaces |
| **CO3** | Analyze and evaluate user interfaces using usability metrics and testing techniques. |
| **CO4** | Integrate AI and ML concepts to develop intelligent and adaptive interfaces. |
| **CO5** | Examine emerging interaction technologies and assess their impact on user experience. |

**Text Books:**


1. A. Dix, J. Finlay, G. Abowd, and R. Beale, *Human–Computer Interaction*, 3rd ed., Pearson Education, Mar. 2004.

2. B. Shneiderman, C. Plaisant, M. Cohen, S. Jacobs, and N. Elmqvist, *Designing the User Interface: Strategies for Effective Human–Computer Interaction*, 6th ed., Pearson, Jan. 2017.

3. D. Benyon, *Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design*, 4th ed., Pearson, Apr. 2019.

**Reference Books:**


1. D. Norman, *The Design of Everyday Things*, Revised and Expanded Ed., Basic Books, Nov. 2013.
2. R. Jacob and K. John, *Human–Computer Interaction: Concepts and Design*, Springer, May 2018.
3. M. Tkalčič, B. De Carolis, and M. De Gemmis, *Emotional Intelligence in Human–Computer Interaction*, Springer, Feb. 2021.
4. J. A. Jacko, *Human–Computer Interaction Handbook*, 3rd ed., CRC Press, Jul. 2012.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 3 | 0 | 1 | 0 | 2 | 2 | 0 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 1 | 2 | 2 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 2 |
| CO5 | 2 | 2 | 3 | 3 | 1 | 0 | 2 | 0 | 0 | 2 | 2 | 2 | 1 | 0 | 2 |

high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT342** | **Number of Hours/ Week** | **3** | | |
| **Semester** | **IV (DSE I)** | **Max. Marks** | **100** | | |
| **Year** | **II** | **Credits** | **3** | | |
| **Discipline Specific Elective I** | | | | | |
| **Course Title** | **Optical Fiber Communication** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the fundamentals of optical fiber communication and light propagation mechanisms.
2. Study fiber types, characteristics, and signal transmission concepts.
3. Analyze different optical sources, detectors, and modulation schemes.
4. Explore optical amplifiers, multiplexing techniques, and system design considerations.
5. Understand advanced optical networks and recent trends in fiber-optic communication.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Optical Fiber Communication**<br><br>Overview of optical communication systems. Historical evolution and advantages of optical fibers. Elements of an optical fiber communication link. Structure and classification of optical fibers: step-index and graded-index fibers. Applications of optical fiber communication in various domains. | **9** |

| | | |
|---|---|---|
| **II** | **Light Propagation and Transmission Characteristics**<br><br>Principles of light propagation in optical fibers. Total internal reflection, acceptance angle, and numerical aperture. Modes in step-index and graded-index fibers. Signal attenuation and dispersion: material, waveguide, and modal dispersion. Fiber losses and bandwidth-distance product. | **9** |
| **III** | **Optical Sources, Detectors, and Couplers**<br><br>Optical sources: LEDs and Laser Diodes — characteristics and comparison. Optical detectors: PIN photodiodes, Avalanche photodiodes (APD). Optical couplers, connectors, and splices. Power launching and coupling techniques. Signal-to-noise ratio and receiver sensitivity. | **9** |
| **IV** | **Optical Fiber Communication Systems and Components**<br><br>Optical transmitters and receivers – design and operation. Digital transmission systems and modulation formats (ASK, PSK, FSK, OOK). Optical amplifiers – EDFA, Raman, and SOA. Wavelength Division Multiplexing (WDM) and DWDM systems. Optical network topologies and system design considerations. | **9** |
| **V** | **Advanced Optical Networks and Applications**<br><br>Coherent optical communication systems. Optical solitons and nonlinear effects in fibers. Passive Optical Networks (PONs) and FTTH technology. Optical switching, routing, and network management. Recent trends: Optical wireless communication, free-space optics, and photonic integrated systems. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the basic principles and structure of optical fiber communication systems. |
| **CO2** | Analyze fiber characteristics, propagation mechanisms, and losses in optical fibers. |
| **CO3** | Evaluate the performance of optical sources, detectors, and coupling components. |
| **CO4** | Design and analyze optical communication systems using various modulation and multiplexing techniques. |

| | |
|---|---|
| **CO5** | Explore advanced optical networks and recent developments in fiber communication technology. |

**Text Book:**


1. G. Keiser, *Optical Fiber Communications*, 5th ed., McGraw Hill Education, Apr. 2017.
2. J. M. Senior, *Optical Fiber Communications: Principles and Practice*, 3rd ed., Pearson Education, Jan. 2009.
3. J. C. Palais, *Fiber Optic Communications*, 5th ed., Pearson, Jul. 2010.


**Reference Books:**


1. I. P. Kaminow and T. Li, *Optical Fiber Telecommunications IV-A: Components*, Academic Press, Mar. 2013.
2. Govind P. Agrawal, *Fiber-Optic Communication Systems*, 5th ed., Wiley-Blackwell, Nov. 2021.
3. S. Subramaniam and J. Hu, *Optical Networks: A Practical Perspective*, Elsevier, Jun. 2019.
4. H. Dutton, *Understanding Optical Communications*, IBM Redbooks, Sep. 2014.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 2 | 1 | 2 | 1 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 2 | 3 |

high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT343 | Number of Hours/ Week | 3 | | |
| Semester | IV (DSE I) | Max. Marks | 100 | | |
| Year | II | Credits | 3 | | |
| Discipline Specific Elective I | | | | | |
| Course Title | MIMO and 5G Technologies | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students to:**

1. Introduce the fundamentals of MIMO (Multiple Input Multiple Output) systems and their importance in modern wireless communication.
2. Explain various MIMO architectures, channel models, and diversity techniques.
3. Study the key enabling technologies for 5G networks such as massive MIMO, millimeter-wave communication, and beamforming.
4. Analyze 5G network architecture, radio access techniques, and performance metrics.
5. Explore current trends, challenges, and applications of MIMO and 5G in intelligent and IoT-based systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Fundamentals of MIMO Systems**<br><br>Overview of MIMO concepts and system model. SISO, SIMO, MISO, and MIMO configurations. Spatial diversity, spatial multiplexing, and channel capacity. Antenna correlation and channel state information (CSI). Benefits and limitations of MIMO. | 9 |
| II | **MIMO Techniques and Channel Models**<br><br>Fading channel models: Rayleigh, Rician, Nakagami-m. Space–time block codes (STBC) and space–time trellis codes (STTC). Alamouti scheme and orthogonal designs. MIMO channel estimation and equalization. Multi-user MIMO and precoding techniques. | 9 |

| | | |
|---|---|---|
| **III** | **5G Network Architecture and Key Enablers**<br><br>Evolution from 1G to 5G – comparative overview. 5G system architecture: Core network, access network, and air interface. 5G spectrum: Sub-6 GHz and millimeter wave bands. Massive MIMO, beamforming, and mmWave technologies. Network slicing and cloud-RAN. | **9** |
| **IV** | **5G Radio Access and Performance Enhancements**<br><br>5G NR (New Radio) physical layer overview. OFDM and FBMC for 5G air interface. Non-orthogonal multiple access (NOMA). Ultra-Reliable Low Latency Communication (URLLC) and Enhanced Mobile Broadband (eMBB). Massive Machine Type Communication (mMTC) for IoT applications. | **9** |
| **V** | **Advanced Topics and Applications**<br><br>Integration of AI and ML in 5G networks. Cognitive radio and spectrum sharing in 5G. Energy-efficient and green 5G networks. Security challenges and solutions in MIMO–5G systems. Case studies: 5G testbeds, Smart city and IoT implementations. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the basic concepts and architectures of MIMO systems and their role in modern wireless communication. |
| **CO2** | Analyze channel models and MIMO signal processing techniques for performance improvement. |
| **CO3** | Describe the architecture, spectrum, and enabling technologies of 5G networks. |
| **CO4** | Evaluate 5G physical layer and multiple access techniques for different applications. |
| **CO5** | Apply MIMO and 5G technologies to real-world applications such as IoT, smart cities, and intelligent networks. |

**Text Books:**


1. A. Paulraj, R. Nabar, and D. Gore, Introduction to Space–Time Wireless Communications, Cambridge University Press, Mar. 2003.
2. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, *Fundamentals of Massive MIMO*, Cambridge University Press, Jun. 2016.
3. A. F. Molisch, *Wireless Communications*, 3rd ed., Wiley-IEEE Press, Sep. 2022.

**Reference Books:**


1. A. Goldsmith, *Wireless Communications*, Cambridge University Press, Aug. 2005.

2. J. G. Andrews, S. Buzzi, W. Choi, S. Hanly, A. Lozano, A. C. Soong, and J. C. Zhang, *"What Will 5G Be?" IEEE Journal on Selected Areas in Communications*, vol. 32, no. 6, pp. 1065–1082, Jun. 2014.

3. M. Agiwal, A. Roy, and N. Saxena, *"Next Generation 5G Wireless Networks: A Comprehensive Survey," IEEE Communications Surveys & Tutorials*, vol. 18, no. 3, pp. 1617–1655, Sep. 2016.

4. F. Boccardi, R. Heath Jr., A. Lozano, T. L. Marzetta, and P. Popovski, *"Five Disruptive Technology Directions for 5G," IEEE Communications Magazine*, vol. 52, no. 2, pp. 74–80, Feb. 2014.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE. (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT344** | **Number of Hours/ Week** | **3** |
| **Semester** | **IV (DSE II)** | **Max. Marks** | **100** |
| **Year** | **II** | **Credits** | **3** |

| | | | | |
|---|---|---|---|---|
| **Discipline Specific Elective** | | | | |
| **Course Title** | **Explainable AI** | **L** | **T** | **P** |
| | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Understand foundational ideas behind explainability, interpretability, transparency and the need for Explainable AI.
2. Learn different classes of interpretable models and post-hoc explanation techniques.
3. Apply XAI methods across various data types – structured, unstructured (images, text), time series, etc.
4. Evaluate explanations in terms of fidelity, robustness, fairness, and usability.
5. Appreciate ethical, legal, and social implications of AI explainability, and use XAI in real-world applications.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | Fundamentals of Explainable AI: Definitions: Interpretability, Explainability, Transparency, Explainable vs Interpretable models. Why XAI: trust, accountability, requirement in regulated domains, debugging, fairness. Taxonomies of explainability: global vs local, model-intrinsic vs model-agnostic. Overview of popular interpretable models (linear models, decision trees, rule-based models). | 9 |
| II | Post-hoc Explanation Techniques<br><br>Feature importance methods: permutation importance, gain, etc Partial Dependence Plots (PDP), Individual Conditional Expectation (ICE) plots. Surrogate models (e.g., decision tree surrogate). Local explanation methods: LIME, SHAP. Counterfactual explanations. | 9 |

| | | |
|---|---|---|
| **III** | **Explainability for Unstructured and Complex Data**<br><br>Explaining images: saliency maps, Grad-CAM, occlusion methods. Explaining text and NLP models: attention, LIME/SHAP with text, integrated gradients. Time series explanations. Explainability for large / deep neural networks, and for foundation/LLM models. | **9** |
| **IV** | **Evaluation, Robustness and Fairness in XAI**<br><br>Metrics for evaluating explanations: fidelity, interpretability, consistency, stability. Robustness: sensitivity to perturbations, adversarial attacks, explanation robustness. Fairness and bias: how explanations help detect bias; ensuring fairness in explanations. Human-centered evaluation: user studies, trust, usability. | **9** |
| **V** | **Ethical, Legal, and Application Aspects + Case Studies**<br><br>Ethical issues: privacy, "right to explanation", accountability, transparency. Legal / regulatory standards: GDPR, explainability requirements. XAI in deployment: model selection trade-offs, performance vs transparency. Case studies: healthcare, finance, judicial systems, recommender systems. Tools and frameworks: e.g. IBM AI Explainability 360, Google What-If Tool, open source libraries. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the fundamental concepts of explainability, interpretability, and transparency in AI systems. |
| **CO2** | Apply interpretable models and post-hoc explanation techniques on various datasets. |
| **CO3** | Utilize explainability methods for unstructured data (images, text, time series). |
| **CO4** | Evaluate explanation methods in terms of fidelity, fairness, usability, and robustness. |
| **CO5** | Understand ethical, legal, and social implications of AI and deploy XAI tools and frameworks in real-world scenarios. |

**Text Book:**


1. D. Rothman, Hands-On Explainable AI (XAI with Python), Packt Publishing, Sept. 2020.
2. M. Munn and D. Pitman, *Explainable AI for Practitioners*, O'Reilly Media, Mar. 2022.
3. Lecture Notes in Computer Science: *Explainable AI: Interpreting, Explaining and Visualizing Deep Learning*, Springer Nature, 2019.


**Reference Books**


1. W. Samek, T. Wiegand, K.-R. Müller, "Explainable Artificial Intelligence: Understanding, Visualizing and Interpreting Deep Learning Models", arXiv:1708.08296, Aug. 2017. arXiv
2. Amrita University course syllabus, "Explainable AI", includes XAI with LLMs, structured/unstructured data, etc. Amrita Vishwa Vidyapeetham
3. A Comprehensive Guide to Explainable AI: From Classical Models to LLMs", recently published arXiv article. arXiv


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 2 | 1 | 2 | 1 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 3 | 3 | 2 | 2 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 1 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 2 | 3 |

3 - high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT345** | **Number of Hours/ Week** | **3** | | |
| **Semester** | **IV (DSE II)** | **Max. Marks** | **100** | | |
| **Year** | **II** | **Credits** | **3** | | |
| **Discipline Specific Elective II** | | | | | |
| **Course Title** | **Software Defined Radio (SDR)** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students to:**

1. Introduce the concept and architecture of Software Defined Radio (SDR).
2. Study various hardware and software platforms used in SDR development.
3. Explore digital signal processing techniques for modulation, demodulation, and channelization.
4. Familiarize with reconfigurable radio design, cognitive radio concepts, and implementation frameworks.
5. Understand practical use cases, applications, and challenges of SDR in modern wireless communication systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Software Defined Radio**<br><br>Evolution of radio systems: from hardware radios to SDR. Definition and characteristics of SDR. Basic SDR architecture: RF front-end, ADC/DAC, baseband processing. Benefits and challenges of SDR implementation. Comparison: Conventional radio vs SDR vs Cognitive Radio. | 9 |
| II | **SDR Architecture and Hardware Platforms**<br><br>Functional blocks of SDR receiver and transmitter.Wideband RF front-end design.ADC/ DAC requirements: sampling, quantization, and bandwidth constraints.SDR hardware platforms: USRP, RTL-SDR, HackRF, BladeRF.Embedded SDRs and FPGA-based SDR systems. | 9 |

| | | |
|---|---|---|
| **III** | **Software Platforms and Signal Processing in SDR**<br><br>Baseband signal processing tasks: filtering, modulation, demodulation, synchronization. Software frameworks: GNU Radio, MATLAB/ Simulink, LabVIEW, SDR# (SDRSharp). Digital up/ down conversion, channel coding, and symbol timing recovery. Interfacing SDR hardware with host software. Spectrum sensing and signal analysis. | **9** |
| **IV** | **Reconfigurable and Cognitive Radios**<br><br>Concept of reconfigurability and dynamic spectrum access. Cognitive cycle: sensing, analysis, decision, and action. Spectrum management, spectrum mobility, and spectrum sharing. SDR as an enabling platform for Cognitive Radio Networks (CRNs). Security and regulatory issues in reconfigurable radios. | **9** |
| **V** | **Applications, Case Studies, and Emerging Trends**<br><br>SDR applications in LTE, 5G, Wi-Fi, and satellite communications. SDR for IoT and wireless sensor networks. Open-source SDR projects and community development. Case studies: LTE transceiver on USRP, FM receiver, and radar signal simulation. Future trends: AI/ML in SDR, cloud-based SDR, and distributed radio networks. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to:

| | |
|---|---|
| **CO1** | Describe the architecture, components, and working principles of SDR systems. |
| **CO2** | Analyze various hardware and software platforms used for SDR implementation. |
| **CO3** | Apply DSP algorithms and modulation/demodulation schemes in SDR frameworks. |
| **CO4** | Develop reconfigurable and cognitive radio systems using SDR tools. |
| **CO5** | Evaluate real-world SDR applications and discuss future advancements in wireless communication. |

**Text Book**

1. J. Mitola, Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering, Wiley, July 2000.

2. W. Tuttlebee, *Software Defined Radio: Enabling Technologies*, Wiley, March 2002.

3. Travis Collins, Robin Getz, Di Pu, Alexander M. Wyglinski, *Software Defined Radio Using MATLAB & Simulink and the RTL-SDR*, Wiley, April 2015.

## Reference Books

**1.** Alexander M. Wyglinski, Di Pu, and Travis F. Collins, Cognitive Radio Communications and Networks: Principles and Practice, Academic Press, **2010**.

2. Jeffrey H. Reed, *Software Radio: A Modern Approach to Radio Engineering*, Prentice Hall, **2002**.

3. GNU Radio Foundation, *GNU Radio Documentation*, Open Source, **Latest Edition, 2023**.

4. Simon Haykin, *Cognitive Radio: Brain-Empowered Wireless Communications*, IEEE Press, **2005**.

### Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 3 |

3 - high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT346 | Number of Hours/Week | 3 | | |
| Semester | IV (DSE II) | Max. Marks | 100 | | |
| Year | II | Credits | 3 | | |
| Discipline Specific Elective II | | | | | |
| Course Title | Cognitive Radio and AI-Enabled Wireless Networks | | L | T | P |
| | | | 3 | 0 | 0 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students for:

1. Introduce the fundamentals of Cognitive Radio (CR) and its role in dynamic spectrum access.
2. Understand CR architecture, spectrum sensing, management, and sharing techniques.
3. Explore how Artificial Intelligence (AI) enhances spectrum learning, prediction, and decision-making.
4. Examine machine learning and deep learning approaches for intelligent wireless communication.
5. Apply CR and AI concepts to emerging 5G/6G networks, IoT, and future wireless systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Cognitive Radio Systems**<br><br>Evolution from Software Defined Radio (SDR) to Cognitive Radio. Concept, need, and goals of cognitive communication. Cognitive Radio architecture and functional model. Cognitive cycle: Observe – Orient – Plan – Decide – Act. Benefits, challenges, and enabling technologies. | 8 |

| | | |
|---|---|---|
| **II** | **Spectrum Sensing and Dynamic Spectrum Access**<br><br>Spectrum management and regulatory issues. Spectrum sensing techniques: energy detection, matched filtering, cyclostationary detection. Cooperative sensing and data fusion. Spectrum decision, sharing, and mobility management. Interference management and coexistence mechanisms. | **8** |
| **III** | **AI and Machine Learning in Cognitive Radio**<br><br>Role of AI/ML in CR: learning, adaptation, and reasoning. Supervised, unsupervised, and reinforcement learning models. Reinforcement learning for dynamic spectrum allocation and power control. Deep learning methods for spectrum prediction and modulation recognition. Case study: Q-learning for dynamic channel selection. | **9** |
| **IV** | **AI-Enabled Wireless Networks and Resource Management**<br><br>AI in 5G/6G networks: network slicing, beamforming, and edge intelligence. Deep reinforcement learning for radio resource management. Federated learning in wireless networks. Intelligent radio access and user association using ML. Network optimization and energy efficiency using AI. | **9** |
| **V** | **Applications and Emerging Trends**<br><br>Cognitive IoT and AI-driven smart spectrum management. AI-assisted vehicular networks and unmanned aerial networks (UAVs). Cognitive satellite communications. Security, privacy, and ethical concerns in AI-enabled networks. Future trends: Explainable AI in CR, digital twins, and 6G cognitive frameworks. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

CO1 : Explain the architecture, working principles, and evolution of cognitive radio systems.

CO2 : Apply spectrum sensing, sharing, and dynamic access techniques in CR environments.

CO3: Utilize AI and ML algorithms for intelligent decision-making in wireless networks.

CO4 : Design and analyze AI-enabled wireless resource management mechanisms.
CO5 : Evaluate advanced applications and research trends in cognitive and AI-driven wireless systems.

**Text Books:**


1. Simon Haykin, *Cognitive Radio: Brain-Empowered Wireless Communications*, IEEE Press, **June 2005**.
2. Alexander M. Wyglinski, Di Pu, and Travis F. Collins, *Cognitive Radio Communications and Networks: Principles and Practice*, Academic Press, **April 2010**.
3. Kwang-Cheng Chen and Ramjee Prasad, *Cognitive Radio Networks*, Wiley, **March 2009**.


**ReferenceBooks:**


1. Fa-Long Luo and Charlie Zhang, *Signal Processing for 5G: Algorithms and Implementations*, Wiley, **2016**.
2. Kaabouch, N., & Hu, W., *Cognitive Radio Networks: Application and Advances*, IGI Global, **2014**.
3. T. O'Shea and J. Hoydis, "An Introduction to Deep Learning for the Physical Layer," *IEEE Trans. on Cognitive Communications and Networking*, vol. 3, no. 4, **Dec. 2017**.
4. Q. Mao, F. Hu, and Q. Hao, "Deep Learning for Intelligent Wireless Networks," *IEEE Communications Magazine*, vol. 58, no. 1, **Jan. 2020**.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 0 | 2 | 3 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | 2 | 2 | 0 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO 5** | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – High, 2 – Average, 1 – Low , 0-Null

# Semester V

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT151** | **Number of Hours/Week** | **3** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Core Course** | | | | | |
| **Course Title** | **DEEP LEARNING** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students to:**

- Understand the principles of deep learning and neural network architecture.
- Design, train, and evaluate deep learning models for various applications such as image classification, speech recognition, and NLP.
- Implement advanced deep learning techniques like CNNs, RNNs, and GANs.
- Optimize and regularize deep learning models to prevent overfitting and enhance generalizati on.
- Apply deep learning methods to solve real-world problems in computer vision, NLP, and other domains.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | **Introduction to Deep Learning**<br>Mathematical building blocks of neural network-neural network Introduction to Neural Networks-Overview of machine learning and deep learning-Perceptron model and neural networks-Activation functions.Deep Learning Frameworks-Overview of frameworks: TensorFlow, Keras, PyTorch-Setting up the environment and tools for deep learning | **9** |
| **II** | **Foundations of Deep Neural Networks (DNNs)**<br>Feedforward Neural Networks-Architecture of feedforward neural networks (FNNs)-Backpropagation and gradient descent-Loss functions and optimization algorithms . Training Neural Networks-Overfitting, underfitting, and regularization-Batch normalization and learning rate scheduling | **9** |

| | | |
|---|---|---|
| **III** | **Convolutional Neural Networks (CNNs)**<br>Introduction to CNNs-Convolutional layers, pooling layers, and fully connected layers-CNN architectures. Applications of CNNs-Image classification, object detection, and segmentation-Transfer learning using pre-trained models. Advanced CNN Techniques-Data augmentation, fine-tuning, and model ensembling | **9** |
| **IV** | **Recurrent Neural Networks (RNNs)**<br>Introduction to RNNs-RNN architecture and vanishing gradient problem-Long Short-Term Memory and Gated Recurrent Units.-Applications of RNNs-Sequence prediction, language modeling, and sentiment analysis-Time-series forecasting, speech recognition. | **9** |
| **V** | **Generative Models (GANs, VAEs)**<br>Generative Adversarial Networks (GANs)-Architecture of GANs-Training GANs and applications. Variational Autoencoders (VAEs)-Introduction to VAEs and their use in unsupervised learning. Multi-modal Deep Learning-Combining vision, speech, and text in a unified model-Applications in autonomous driving, robotics, and healthcare | **9** |

**Andragogy:**

Class Room Lectures, Power point presentation, You Tube, Group Discussion, Seminar, Quiz, Formative Assessments, Brain storming, Activity

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

**Text Books:**

1. **"Deep Learning with Python"** by François Chollet,Publisher: Manning, ISBN: 978-1617294433
2. **"Deep Learning"** by Ian Goodfellow, Yoshua Bengio, and Aaron Courville,Publisher: MIT Press, ISBN: 978-0262035613
3. **"Neural Networks and Deep Learning: A Textbook"** by Charu Aggarwal,Publisher: Springer, ISBN: 978-3319944623

**Reference Books:**

1. **"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"** by Aurélien Géron,Publisher: O'Reilly Media, ISBN: 978-1492032649
2. **"Deep Learning for Computer Vision"** by Rajalingappaa Shanmugamani,Publisher: Apress, ISBN: 978-1484229577

3. **"Pattern Recognition and Machine Learning"** by Christopher Bishop,Publisher: Springer, ISBN: 978-0387310732

**Websites for Learning & Tools:**

1. **TensorFlow**
   - Website: https://www.tensorflow.org/
   - A popular deep learning framework for building and training neural networks.
2. **Keras**
   - Website: https://keras.io/
   - A high-level neural networks API, written in Python, running on top of TensorFlow.
3. **PyTorch**
   - Website: https://pytorch.org/
   - An open-source deep learning framework widely used in both research and industry.
4. **Fast.ai**
   - Website: https://www.fast.ai/
   - A research group that provides practical deep learning tutorials and libraries based on PyTorch.
5. **Kaggle**
   - Website: https://www.kaggle.com/
   - A platform for machine learning competitions with datasets and kernels, including many deep learning challenges.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 3 | 2 | - |
| CO2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT152 | Number of Hours/Week | 3 | | |
| Semester | V | Max. Marks | 100 | | |
| Year | III | Credits | 3 | | |
| Core Course | | | | | |
| Course Title | COMPUTER NETWORKS | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO NETWORK MODELS**<br>Data Communication - Networks - Network Types: WAN, MAN, LAN - Protocol Layering – TCP/IP Protocol suite - OSI Model - Introduction to Sockets. Physical Layer: Transmission techniques - Guided - Un-Guided - Multiplexing: TDM, FDM, and WDM**.** | 8 |
| II | **DATA LINK LAYER**<br>Framing - Error Detection - Error Correction - Hamming Distance, Cyclic Redundancy Check, Flow Control and Error Control Protocol - Stop and Wait, Go-Back-N ARQ - Selective Repeat ARQ - Sliding Window - Piggybacking - Multiple Access Protocols - ALOHA, CSMA/CD, CSMA/CA. | 10 |
| III | **NETWORK LAYER**<br>Switching Techniques: Circuit Switching, Message Switching, Packet Switching - Internet protocol - IPv4 and IPv6 - Address Resolution Protocol (ARP), RARP – Internet Control Message Protocol (ICMP) - DHCP - Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing - OSPF - Path-vector routing - BGP - Multicast Routing: DVMRP – PIM. | 10 |

| | | |
|---|---|---|
| **IV** | **TRANSPORT LAYER**<br>User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Flow control - Congestion Control Algorithms: Leaky Bucket and Token Bucket Algorithm - Quality of Service. | **9** |
| **V** | **APPLICATION LAYER**<br>Application Layer protocols: HTTP - FTP - Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1:** | Explain the basic layers and its functions in computer networks. |
| **CO2:** | Design and implement simple models to simulate how data flows between nodes in a network. |
| **CO3:** | Evaluate and compare different routing algorithms. |
| **CO4:** | Design custom protocols to address specific network functions. |
| **CO5:** | Demonstrate various application-layer protocols in achieving end-to-end communication. |

**Text Books:**


a. Data Communications and Networking, 5th Edition, Behrouz Forouzan, Mc Graw Hill, 2017.
b. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.


**Reference Books:**


**a.** Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
**b.** William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
**c.** Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
**d.** Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2012.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 |
| CO5 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT153** | **Number of Hours/ Week** | **3** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Core Course** | | | | | |
| **Course Title** | **Microcontrollers & IoT Devices** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the fundamentals of microcontrollers, embedded hardware design, and programming concepts.
2. Understand different architectures and peripherals of commonly used microcontrollers.
3. Explore the interfacing of sensors, actuators, and communication modules for IoT applications.
4. Learn firmware development, communication protocols, and real-time operation concepts.
5. Apply microcontrollers for designing and implementing IoT-based smart systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | Introduction to Microcontrollers<br><br>Evolution of microprocessors and microcontrollers. Architecture of 8-bit and 32-bit microcontrollers. Comparison of microcontrollers: 8051, AVR, PIC, ARM Cortex-M series. Memory organization, instruction set, and addressing modes. Overview of embedded development tools and environments. | 9 |
| II | ARM Cortex-M Architecture and Programming:<br><br>ARM Cortex-M core features: registers, modes, pipelines. NVIC (Nested Vectored Interrupt Controller) and exceptions. GPIO, timers, PWM, ADC, UART, SPI, and I2C peripherals. ARM assembly and embedded C programming. Introduction to STM32 and NXP LPC series controllers. | 10 |

| | | |
|---|---|---|
| **III** | IoT Hardware Platforms and Devices:<br><br>IoT architecture and building blocks. Overview of IoT development boards: Arduino, ESP32, Raspberry Pi, BeagleBone. Sensors and actuators used in IoT (temperature, humidity, motion, gas, etc.). Power management and low-power design concepts. Introduction to Edge devices and SoC platforms. | **10** |
| **IV** | Communication Interfaces and Protocols:<br><br>Serial communication: UART, SPI, I2C, and CAN. Wireless communication standards: Wi-Fi, Bluetooth, ZigBee, LoRa, NB-IoT. Internet connectivity: MQTT, HTTP, CoAP protocols. Cloud integration and data transmission. Interfacing microcontrollers with IoT cloud platforms (ThingSpeak, AWS IoT, Blynk). | **9** |
| **V** | Applications and Case Studies<br><br>IoT-based system design methodology. Firmware development and debugging techniques. Security and privacy considerations in IoT devices. Case studies: smart home, smart agriculture, and industrial monitoring systems. Emerging trends: AI at the edge, TinyML, and low-power embedded intelligence**.** | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1:** | Explain the architecture, features, and programming concepts of microcontrollers. |
| **CO2:** | Develop embedded programs using ARM Cortex-M architecture and peripherals. |
| **CO3:** | Interface microcontrollers with sensors, actuators, and IoT hardware platforms. |
| **CO4:** | Apply wired and wireless communication protocols for IoT applications. |
| **CO5:** | Design and implement IoT-based embedded systems for real-world scenarios. |

**Text Books:**


1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, *The 8051 Microcontroller and Embedded Systems*, Pearson, **2nd Edition, 2006**.
2. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*, Elsevier, **4th Edition, 2017**.
3. Raj Kamal, *Embedded Systems: Architecture, Programming and Design*, McGraw Hill Education, **3rd Edition, 2017**.


**Reference Books:**

1. Han-Way Huang, *Embedded System Design Using the ARM Cortex-M4 Microcontroller*, Cengage Learning, **2019**.

2. Rajesh Singh, Anita Gehlot, and Bhupendra Singh, *Internet of Things: Technologies and Applications for a New Age*, CRC Press, **2019**.

3. Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, Wiley, **2013**.

4. Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, **2017.**

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 0 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT851** | **Number of Hours/ Week** | **3** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Skill Enhancement Course** | | | | | |
| **Course Title** | **PRINCIPLES OF MANAGEMENT** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

- Understand the basic concepts and importance of management and its early thinkers.
- Learn the purpose, steps, and methods of planning and decision making.
- Know how organizations are structured and how authority is managed.
- Understand how managers direct, lead, motivate, and communicate with teams.
- Learn how controlling helps managers check progress and improve performance.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Fundamentals of Management**: Introduction Concepts, Objectives, Nature Scope and Significance of management Evolution of management thought-Contribution of Taylor, Weber and Fayol management. | 12 |
| II | **Planning**: Concept, Objectives, Nature, Limitation, Process of planning, Importance, Forms, Techniques and Process of decision making. | 10 |
| III | **Organizing:** Concept, Objectives, Nature of organizing, Types of Organization, delegation of authority, Authority and responsibilities, Centralization and Decentralization, Span of control. | 12 |
| IV | **Directing:** Concept, Principles & Techniques of directing and Coordination Concept of leadership-Style. Importance, Styles, Supervision, Motivation, Importance Theory of Motivation, Communication. | 10 |

| | | |
|---|---|---|
| **V** | **Controlling:** Concept, Principles, Process and Techniques of Controlling, Relationship between planning and controlling. | 10 |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Discuss the management concepts, objectives, nature, scope, significance and evolution, with contributions from Taylor, Weber, and Fayol. |
| **CO2** | Illustrate the process of planning, including its objectives, forms, techniques and decision-making processes, explaining its importance and limitations in a management context. |
| **CO3** | Apply the principles of organizing by evaluating different organizational structures, analyzing delegation of authority, and assessing the impact of centralization and decentralization on business operations. |
| **CO4** | Examine the principles and techniques of directing, leadership styles and motivational theories, and analyze their significance in managing teams, ensuring effective communication, supervision and coordination within |
| **CO5** | Estimate the effectiveness of controlling processes and techniques and assess the relationship between planning and controlling to improve organizational performance**.** |

**Text Book:**


1. D. Pagare, Principles of Management, 6th ed. New Delhi, India: Sultan Chand & Sons, 2018.


**Reference Books:**


1. L. M. Prasad, Principles and Practice of Management, 9th ed. New Delhi, India: Sultan Chand & Sons, 2016.
2. V. S. P. Rao and P. S. Narayana, Principles and Practice of Management. New Delhi, India: Konark Publishers Pvt. Ltd., 1987.
3. R. Srinivasan and S. A. Chunawalla, Management Principles and Practice, 1st ed. Mumbai, India: Himalaya Publishing House, 2014.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |
| CO2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 |
| CO3 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 2 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT351 | Number of Hours/Week | 3 | | |
| Semester | V | Max. Marks | 100 | | |
| Year | III | Credits | 3 | | |
| Discipline Specific Elective III: | | | | | |
| Course Title | Natural Language Processing (NLP) | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the fundamentals of natural language and linguistic analysis.
2. Provide knowledge of syntactic, semantic, and pragmatic aspects of NLP.
3. Familiarize students with various NLP algorithms and deep learning approaches.
4. Enable understanding of machine translation, speech recognition, and text generation systems.
5. Develop hands-on ability to implement NLP models using Python and deep learning frameworks.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | INTRODUCTION TO NATURAL LANGUAGE PROCESSING<br><br>Basics of NLP – Syntax, Semantics, Pragmatics, Morphology, and Phonology. Text Preprocessing: Tokenization, Stemming, Lemmatization, Stop-word removal. Regular Expressions and Pattern Matching. Word Representation: Bag-of-Words, TF-IDF, and Word Embeddings. Challenges in NLP: Ambiguity, Multilinguality, and Contextual Understanding. | 9 |
| II | LINGUISTIC STRUCTURES AND PARSING<br><br>POS Tagging – Rule-Based, Statistical, and Neural Approaches. Context-Free Grammars (CFGs) and Parsing Techniques. Dependency Parsing and Constituency Parsing. Syntax Trees and Parse Tree Construction. Evaluation Metrics for Parsing and POS Tagging. | 9 |

| | | |
|---|---|---|
| **III** | SEMANTIC ANALYSIS AND LANGUAGE MODELING<br><br>Lexical Semantics – WordNet, Synsets, Hyponyms, and Hypernyms. Statistical Language Models – n-grams and Smoothing Techniques. Neural Language Models – Word2Vec, GloVe, and Transformer-based Models. Sentence Embeddings – BERT, GPT, and Contextual Representations. Semantic Role Labeling and Named Entity Recognition (NER). | **9** |
| **IV** | NLP APPLICATIONS<br><br>Text Classification and Sentiment Analysis. Question Answering Systems. Machine Translation – Statistical, Neural, and Transformer-based. Text Summarization – Extractive and Abstractive Approaches. Speech Recognition and Chatbot Design. | **9** |
| **V** | ADVANCED TOPICS AND RECENT TRENDS<br><br>Explainable NLP and Ethical AI in Language Models. Low-resource and Multilingual NLP. Large Language Models (LLMs) and Prompt Engineering. Multimodal NLP (Vision-Language Models). Case Studies – ChatGPT, BERT, and T5 in Real-World Applications. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the core linguistic concepts and text preprocessing methods. |
| **CO2** | Apply syntactic and semantic parsing techniques to analyze language data. |
| **CO3** | Build and evaluate statistical and neural language models. |
| **CO4** | Implement NLP applications like sentiment analysis, translation, and summarization. |
| **CO5** | Analyse advanced NLP models, ethical issues, and current research trends |

**Text Book:**


1. D. Jurafsky and J. H. Martin, *Speech and Language Processing*, 3rd ed., Pearson Education, March 2023.

2. S. Bird, E. Klein, and E. Loper, *Natural Language Processing with Python*, O'Reilly Media, May 2021.

3. P. Chowdhury, *Natural Language Processing: A Practical Guide to NLP and Deep Learning*, Packet Publishing, June 2022.

**Reference Books:**


1. C. D. Manning and H. Schütze, Foundations of Statistical Natural Language Processing, MIT Press, January 2021.
2. Y. Goldberg, Neural Network Methods for Natural Language Processing, Morgan & Claypool Publishers, August 2019.
3. T. Young, D. Hazarika, S. Poria, and E. Cambria, Recent Trends in Deep Learning Based Natural Language Processing, IEEE Computational Intelligence Magazine, February 2018.


## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT352** | **Number of Hours/Week** | **3** |
| **Semester** | **V** | **Max. Marks** | **100** |
| **Year** | **III** | **Credits** | **3** |

**Discipline Specific Elective III**

| **Course Title** | **Reinforcement Learning** | **L** | **T** | **P** |
|---|---|---|---|---|
| | | **3** | **0** | **0** |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the fundamental principles and mathematical foundations of reinforcement learning.
2. Familiarize students with Markov Decision Processes (MDPs) and dynamic programming techniques.
3. Explore various model-free learning methods including Monte Carlo, Temporal Difference, and Q-Learning.
4. Provide an understanding of deep reinforcement learning architectures and policy gradient methods.
5. Develop the ability to apply RL algorithms to real-world decision-making and control problems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | INTRODUCTION TO REINFORCEMENT LEARNING<br><br>Overview of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning. Elements of Reinforcement Learning: Agent, Environment, Reward, and Policy. Types of RL: Model-Based vs. Model-Free. Markov Decision Processes (MDP): States, Actions, Rewards, Transitions. The RL Framework and Examples – Grid World, Multi-Armed Bandits. | **9** |
| **II** | DYNAMIC PROGRAMMING AND MONTE CARLO METHODS<br><br>Bellman Equations and Optimality. Policy Evaluation and Policy Improvement. Policy Iteration and Value Iteration. Monte Carlo Prediction and Control. Exploring Starts and Off-policy Methods. | **9** |

| | | |
|---|---|---|
| **III** | TEMPORAL DIFFERENCE LEARNING<br><br>Temporal Difference (TD) Prediction. TD(0), TD(λ), and Eligibility Traces. SARSA and Q-Learning Algorithms. Expected SARSA and Double Q-Learning. On-policy vs. Off-policy Learning. Convergence and Stability of TD Methods. | **9** |
| **IV** | FUNCTION APPROXIMATION AND DEEP RL<br><br>Need for Function Approximation. Linear Function Approximation. Deep Q-Networks (DQN) and Variants (Double DQN, Dueling DQN). Policy Gradient Methods and REINFORCE Algorithm. Actor-Critic Methods: A2C, A3C. Deep Deterministic Policy Gradient (DDPG), PPO, and SAC. | **9** |
| **V** | ADVANCED TOPICS AND APPLICATIONS<br><br>Model-Based Reinforcement Learning. Multi-Agent Reinforcement Learning. Hierarchical and Meta-Reinforcement Learning. Safe and Explainable RL. Applications in Robotics, Game AI, and Autonomous Systems. Case Studies: AlphaGo, OpenAI Gym, DeepMind Control Suite. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the fundamentals and framework of reinforcement learning. |
| **CO2** | Apply dynamic programming and Monte Carlo methods to decision problems. |
| **CO3** | Implement and analyze temporal difference learning algorithms. |
| **CO4** | Design and train deep reinforcement learning architectures. |
| **CO5** | Explore and evaluate advanced RL techniques and real-world applications. |

**Text Books:**


1. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, 2nd ed., MIT Press, October 2018.
2. M. Lapan, *Deep Reinforcement Learning Hands-On*, 2nd ed., Packet Publishing, June 2020.
3. R. Y. Rubinstein and D. P. Kroese, *Simulation and the Monte Carlo Method*, 3rd ed., Wiley, January 2017.


**Reference Books:**


1. Y. Li, *Deep Reinforcement Learning: An Overview*, Foundations and Trends in Machine Learning, vol. 12, no. 4, pp. 307–492, July 2019.
2. S. Arulkumaran, M. Deisenroth, M. Brundage, and A. Bharath, *Deep Reinforcement Learning: A Brief Survey*, IEEE Signal Processing Magazine, vol. 34, no. 6, pp. 26–

38, November 2017.

3. F. L. Lewis, D. Vrabie, and K. G. Vamvoudakis, Reinforcement Learning and Adaptive Dynamic Programming for Feedback Control, IEEE Press, April 2012.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT353** | **Number of Hours/Week** | **3** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Discipline Specific Elective III:** | | | | | |
| **Course Title** | **Edge AI and TinyML** | **L** | **T** | **P** | |
| | | **3** | **0** | **0** | |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the concepts of Edge Artificial Intelligence (Edge AI) and Tiny Machine Learning (TinyML).
2. Provide an understanding of hardware and software components used in deploying AI models on embedded systems.
3. Explore model compression, quantization, and optimization techniques for on-device intelligence.
4. Discuss frameworks, tools, and architectures for Edge AI deployment.
5. Enable students to design and develop intelligent, low-power IoT devices capable of real-time learning and decision-making.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | INTRODUCTION TO EDGE AI AND TINYML<br><br>Overview of Edge Computing and AI at the Edge. Cloud vs. Edge vs. Fog Computing Architectures. Motivation for TinyML – Constraints, Challenges, and Opportunities. Embedded AI System Components – Sensors, Microcontrollers, Edge Devices. Applications – Smart Home, Healthcare, Industrial IoT, and Autonomous Systems. | 9 |
| II | FOUNDATIONS OF MACHINE LEARNING FOR EDGE<br><br>Review of Supervised, Unsupervised, and Deep Learning. Neural Network Fundamentals and Lightweight Architectures. Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) for Edge. Data Collection, Labeling, and Preprocessing for Edge AI Models. Transfer Learning and Knowledge Distillation Techniques. | 9 |

| | | |
|---|---|---|
| **III** | MODEL OPTIMIZATION AND DEPLOYMENT<br><br>Model Compression Techniques: Pruning, Quantization, and Weight Sharing. Hardware-Aware Neural Network Optimization. On-Device Learning and Federated Learning Concepts. Deployment Pipelines: TensorFlow Lite, PyTorch Mobile, ONNX Runtime. Energy Efficiency, Latency, and Performance Evaluation Metrics. | 10 |
| **IV** | EDGE HARDWARE PLATFORMS AND FRAMEWORKS<br><br>Overview of Edge Hardware: Arduino Nano 33 BLE, Raspberry Pi, Google Coral, NVIDIA Jetson Nano. Microcontrollers and AI Accelerators. Edge AI Frameworks: TensorFlow Lite for Microcontrollers, Edge Impulse, and AWS Green grass. Communication Protocols for Edge AI – MQTT, BLE, LoRa, and Wi-Fi. Case Study: Deploying an Image Classifier on Edge Hardware. | 10 |
| **V** | APPLICATIONS AND FUTURE TRENDS<br><br>TinyML Applications – Predictive Maintenance, Environmental Monitoring, Wearable Health Devices. Edge AI Security and Privacy Challenges. Explainable AI (XAI) for Edge Devices. Integration of Edge AI with 5G, IoT, and Cloud Ecosystems. Future Trends – Neuromorphic Computing, Federated TinyML, and Sustainable AI. | 10 |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Understand the fundamental concepts of Edge AI and TinyML. |
| **CO2** | Apply machine learning and neural network techniques in resource-constrained environments. |
| **CO3** | Optimize and deploy AI models on embedded and edge platforms. |
| **CO4** | Implement and evaluate Edge AI systems using real hardware and frameworks. |
| **CO5** | Analyze modern trends, ethical aspects, and future challenges in Edge AI. |

**Text Books:**


**1.** P. Warden and D. Situnayake, TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers, O'Reilly Media, March 2020.

2. L. Deng and Y. Zhang, *Edge AI: Convergence of Edge Computing and Artificial Intelligence*, Springer, April 2022.

3. A. Howard and M. Sandler, *Efficient Deep Learning for Edge AI*, Morgan & Claypool Publishers, June 2021.

**Reference Books:**


1. A. Zhang, Z. C. Lipton, M. Li, and A. Smola, Dive into Deep Learning, Amazon Science Press, July 2023.

2. Y. LeCun, On-Device Intelligence: The Future of AI, Communications of the ACM, vol. 65, no. 8, pp. 38–45, August 2022.

3. E. Sanchez and V. Sze, Efficient Processing of Deep Neural Networks: A Tutorial and Survey, Proceedings of the IEEE, vol. 107, no. 12, pp. 2230–2263, December 2019


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT354 | Number of Hours/ Week | 3 | | |
| Semester | V | Max. Marks | 100 | | |
| Year | III | Credits | 3 | | |
| Discipline Specific Elective IV | | | | | |
| Course Title | Mobile Ad-hoc Networks (MANETs) | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the fundamentals of Mobile Ad-hoc Networks and their characteristics.
2. Provide knowledge about MAC and routing protocols in wireless ad-hoc environments.
3. Understand the issues related to transport and security in MANETs.
4. Explore performance metrics and simulation tools for ad-hoc networks.
5. Discuss recent trends, challenges, and emerging technologies in MANETs and VANETs.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | INTRODUCTION TO MOBILE AD-HOC NETWORKS<br><br>Overview of Wireless Networks and Ad-hoc Networks. Characteristics and Challenges of MANETs. Mobile Node Architecture and Network Models. Applications of MANETs – Military, Disaster Management, IoT Integration. Design Issues and Requirements of Ad-hoc Networks. | 9 |
| II | MEDIUM ACCESS CONTROL (MAC) PROTOCOLS<br><br>MAC Protocol Design Goals and Challenges. Classification of MAC Protocols – Contention-based and Contention-free. IEEE 802.11 MAC, Bluetooth, and TDMA-based Protocols. Power-Aware MAC Protocols. QoS Issues and Cross-layer Optimization. | 9 |

| | | |
|---|---|---|
| **III** | ROUTING PROTOCOLS<br><br>Design Issues in Routing for Ad-hoc Networks. Proactive Routing Protocols: DSDV, OLSR. Reactive Routing Protocols: AODV, DSR, TORA. Hybrid Routing Protocols: ZRP, SHARP. Location-based and Hierarchical Routing Protocols. Performance Comparison of Routing Protocols. | 9 |
| **IV** | TRANSPORT, SECURITY, AND QoS<br><br>Transport Layer Solutions – TCP Variants for MANETs (TCP-F, TCP-ELFN). Congestion and Flow Control Mechanisms. Security Threats in MANETs – Eavesdropping, Blackhole, Wormhole, and Sybil Attacks. Security Mechanisms – Authentication, Secure Routing, and Trust Management. QoS Provisioning in MANETs. | 9 |
| **V** | SIMULATION, APPLICATIONS, AND FUTURE TRENDS<br><br>Simulation Tools – NS2, NS3, OPNET, and QualNet. Performance Metrics – Throughput, Delay, Jitter, and Packet Delivery Ratio. Vehicular Ad-hoc Networks (VANETs) and FANETs (Flying Ad-hoc Networks). Integration of MANETs with IoT and 5G. Emerging Research Areas – Cognitive MANETs, AI-Enabled Ad-hoc Networks. | 9 |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Understand the principles, characteristics, and applications of MANETs. |
| **CO2** | Analyze MAC layer protocols and their performance in ad-hoc environments. |
| **CO3** | Evaluate and compare various routing protocols used in MANETs. |
| **CO4** | Examine security, transport, and QoS mechanisms in MANETs. |
| **CO5** | Apply simulation tools and explore advanced research trends in ad-hoc and vehicular networks. |

**Text Books:**


**1.** C. Siva Ram Murthy and B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, 2nd ed., Pearson Education, April 2019.

2. M. Ilyas, *The Handbook of Ad Hoc Wireless Networks*, CRC Press, June 2018.

3. S. Corson and J. Macker, *Mobile Ad Hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations*, IEEE RFC 2501, January 2017.

**Reference Books:**


1. I. Chlamtac, M. Conti, and J. Liu, Mobile Ad Hoc Networking: Imperatives and Challenges, Ad Hoc Networks Journal, vol. 1, no. 1, pp. 13–64, January 2020.

2. H. Moustafa and Y. Zhang, Vehicular Networks: Techniques, Standards, and Applications, CRC Press, March 2021.

3. S. Basagni, M. Conti, S. Giordano, and I. Stojmenovic, Mobile Ad Hoc Networking: The Cutting Edge Directions, 2nd ed., Wiley-IEEE Press, May 2019.


## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO. 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT355 | Number of Hours/ Week | 3 | | |
| Semester | V | Max. Marks | 100 | | |
| Year | III | Credits | 3 | | |
| Discipline Specific Elective IV | | | | | |
| Course Title | AI for Network Security and Intrusion Detection | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

- To introduce the fundamentals of network security, attack models, and intrusion detection systems.
- To understand and apply artificial intelligence (AI) and machine learning techniques for network anomaly detection.
- To explore deep learning methods and explainable AI for cybersecurity analytics.
- To analyze performance metrics and datasets used for evaluating intrusion detection systems.
- To gain hands-on knowledge of AI-enabled security frameworks for real-time monitoring and defense.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO NETWORK SECURITY**<br><br>Overview of cybersecurity and network threats Attack types: DoS, DDoS, malware, phishing, insider attacks Firewalls, VPNs, and IDS/IPS systems Security goals: confidentiality, integrity, availability Challenges in modern network security | 9 |
| II | **INTRUSION DETECTION SYSTEMS (IDS)**<br><br>IDS architecture and types (host-based, network-based, hybrid) Signature-based vs anomaly-based IDS Dataset overview: KDD'99, NSL-KDD, UNSW-NB15, CICIDS2017 Feature selection and data preprocessing, Evaluation metrics for IDS performance (accuracy, precision, recall, F1-score, ROC) | 8 |
| III | **MACHINE LEARNING FOR INTRUSION DETECTION**<br><br>Application of ML algorithms: SVM, Decision Trees, Random Forests, Naïve Bayes, Feature engineering and dimensionality reduction (PCA, LDA), Model training, validation, and testing , Ensemble learning and hybrid models for intrusion detection, Case studies of ML-based IDS systems | 9 |

| | | |
|---|---|---|
| **IV** | **DEEP LEARNING AND EXPLAINABLE AI IN SECURITY**<br><br>Deep neural networks for network traffic analysis ,CNN, RNN, and LSTM architectures for intrusion detection , Autoencoders for anomaly detection , Explainable AI (XAI) concepts in cybersecurity , Model interpretability and transparency techniques. | **9** |
| **V** | **AI-ENABLED NETWORK SECURITY FRAMEWORKS**<br><br>Security orchestration and automated response (SOAR), AI-based threat intelligence and prediction models , Edge and cloud-based AI security systems , Blockchain and federated learning for secure data sharing , Future trends in AI-driven cybersecurity | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the fundamental concepts of network security and intrusion detection. |
| **CO2** | Apply suitable machine learning algorithms for network intrusion detection. |
| **CO3** | Design and analyze deep learning models for anomaly detection. |
| **CO4** | Interpret and explain AI model behavior using XAI methods for cybersecurity. |
| **CO5** | Evaluate and deploy AI-based frameworks for secure network environments. |

**Text Books:**


1. J. Kim and J. H. Park, Artificial Intelligence for Cyber Security: Techniques, Challenges and Applications, Springer, June 2021.
2. S. Mohurle and M. Patil, *Machine Learning for Cybersecurity*, CRC Press, October 2022.
3. K. Scarfone and P. Mell, *Guide to Intrusion Detection and Prevention Systems (IDPS)*, NIST Special Publication 800-94, March 2020.


**Reference Books:**


1. A. K. Sood and R. J. Enbody, *Cybersecurity for Beginners and Professionals*, Wiley, January 2023.
2. N. Shone and T. N. Ngoc, *Deep Learning and Explainable AI for Intrusion Detection Systems*, Springer, May 2022.
3. C. Sammut and G. I. Webb, *Encyclopedia of Machine Learning and Data Mining*, 2nd ed., Springer, 2020.

Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 0 | 1 | 0 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT356** | **Number of Hours/Week** | **3** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Discipline Specific Elective IV** | | | | | |
| **Course Title** | **Digital Forensics** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide a comprehensive understanding of digital forensics principles and methodologies.
2. To familiarize students with forensic tools used to analyze digital evidence from computers and mobile devices.
3. To understand laws, policies, and ethical considerations related to digital evidence.
4. To gain knowledge on incident response, data recovery, and malware analysis.
5. To equip learners with skills to conduct forensic investigations using systematic approaches.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO DIGITAL FORENSICS**<br><br>Overview of cybercrime and digital forensics, Digital evidence: characteristics, integrity, and admissibility, Forensic process: identification, acquisition, preservation, analysis, and presentation , Chain of custody and legal considerations, Forensic readiness and challenges in digital forensics. | 9 |
| II | **COMPUTER FORENSICS**<br><br>Forensic investigation process for computer systems, Evidence acquisition and duplication techniques, File system analysis (FAT, NTFS, EXT, HFS), Recovering deleted files and hidden data, Tools: EnCase, FTK, Autopsy, Sleuth Kit. | 9 |
| III | **NETWORK AND MOBILE FORENSICS**<br><br>Network forensics fundamentals, Packet capturing and analysis (Wireshark, tcpdump), Intrusion detection and log analysis, Mobile device forensics: Android and iOS data acquisition, SIM card, cloud, and app data forensics. | 9 |
| IV | **MALWARE AND MEMORY FORENSICS**<br><br>Malware types and forensic analysis techniques, Static and dynamic malware analysis, Memory forensics and volatility framework, Rootkits, Trojans, ransomware analysis, Detecting anti-forensic techniques. | 8 |

| | | |
|---|---|---|
| **V** | **LEGAL, ETHICAL, AND FUTURE TRENDS**<br><br>Cyber laws and digital evidence in court, Privacy, ethics, and professional responsibilities, Reporting and documentation of forensic findings, Forensic readiness in organizations, AI and automation in digital forensics, future challenges. | 9 |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain digital forensic concepts, types of evidence, and investigation processes. |
| **CO2** | Apply forensic tools and methodologies for computer-based investigations. |
| **CO3** | Analyze network and mobile forensic data using industry-standard tools. |
| **CO4** | Perform malware and memory analysis for identifying security breaches. |
| **CO5** | Evaluate forensic reports considering legal and ethical aspects. |

**Text Books:**


1. E. Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, 4th ed., Academic Press, January 2020.
2. B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, Guide to Computer Forensics and Investigations, 6th ed., Cengage Learning, March 2022.
3. D. P. Lyle, Digital Forensics for Cyber Professionals, Wiley, October 2021.


**Reference Books:**


1. J. Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, 3rd ed., CRC Press, June 2022.
2. C. Hargreaves and M. Medlin, Practical Memory Forensics: Dump Analysis and Malware Detection, Elsevier, 2023.
3. R. L. Rogers, Network Forensics: Tracking Hackers through Cyberspace, Springer, 2020.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 0 | 1 | 1 | 0 | 1 | 0 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 0 | 1 | 0 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT051** | **Number of Hours/ Week** | **3** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Generic Elective I (Open Elective)** | | | | | |
| **Course Title** | **Solar Power and Applications** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide a comprehensive understanding of solar energy principles and its conversion technologies.
2. To study the characteristics and operation of photovoltaic (PV) systems and their components.
3. To analyze solar radiation data, site assessment, and system design methodologies.
4. To understand power electronic interfaces and grid integration of solar systems.
5. To explore the applications of solar energy in domestic, industrial, and remote areas.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **SOLAR ENERGY BASICS**<br><br>Solar radiation: extraterrestrial and terrestrial, Solar constant, solar geometry, declination, hour angle, and altitude angle, Measurement of solar radiation – Pyranometer, Pyrheliometer, Estimation of global and diffuse radiation, Overview of solar energy technologies and potential. | 9 |
| II | **SOLAR PHOTOVOLTAIC FUNDAMENTALS**<br><br>Semiconductor physics relevant to PV devices , Working principle of photovoltaic cells, Types of solar cells: crystalline silicon, thin film, perovskite, organic, and hybrid, I–V characteristics, efficiency, and performance parameters, PV cell modeling and temperature effects. | 9 |

| | | |
|---|---|---|
| **III** | **SOLAR PV SYSTEM DESIGN AND COMPONENTS**<br><br>Stand-alone and grid-connected PV systems , Balance of system components: batteries, charge controllers, inverters, MPPT techniques, PV array sizing and optimization, Shadow analysis and performance ratio, Design examples using standard tools (e.g., PVsyst, HOMER). | 9 |
| **IV** | **POWER ELECTRONIC INTERFACES AND GRID INTEGRATION**<br><br>DC–DC converters for solar PV applications, Inverter topologies and control strategies ,Grid synchronization, power quality, and anti-islanding, Smart inverters and communication standards, Energy storage integration and hybrid renewable systems | 9 |
| **V** | **SOLAR APPLICATIONS AND EMERGING TRENDS**<br><br>Solar thermal systems – water heaters, cookers, dryers, Solar-powered vehicles, street lighting, and irrigation systems, Building-integrated photovoltaics (BIPV), Floating solar, solar hydrogen, and AI-based solar optimization, Government policies, incentives, and future prospects. | 9 |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the fundamental principles of solar radiation and solar energy conversion. |
| **CO2** | Analyze the operation and characteristics of various photovoltaic cells and modules. |
| **CO3** | Design standalone and grid-connected PV systems with appropriate components. |
| **CO4** | Evaluate power electronic converters and grid integration strategies for PV systems. |
| **CO5** | Apply solar energy technologies for real-world applications and sustainable solutions. |

**Text Books:**


**1.** S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, 4th ed., McGraw Hill, March 2020.

2. C. S. Solanki, *Solar Photovoltaics: Fundamentals, Technologies and Applications*, 4th ed., PHI Learning, January 2022.

3. J. Nelson, *The Physics of Solar Cells*, 2nd ed., Imperial College Press, 2021.


**Reference Books:**


1. T. Markvart and L. Castañer, Practical Handbook of Photovoltaics: Fundamentals and Applications, 3rd ed., Academic Press, June 2021.

2. M. G. Villalva and E. Ruppert Filho, Photovoltaic System Design and Practice, Wiley, September 2020.

3. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, 5th ed., Wiley, 2023.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 0 | 1 | 0 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT052** | **Number of Hours/Week** | **3** |
| **Semester** | **V** | **Max. Marks** | **100** |
| **Year** | **III** | **Credits** | **3** |

**Generic Elective I (Open Elective)**

| **Course Title** | **Entrepreneurship and Innovation** | **L** | **T** | **P** |
|---|---|---|---|---|
| | | **3** | **0** | **0** |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamentals of entrepreneurship, innovation, and startup ecosystems.
2. To develop an entrepreneurial mindset and leadership qualities among students.
3. To understand the process of ideation, opportunity identification, and business model design.
4. To learn financial, marketing, and operational strategies for launching a venture.
5. To familiarize students with government initiatives, policies, and incubation support systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO ENTREPRENEURSHIP**<br><br>Definition and types of entrepreneurship – necessity, opportunity, and social entrepreneurship, Role of entrepreneurs in economic development, Characteristics and competencies of successful entrepreneurs, Myths and realities of entrepreneurship, Entrepreneurial motivation and self-assessment. | **9** |
| II | **OPPORTUNITY IDENTIFICATION AND BUSINESS PLANNING**<br><br>Sources and methods of identifying business opportunities, Idea generation techniques – brainstorming, SCAMPER, design thinking, Market research and feasibility analysis, Elements of a business plan – executive summary, marketing, operations, and finance, Business model canvas and value proposition design. | **9** |
| III | **INNOVATION AND STARTUP ECOSYSTEM**<br><br>Types of innovation – product, process, service, and business model, Innovation management and diffusion, Technology commercialization and intellectual property rights (IPR), Role of incubators, accelerators, and innovation hubs, National and global startup ecosystems (Startup India, Atal Innovation Mission). | **9** |

| | | |
|---|---|---|
| **IV** | **FINANCIAL AND MARKETING STRATEGIES**<br><br>Entrepreneurial finance and funding sources, Bootstrapping, angel investors, venture capital, and crowdfunding, Financial projections and break-even analysis, Branding, digital marketing, and customer relationship management, Growth strategies and scaling challenges. | 9 |
| **V** | **ENTREPRENEURIAL LEADERSHIP AND ETHICS**<br><br>Leadership and team-building skills for entrepreneurs, Time management, negotiation, and communication, Entrepreneurial ethics and social responsibility, Case studies of successful startups and social enterprises, Future of entrepreneurship in the digital and AI era. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the concept, role, and importance of entrepreneurship and innovation. |
| **CO2** | Identify business opportunities and develop effective business plans. |
| **CO3** | Apply innovation and design thinking in solving real-world problems. |
| **CO4** | Analyze funding strategies and marketing approaches for startups. |
| **CO5** | Demonstrate leadership, ethics, and social responsibility in entrepreneurial contexts. |

**Text Books:**


1. D. F. Kuratko, Entrepreneurship: Theory, Process and Practice, 12th ed., Cengage Learning, February 2022.
2. R. Hisrich, M. Peters, and D. Shepherd, Entrepreneurship, 12th ed., McGraw Hill, May 2021.
3. P. Burns, Entrepreneurship and Small Business: Start-up, Growth and Maturity, 5th ed., Palgrave Macmillan, 2020.


**Reference Books:**


1. A. Osterwalder and Y. Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Wiley, January 2020.
2. E. Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business, 2021.
3. P. Drucker, Innovation and Entrepreneurship: Practice and Principles, Routledge, 2022.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT053 | Number of Hours/ Week | 3 |
| Semester | V | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Generic Elective I (Open Elective)**

| Course Title | AI and IoT in Healthcare Systems | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamentals of IoT and AI technologies in healthcare environments.
2. To familiarize students with wearable sensors, medical devices, and smart health monitoring systems.
3. To explore AI methods such as machine learning and deep learning for healthcare data analytics.
4. To understand system architectures for AI-IoT-enabled healthcare applications.
5. To address security, privacy, and ethical considerations in AI-IoT healthcare systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO AI AND IoT IN HEALTHCARE**<br><br>Overview of AI and IoT in healthcare, Smart healthcare ecosystems , Digital health concepts: e-health, m-health, telemedicine, Benefits, challenges, and applications of AI-IoT integration. | 8 |
| II | **IoT INFRASTRUCTURE AND MEDICAL DEVICES**<br><br>IoT architectures for healthcare, Sensors and actuators for vital signs monitoring, Wearable devices and body area networks (BANs), Remote patient monitoring systems, Communication protocols and IoT platforms for healthcare. | **9** |
| III | **AI TECHNIQUES FOR HEALTHCARE DATA**<br><br>Data acquisition and preprocessing in healthcare, Machine learning: classification, regression, clustering for health data, Deep learning: CNNs, RNNs, LSTMs for medical imaging and diagnostics, Predictive analytics and anomaly detection, Case studies on AI-based disease detection. | **9** |

| | | |
|---|---|---|
| **IV** | **AI-IOT SYSTEM DESIGN AND INTEGRATION**<br><br>Edge and cloud computing in healthcare IoT, Integration of AI algorithms with IoT devices, Real-time data analytics and decision-making, Smart healthcare applications: ICU monitoring, chronic disease management, Performance evaluation and optimization techniques. | **9** |
| **V** | **SECURITY, PRIVACY, AND ETHICAL ISSUES**<br><br>Cybersecurity in healthcare IoT networks, Data privacy regulations: HIPAA, GDPR, Blockchain for secure healthcare data management, Ethical considerations in AI decision-making, Future trends: AI-IoT-enabled personalized medicine and smart hospitals. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Explain the role of AI and IoT in modern healthcare systems. |
| **CO2** | Analyze IoT-based medical devices and wearable sensor networks. |
| **CO3** | Apply AI techniques for healthcare data analysis and predictive modeling. |
| **CO4** | Design AI-IoT architectures for remote patient monitoring and smart healthcare. |
| **CO5** | Evaluate security, privacy, and ethical aspects of AI-IoT healthcare systems. |

**Text Books:**


1. K. A. Hossain and S. Muhammad, AI and IoT for Healthcare: Concepts, Technologies, and Applications, CRC Press, March 2022.
2. S. Alotaibi and H. Singh, IoT and Machine Learning for Healthcare Systems, Springer, 2021.
3. T. M. Mitchell, Machine Learning, 3rd ed., McGraw Hill, 2020.


**Reference Books:**


1. R. R. Gupta and N. Sharma, Smart Healthcare with IoT and AI, Wiley, 2022.
2. M. S. Hossain, Deep Learning and IoT for Smart Healthcare, Springer, 2021.
3. S. G. Kapoor and A. K. Jain, Healthcare Analytics: AI and Big Data in Medicine, Elsevier, 2020.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT251** | **Number of Hours/Week** | **2** | | |
| **Semester** | **V** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credit** | **1** | | |
| **Core Course** | | | | | |
| **Course Title** | **DEEP LEARNING LAB** | | **L** | **T** | **P** |
| | | | **0** | **0** | **2** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students to:**

- Understand the principles of deep learning and neural network architecture.
- Design, train, and evaluate deep learning models for various applications such as image classification, speech recognition, and NLP.
- Implement advanced deep learning techniques like CNNs, RNNs, and GANs.
- Optimize and regularize deep learning models to prevent overfitting and enhance generalization.
- Apply deep learning methods to solve real-world problems in computer vision, NLP, and other domains.

**PROGRAMS**

1. **Implement basic matrix operations and their application in neural networks.**
    - Perform operations like dot product, matrix multiplication, and transpose.
    - Use NumPy for efficient computation.
2. **Build a perceptron model for binary classification.**
    - Implement a single-layer neural network using Python.
    - Train it on a simple dataset like OR, AND, or XOR.
3. **Visualize activation functions (Sigmoid, ReLU, Tanh, Softmax).**
    - Plot the functions and demonstrate their outputs for a range of inputs.
4. **Set up a deep learning environment.**
    - Install and configure TensorFlow, Keras, and PyTorch.
    - Verify the setup by running a simple "Hello World" program using each framework.
5. **Implement a feedforward neural network (FNN).**
    - Use TensorFlow/Keras to create a simple FNN for MNIST digit classification.
6. **Back propagation and gradient descent implementation.**
    - Write a Python program to implement back propagation for a basic FNN.
    - Visualize the loss reduction over epochs.
7. **Demonstrate L1 and L2 regularization.**
    - Train a neural network on a small dataset and showcase the effects of L1/L2 regularization.
8. **Apply batch normalization.**
    - Train a network with and without batch normalization to observe its impact on convergence.
9. **Build and train a simple CNN.**
    - Implement a CNN for image classification using the CIFAR-10 dataset.
10. **Experiment with different CNN architectures.**
    - Use pre-defined architectures like LeNet, AlexNet, and VGG.
11. **Perform image classification using transfer learning.**
    - Use a pre-trained model (e.g., ResNet or Inception) and fine-tune it on a custom dataset.
12. **Apply data augmentation techniques.**
    - Augment an image dataset using rotation, flipping, zooming, etc., and retrain a CNN.
13. **Implement a simple RNN for sequence prediction.**
    - Use a dataset like sine wave data to predict the next value in a sequence.
14. **Train an LSTM model for text generation.**
    - Use a text corpus to generate text using LSTM.

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Understand and implement basic neural network operations and activation functions. |
| **CO2** | Design and train feedforward neural networks using modern frameworks. |
| **CO3** | Apply optimization, regularization, and normalization techniques. |
| **CO4** | Build and evaluate deep learning models for CV and NLP tasks (CNN, RNN, LSTM, GRU). |
| **CO5** | Implement advanced models like GANs, VAEs, and multi-modal systems. |

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 2 | - | - | - | 1 | 2 | 1 | - |
| CO2 | 2 | 3 | 2 | 2 | 3 | - | - | - | 1 | 3 | 2 | 1 |
| CO3 | 2 | 3 | 2 | 3 | 3 | - | - | - | 1 | 3 | 2 | 1 |
| CO4 | 2 | 3 | 3 | 3 | 3 | - | - | - | 2 | 3 | 3 | 2 |
| CO5 | 2 | 3 | 3 | 3 | 3 | - | - | - | 2 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT252 | Number of Hours/ Week | 2 | | |
| Semester | V | Max. Marks | 100 | | |
| Year | III | Credits | 1 | | |
| Core Course | | | | | |
| Course Title | COMPUTER NETWORKS LAB | | L | T | P |
| | | | 0 | 0 | 2 |
| L-Lecture Hours | T-Tutorial Hours | P-Practical Hours | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students for:**

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

**LIST OF EXPERIMENTS**

1. Chat application for real-time communication between client and server.
2. Simulation of DNS using UDP Sockets.
3. Basic Packet Analysis.
4. Simulation of ARP/RARP Protocols.
5. Simulation of Leaky Bucket and Token Bucket algorithms.
6. Implementation of data transmission using TCP and UDP and measure metrics using throughput and latency.
7. Simulation of Distance Vector Routing Algorithm.
8. Implementation of Link State Routing Algorithm.
9. Simulation of CRC (Cyclic Redundancy Check).
10. Implementation of Simple Mail Transfer Protocol (SMTP) for sending emails.

**Course Outcomes:**

By learning Computer Networks, students will be able to

| | |
|---|---|
| **CO1:** | Explain the basic layers and its functions in computer networks. |
| **CO2:** | Understand the basics of how data flows from one node to another. |
| **CO3:** | Analyze routing algorithms. |
| **CO4:** | Describe protocols for various functions in the network.. |
| **CO5:** | Analyze the working of various application layer protocols. |

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 |
| CO 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| CO 4 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 |
| CO 5 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

# Semester VI

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT161 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

| Course Title | Reinforcement Learning | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the concepts of reinforcement learning (RL) and its role in AI.
2. Teach the mathematical foundations of RL, including Markov Decision Processes (MDPs).
3. Explore model-based and model-free RL techniques.
4. Apply RL methods to real-world problems and simulations.
5. Discuss advanced RL topics, including deep reinforcement learning and policy optimization.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Reinforcement Learning**<br>Overview of RL, agents, environment, reward, and feedback, Types of RL problems: episodic and continuous, Exploration vs. exploitation, Applications of RL in robotics, gaming, and healthcare. | 9 |
| II | **Markov Decision Processes (MDP)**<br>States, actions, rewards, transition probabilities, Policy, value functions, Bellman equations, Optimal policy and value iteration, Discounted and undiscounted rewards. | 8 |
| III | **Model-Free RL Methods**<br>Monte Carlo methods, Temporal Difference (TD) learning, Q-learning and SARSA algorithms, On-policy vs. off-policy learning and its various types . | 8 |

| | | |
|---|---|---|
| **IV** | **Function Approximation and Deep RL**<br><br>Linear function approximation, Neural networks for value function approximation, Deep Q-Networks (DQN), Policy gradient methods and Actor-Critic algorithms. | 8 |
| **V** | **Advanced Topics and Applications**<br><br>Multi-agent reinforcement learning, Inverse reinforcement learning, RL for games, autonomous systems, and IoT environments, Challenges: scalability, sample efficiency, and safety. | **9** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1:** | Understand the fundamentals of reinforcement learning and MDPs. |
| **CO2:** | Formulate problems using RL models and evaluate policies. |
| **CO3:** | Implement model-free methods such as Q-learning and SARSA. |
| **CO4:** | Apply function approximation and deep RL techniques. |
| **CO5:** | Analyze RL algorithms for decision-making in complex environments. |

**Text Books:**


1. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, 2nd ed., MIT Press, 2018.
2. L. Busoniu, R. Babuska, B. De Schutter, and D. Ernst, Reinforcement Learning and Dynamic Programming Using Function Approximators, CRC Press, 2010.


**Reference Books:**


1. M. Wiering and M. van Otterlo, Reinforcement Learning: State-of-the-Art, Springer, 2012.
2. F. R. K. Chung and D. B. Fogel, Deep Reinforcement Learning in Action, Manning Publications, 2021.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT162** | **Number of Hours/ Week** | **3** |
| **Semester** | **VI** | **Max. Marks** | **100** |
| **Year** | **III** | **Credits** | **3** |

| | | | | |
|---|---|---|---|---|
| **Course Title** | **Cloud & Edge Computing for IoT** | **L** | **T** | **P** |
| | | **3** | **0** | **0** |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamentals of cloud computing and edge computing paradigms.
2. To study IoT system architectures and their integration with cloud and edge platforms.
3. To understand resource management, data storage, and computation offloading in IoT systems.
4. To explore security, privacy, and QoS issues in cloud-edge IoT deployments.
5. To provide insight into practical applications of cloud and edge computing in smart IoT environments.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO CLOUD AND EDGE COMPUTING**<br><br>Fundamentals of cloud computing: IaaS, PaaS, SaaS, Edge and fog computing concepts, Comparison: cloud vs. edge computing, Benefits and challenges for IoT applications. | 8 |
| II | **IoT SYSTEM ARCHITECTURES (9 Hours)**<br><br>IoT ecosystem: sensors, actuators, gateways, cloud/edge nodes, IoT communication protocols (MQTT, CoAP, HTTP), Data collection, aggregation, and analytics in IoT, IoT deployment models: centralized, distributed, hybrid. | **9** |
| III | **CLOUD COMPUTING FOR IoT (9 Hours)**<br><br>Cloud platforms for IoT: AWS IoT, Microsoft Azure IoT, Google Cloud IoT, Cloud storage, virtualization, and resource management, Data analytics and machine learning on the cloud, Scalability, reliability, and service-level agreements (SLAs). | 9 |

| | | |
|---|---|---|
| **IV** | **EDGE COMPUTING FOR IOT (10 Hours)**<br><br>Edge architecture and edge devices, Computation offloading strategies, Real-time processing and latency reduction, Edge analytics, AI at the edge, and containerization (Docker, Kubernetes) | **9** |
| **V** | **SECURITY, PRIVACY, AND APPLICATIONS (8 Hours)**<br><br>IoT security challenges: authentication, encryption, intrusion detection, Privacy-preserving mechanisms for IoT, Use cases: smart cities, smart healthcare, industrial IoT, Emerging trends: 5G, AIoT, and serverless edge computing. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Understand cloud and edge computing architectures and their relevance to IoT. |
| **CO2** | Analyze IoT system design, data flow, and communication protocols. |
| **CO3** | Apply cloud and edge computing techniques for data processing and storage. |
| **CO4** | Evaluate performance, security, and privacy issues in IoT-enabled systems. |
| **CO5** | Design cloud-edge IoT solutions for real-world applications. |

**Text Books:**


**1.** R. Buyya, S. Srirama, and M. D. Rosário, *Mastering Cloud Computing for IoT*, McGraw Hill, 2021.

2. S. Yi, C. Li, and Q. Li, Fog and Edge Computing: Principles and Paradigms, Wiley, 2019.

3. M. Satyanarayanan, *Edge Computing: A Primer*, Morgan & Claypool, 2020.


**Reference Books:**


1 F. Bonomi, R. Milito, J. Zhu, and S. Addepalli, Fog Computing and Its Role in the Internet of Things, Springer, 2018.

2. A. Dastjerdi and R. Buyya, Fog and Edge Computing: Concepts, Architectures and Applications, Elsevier, 2020.

3. K. Rose, Cloud and Edge Computing for the Internet of Things, CRC Press, 2021.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT163** | **Number of Hours/ Week** | **3** |
| **Semester** | **VI** | **Max. Marks** | **100** |
| **Year** | **III** | **Credits** | **3** |

| **Course Title** | **Industrial Electronics and Power Convertors** | **L** | **T** | **P** |
|---|---|---|---|---|
| | | **3** | **0** | **0** |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To understand the principles and applications of power electronic devices in industrial systems.
2. To study the operation and control of various power converters.
3. To analyze power electronic circuits for efficient energy conversion.
4. To explore industrial control techniques using electronic circuits.
5. To gain practical insight into industrial drives, automation, and protection mechanisms.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO INDUSTRIAL ELECTRONICS**<br><br>Overview of industrial electronics and automation, Classification of power electronic systems, Characteristics of SCR, TRIAC, DIAC, IGBT, MOSFET, Triggering and commutation techniques, Protection and heat-sinking methods. | **8** |
| II | **AC–DC CONVERTERS**<br><br>Single-phase and three-phase controlled rectifiers, Half-wave and full-wave converters, Performance parameters and power factor improvement, Freewheeling diode applications, Industrial applications: DC drives, battery charging systems. | **9** |

| | | |
|---|---|---|
| **III** | **DC–DC CONVERTERS**<br><br>Step-down (buck), step-up (boost), buck-boost converters, Continuous and discontinuous conduction modes, PWM techniques and duty ratio control, Applications: DC motor speed control, renewable energy conversion. | **9** |
| **IV** | **DC–AC AND AC–AC CONVERTERS**<br><br>Single-phase and three-phase inverters, Voltage and frequency control of inverters, Cycloconverters and AC voltage controllers, Harmonics, filtering, and waveform quality, Industrial applications: induction heating, UPS systems. | **9** |
| **V** | **INDUSTRIAL APPLICATIONS AND CONTROL**<br><br>Power electronic drives for DC and AC motors, Industrial automation and process control, Microcontroller-based converter control, Protection and EMI/EMC considerations, Case studies: robotic drives, renewable energy interfaces, industrial furnaces. | **8** |

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

| | |
|---|---|
| **CO1** | Understand the characteristics and operation of power semiconductor devices used in industrial systems. |
| **CO2** | Analyze and design rectifier and inverter circuits for industrial power conversion. |
| **CO3** | Apply DC–DC and AC–AC converter principles in industrial control applications. |
| **CO4** | Evaluate industrial control and protection systems using power electronics. |
| **CO5** | Design and implement power electronic solutions for automation and motor drives. |

**Text Books:**


1. M. H. Rashid, *Power Electronics: Devices, Circuits, and Applications*, Pearson Education, 5th Ed., 2023.
2. P. S. Bimbhra, *Power Electronics*, Khanna Publishers, 2019.
3. S. K. Bhattacharya, *Industrial Electronics and Control*, McGraw Hill, 2018.

**Reference Books:**


***1.*** B. W. Williams, *Power Electronics: Devices, Drivers, Applications, and Passive Components*, McGraw Hill, 2019.

2. J. M. Jacob, *Industrial Control Electronics: Devices, Systems, and Applications*, Prentice Hall, 2020.

3. N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications, and Design*, Wiley, 2021.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT361 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Discipline Specific Elective V**

| Course Title | AI for Signal and Image Processing | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours. T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamentals of artificial intelligence techniques applied to signal and image processing.
2. To understand how AI models can enhance traditional digital signal processing (DSP) algorithms.
3. To explore deep learning architectures used for image and signal classification, segmentation, and restoration.
4. To study practical applications of AI in computer vision, speech, and biomedical signal analysis.
5. To provide a foundation for developing intelligent, real-time signal and image processing systems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO AI AND SIGNAL PROCESSING**<br><br>Overview of artificial intelligence in signal and image domains, Basics of digital signal and image processing, Sampling, filtering, and transformations, Role of AI and ML in signal analysisCase studies: AI-enhanced DSP applications | 8 |
| II | **MACHINE LEARNING FOR SIGNAL ANALYSIS**<br><br>Supervised and unsupervised learning for signals- Feature extraction from temporal data- Classification and clustering of signals- AI applications in audio and speech recognition- Case studies: ECG and EEG signal interpretation | 9 |

| | | |
|---|---|---|
| **III** | **DEEP LEARNING FOR IMAGE PROCESSING**<br><br>Neural network basics: CNN, RNN, and Autoencoders, Image classification, object detection, and segmentation, Image enhancement and super-resolution using deep learning, Data augmentation and transfer learning, Frameworks: TensorFlow, PyTorch applications | **9** |
| **IV** | **AI-BASED FEATURE EXTRACTION AND FUSION**<br><br>Feature engineering for multimodal data, Dimensionality reduction and PCA, Fusion of visual and sensor data using AI, Edge and texture analysis, Real-time AI image/video analytics | **9** |
| **V** | **APPLICATIONS AND PERFORMANCE EVALUATION**<br><br>AI in medical imaging, remote sensing, and video surveillance, Evaluation metrics: accuracy, precision, recall, F1-score, ROC, Explainable AI in image interpretation, Ethical and reliability considerations in AI-driven imaging, Future trends: Edge AI for image and signal processing | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamental concepts of signal and image processing and their relevance to AI techniques. |
| **CO2** | Apply machine learning and deep learning algorithms for analyzing signals and images. |
| **CO3** | Design AI-based models for feature extraction, pattern recognition, and enhancement. |
| **CO4** | Evaluate performance metrics for AI-based signal and image processing systems. |
| **CO5** | Implement AI-driven solutions in real-world domains such as medical imaging, audio analysis, and remote sensing. |

**Text Books:**


1. S. Haykin and B. Van Veen, *Signals and Systems*, 2nd ed., Wiley, Jan. 2020.
2. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, MIT Press, Mar. 2018.
3. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 4th ed., Pearson, Jul. 2021.

## Reference Books:


1. S. S. Haykin, Neural Networks and Learning Machines, 4th ed., Pearson Education, 2022.
2. R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2020.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2022.
4. A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 2019.


## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT362 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Discipline Specific Elective V:**

| Course Title | Network Function Virtualization (NFV) | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours. T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To understand the fundamental concepts and architecture of Network Function Virtualization (NFV).
2. To study the integration of NFV with Software Defined Networking (SDN) for flexible and scalable networks.
3. To explore the design, deployment, and orchestration of virtualized network services.
4. To gain insight into performance optimization, security, and management challenges in NFV environments.
5. To familiarize students with modern tools and frameworks for NFV implementation in 5G and cloud environments.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO NFV**<br><br>Evolution of network architectures, Traditional network functions vs. virtualized functions, NFV motivation and benefits, NFV architecture – ETSI NFV reference model, Virtual Network Functions (VNFs), NFVI, and MANO framework | 8 |
| II | **NFV ARCHITECTURE AND DESIGN PRINCIPLES**<br><br>NFV Infrastructure: compute, storage, and networking components, Virtualization technologies: hypervisors, containers, and VMs, VNF lifecycle management, Service chaining and function orchestration, Case studies: OpenStack, OpenDaylight | 9 |

| | | |
|---|---|---|
| **III** | **NFV AND SOFTWARE DEFINED NETWORKING (SDN)**<br><br>SDN architecture and OpenFlow protocol, SDN–NFV integration and interoperability, Network programmability and control plane separation, Use cases: dynamic traffic management, virtual routing, firewalls, SDN controllers for NFV orchestration | **9** |
| **IV** | **MANAGEMENT, SECURITY, AND PERFORMANCE**<br><br>NFV MANO architecture: Orchestrator, VNFM, VIM, Resource allocation and scalability challenges, Fault tolerance and monitoring in NFV, Security in virtualized environments: isolation, intrusion detection, Benchmarking NFV performance | **9** |
| **V** | **APPLICATIONS AND FUTURE TRENDS**<br><br>NFV in 5G networks: slicing, MEC integration, Cloud-native NFV and containerization (Kubernetes, Docker), NFV for IoT and edge computing, AI-driven NFV management and analytics, Future research directions and industrial case studies | **8** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Explain the principles, motivation, and architecture of Network Function Virtualization. |
| **CO2** | Analyze the interaction between NFV and SDN in next-generation networks. |
| **CO3** | Design and manage network services using virtualization and orchestration tools. |
| **CO4** | Evaluate NFV system performance, scalability, and reliability. |
| **CO5** | Apply NFV concepts to real-world 5G, IoT, and cloud-based networking applications. |

**Text Books:**


**1.** D. R. Lopez and E. M. Calle, Network Function Virtualization: Concepts and Implementation, Wiley, Feb. 2020.

2. T. Lin, Network Function Virtualization (NFV): Principles and Practice, Springer, Jun. 2019.

3. R. Mijumbi, Network Function Virtualization: State of the Art and Research Directions, Elsevier, 2021

**Reference Books:**


1. W. Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, Pearson Education, 2019.

2. A. Basta, W. Kellerer, and M. Hoffmann, A Complete Guide to Network Function Virtualization (NFV) and SDN, Wiley, 2022.

3. P. Goransson, C. Black, and T. Culver, Software Defined Networks: A Comprehensive Approach, Morgan Kaufmann, 2021.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT363 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Discipline Specific Elective V**

| Course Title | Internet of Things (IoT) Protocols | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours. T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce various communication protocols used in IoT systems and architectures.
2. To understand the design and operation of IoT networking layers and communication models.
3. To study application, transport, and network layer protocols specific to IoT.
4. To explore interoperability, data exchange formats, and protocol stack integration.
5. To analyze security, performance, and scalability aspects of IoT communication protocols.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO IoT ARCHITECTURE AND COMMUNICATION**<br><br>IoT architecture and communication models, IoT protocol stack overview, Requirements for IoT communication (low power, low latency, scalability), OSI and TCP/IP models for IoT, Overview of physical and data link layer technologies: IEEE 802.15.4, BLE, LoRa, and ZigBee | 8 |
| II | **NETWORK AND TRANSPORT LAYER PROTOCOLS**<br><br>LoWPAN: adaptation and header compression, IPv6 for IoT networks, RPL (Routing Protocol for Low Power and Lossy Networks), UDP and TCP in IoT applications, MQTT, CoAP, AMQP: transport and lightweight messaging protocols | 9 |

| | | |
|---|---|---|
| **III** | **APPLICATION LAYER PROTOCOLS**<br><br>CoAP architecture and RESTful communication, MQTT publish/subscribe model, AMQP and DDS for industrial IoT, XMPP and WebSocket protocols, Case studies: smart home and industrial communication using CoAP and MQTT | **9** |
| **IV** | **SECURITY AND INTEROPERABILITY (9 Hours)**<br><br>IoT security challenges and threats, Encryption, authentication, and access control, DTLS and TLS in IoT communication, Interoperability between heterogeneous IoT devices and protocols, Standardization efforts: OCF, oneM2M, and W3C Web of Things | **9** |
| **V** | **ADVANCED IoT PROTOCOLS AND APPLICATIONS (10 Hours)**<br><br>Edge and fog computing integration with IoT protocols, Lightweight M2M (LwM2M), Time-Sensitive Networking (TSN) for industrial IoT, AI-enabled IoT communication frameworks, Case studies: IoT in smart healthcare, transportation, and energy systems | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals of IoT architecture and communication requirements. |
| **CO2** | Analyze IoT-specific networking, transport, and application layer protocols. |
| **CO3** | Design IoT systems using suitable communication and messaging protocols. |
| **CO4** | Evaluate protocol performance in terms of reliability, latency, and security. |
| **CO5** | Apply standard IoT protocols in real-world applications such as smart cities and healthcare. |

**Text Books:**


**1.** A. Bahga and V. Madisetti, Internet of Things: A Hands-On Approach, Universities Press, Jan. 2019.

*2.* O. Hersent, D. Boswarthick, and O. Elloumi, *The Internet of Things: Key Applications and Protocols*, Wiley, Mar. 2021.

3. S. P. Singh and P. K. Sharma, *Protocols and Architectures for IoT*, Springer, Aug. 2022.

**Reference Books:**


1. D. Minoli, *Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications*, Wiley, Jul. 2020.
2. M. Ammar, J. Russello, and B. Crispo, *Internet of Things: Security and Protocols*, Springer, 2021.
3. A. Al-Fuqaha and M. Guizani, *IoT Protocols and Standards*, Morgan Kaufmann, 2022.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT364 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Programme Specific Elective VI:**

| Course Title | AI in Optical and Satellite Communication | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hour. T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the fundamentals of optical and satellite communication systems.
2. Explain how Artificial Intelligence (AI) techniques enhance communication efficiency, resource allocation, and fault management.
3. Analyze various AI models applied in optical networks and satellite links.
4. Enable students to apply machine learning for optimization, prediction, and automation in communication systems.
5. Provide exposure to current trends and research in AI-enabled communication networks.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO OPTICAL AND SATELLITE COMMUNICATION**<br><br>Overview of Optical Fiber Communication systems – components, transmission link design, optical sources, and detectors., Introduction to Satellite Communication: orbits, link design, frequency bands, transponders., Challenges in optical and satellite networks – latency, bandwidth, interference, and noise., Role of AI in modern communication systems. | 9 |
| II | **MACHINE LEARNING FOR OPTICAL NETWORKS**<br><br>Supervised and unsupervised learning techniques in optical systems., Fault detection and localization using ML., AI for wavelength allocation, routing, and dynamic bandwidth management, Intelligent network management and predictive maintenance in optical links. | 8 |

| | | |
|---|---|---|
| **III** | **AI-BASED SATELLITE COMMUNICATION SYSTEMS**<br><br>AI for satellite orbit optimization and resource scheduling., Beamforming and adaptive modulation using AI, AI-based interference mitigation and channel estimation, Case studies: AI-enabled satellite constellations (e.g., Starlink, OneWeb). | **9** |
| **IV** | **DEEP LEARNING IN OPTICAL AND SATELLITE COMMUNICATION**<br><br>CNNs and RNNs for signal detection, image-based channel analysis, and noise reduction., Deep Reinforcement Learning (DRL) for adaptive control and spectrum management, Neural network-based channel modeling and fault prediction, Intelligent automation in network operation centers. | **9** |
| **V** | **FUTURE TRENDS AND RESEARCH DIRECTIONS**<br><br>Integration of AI, IoT, and 6G communication., Quantum communication and AI-driven photonic computing, Edge AI for real-time signal processing, Emerging standards and ethical considerations in AI-based communication systems. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Explain the fundamentals of optical and satellite communication systems. |
| **CO2** | Apply AI and ML algorithms for optimization and fault detection in communication systems. |
| **CO3** | Analyze AI models for adaptive routing, scheduling, and modulation in optical/ satellite links. |
| **CO4** | Design AI-based frameworks for intelligent communication and automation. |
| **CO5** | Evaluate emerging AI techniques and their role in next-generation communication systems. |

**Text Books:**


1. G. Keiser, Optical Fiber Communications, 5th Edition, McGraw Hill, 2021 (January).
2. D. Roddy, *Satellite Communications*, 5th Edition, McGraw Hill, 2020 (July).
3. S. Haykin, *Neural Networks and Learning Machines*, 4th Edition, Pearson, 2021 (April).
4. S. O. Arik et al., *AI for Optical and Satellite Communications*, Springer, 2022, (October).

**Reference Books:**


**1.** I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, MIT Press, **2017 (November)**.

2. A. Goldsmith, *Wireless Communications*, Cambridge University Press, **2019 (March)**.

*3.* T. O'Shea and J. Hoydis, *Deep Learning for Wireless Communications*, IEEE Press, **2020 (December)**.

4. K. David and H. Berndt, *6G Vision – AI and Communication*, Wiley, **2023 (May)**.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | - | - | - | - | - | - | 2 | - | 1 | 3 | - | - |
| CO2 | 3 | 3 | 2 | 2 | - | - | - | - | - | 2 | - | 2 | 3 | 2 | - |
| CO3 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | 2 | - | 3 | 3 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 3 | - | 3 | 3 | 3 | 2 |
| CO5 | 2 | 3 | 2 | 3 | 2 | - | - | - | 1 | 3 | - | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT365 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Programme Specific Elective VI:**

| Course Title | Network Management and Monitoring | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours. T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce the principles and architecture of network management systems.
2. Explain various network monitoring tools, protocols, and performance metrics.
3. Analyze fault, configuration, accounting, performance, and security (FCAPS) management in networks.
4. Apply automation and AI-based methods for intelligent network monitoring.
5. Expose students to emerging trends in SDN, NFV, and AI-driven network management.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO NETWORK MANAGEMENT**<br><br>Overview of Network Management concepts and standards., Network management architecture and functions., The FCAPS framework – Fault, Configuration, Accounting, Performance, and Security management., Simple Network Management Protocol (SNMP) – structure, components, and operation., Network Management models – centralized, distributed, and hierarchical. | 9 |
| II | **NETWORK MANAGEMENT PROTOCOLS AND TOOLS**<br><br>SNMP versions (v1, v2, v3) and MIB (Management Information Base)., Remote Monitoring (RMON) and NetFlow., Syslog, ICMP, and SNMP traps for event reporting., Network Management tools – Wireshark, SolarWinds, Nagios, Zabbix, PRTG, and OpenNMS., Case studies on enterprise network monitoring systems. | 9 |

| | | |
|---|---|---|
| **III** | **PERFORMANCE MANAGEMENT AND DATA ANALYTICS**<br><br>Metrics for network performance – latency, jitter, throughput, and packet loss, Traffic analysis and bandwidth utilization, Network anomaly detection and visualization techniques., Role of big data and analytics in network monitoring, Predictive maintenance using data-driven approaches. | **8** |
| **IV** | **AUTOMATED AND AI-BASED NETWORK MANAGEMENT**<br><br>Network automation concepts – configuration management and orchestration, SDN (Software Defined Networking) for centralized control and monitoring, NFV (Network Function Virtualization) for scalable network management, AI and ML models for fault prediction, traffic optimization, and intrusion detection, Intelligent monitoring using reinforcement learning and deep learning. | **9** |
| **V** | **FUTURE TRENDS IN NETWORK MANAGEMENT**<br><br>Cloud and edge-based network monitoring frameworks.IoT network management challenges and solutions, Self-healing and self-optimizing networks, Blockchain for secure network management, Emerging standards and open-source initiatives in network management. | **8** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Explain the architecture and basic components of network management systems. |
| **CO2** | Apply management protocols and tools for monitoring network performance. |
| **CO3** | Analyze network data and detect anomalies using monitoring frameworks. |
| **CO4** | Design intelligent and automated network management systems using SDN/ NFV. |
| **CO5** | Evaluate advanced AI-based network management and emerging technologies. |

**Text Books:**


1. M. Subramanian, Network Management: Principles and Practice, Pearson Education, 2nd Ed., June 2020.
2. Mani Subramanian, Network Management: Concepts and Practice, Addison-Wesley, Reprint Edition, 2021 (March).
3. W. Stallings, SNMP, SNMPv2, SNMPv3, and RMON 1 and 2, Addison-Wesley, 3rd Ed., July 2018.
4. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, Pearson, 8th Ed., December 2021.

**Reference Books:**


1. O. Hersent, D. Boswarthick, and P. L. Drogoul, *The Internet of Things: Key Applications and Protocols*, Wiley, **2nd Ed.,October 2019**.
2. T. Erl, *Cloud Computing: Concepts, Technology & Architecture*, Pearson, **2017 (April)**.
3. S. Sezer et al., *Software-Defined Networking: A Comprehensive Survey*, IEEE Communications Surveys & Tutorials, **Vol. 16, No. 4, Dec. 2020**.
4. M. P. Singh and R. S. Ghosh, *Network Management and Automation using AI/ ML*, Springer, **2022 (May)**.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | – | – | – | – | – | 2 | – | 2 | 3 | 2 | – |
| CO2 | 3 | 3 | 2 | 2 | 2 | – | – | – | – | 3 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | – | – | – | – | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | – | – | – | 1 | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | – | – | – | 1 | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT366** | **Number of Hours/ Week** | **3** | | |
| **Semester** | **VI** | **Max. Marks** | **100** | | |
| **Year** | **III** | **Credits** | **3** | | |
| **Programme Specific Elective VI** | | | | | |
| **Course Title** | **Advanced Computer Networks** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours.** | **T-Tutorial Hours P-Practical Hours** | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Provide a deep understanding of advanced networking concepts, protocols, and architectures.
2. Analyze various network layer and transport layer protocols for performance optimization.
3. Introduce advanced topics such as QoS, MPLS, and Traffic Engineering.
4. Explore recent advancements in Software Defined Networking (SDN), Network Function Virtualization (NFV), and Cloud Networking.
5. Enable students to apply network simulation and analytical methods to design efficient and secure networks.

| UNIT | TOPICS | HOURS |
|---|---|---|
| **I** | **ADVANCED NETWORK ARCHITECTURE AND LAYERING**<br><br>Review of OSI and TCP/IP models.Next Generation Internet (IPv6) – features, addressing, and transition mechanisms, Internet routing architectures – intra-domain (RIP, OSPF) and inter-domain (BGP), Network performance metrics – latency, throughput, congestion, and delay, Emerging architectures – data center networks and content delivery networks (CDNs). | **9** |

| | | |
|---|---|---|
| **II** | **TRANSPORT AND APPLICATION LAYER PROTOCOLS**<br><br>TCP variants (Tahoe, Reno, New Reno, Vegas, Cubic) and congestion control mechanisms, UDP and QUIC protocols, SCTP and DCCP overview, Real-time communication protocols – RTP/RTCP, SIP, and WebRTC., Application layer protocols – DNS, HTTP/3, MQTT, CoAP. | **9** |
| **III** | **QUALITY OF SERVICE (QoS) AND TRAFFIC ENGINEERING**<br><br>QoS principles, Integrated and Differentiated Services, Traffic shaping, policing, and scheduling (Leaky Bucket, Token Bucket), MPLS architecture, label switching, and forwarding, Traffic Engineering using MPLS and RSVP, Performance analysis and congestion avoidance strategies. | **9** |
| **IV** | **SOFTWARE DEFINED NETWORKING AND NETWORK VIRTUALIZATION**<br><br>Introduction to SDN – architecture, control, and data planes, OpenFlow protocol – structure and working, Network Function Virtualization (NFV) and orchestration, SDN controllers – ONOS, OpenDaylight, Case studies – SDN in data centers and 5G networks. | **9** |
| **V** | **CLOUD AND FUTURE NETWORKS**<br><br>Cloud networking and inter-cloud connectivity, Edge and Fog networking concepts, Network Security in cloud environments, AI/ML applications in network optimization, Future trends – 6G networks, Quantum networking, and Autonomous networks. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Explain the architecture, protocols, and functionalities of advanced computer networks. |
| **CO2** | Apply and compare advanced transport and application layer protocols for different scenarios. |
| **CO3** | Analyze QoS and traffic engineering mechanisms for performance optimization. |
| **CO4** | Design SDN and NFV-based network solutions for flexible management. |
| **CO5** | Evaluate and research emerging technologies such as AI-driven and cloud-based networking. |

**Text Books:**


1. A. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 6th Ed., Pearson, March 2021.
2. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, 8th Ed., Pearson, December 2021.
3. L. Peterson and B. Davie, Computer Networks: A Systems Approach, 6th Ed., Morgan Kaufmann, July 2022.
4. N. Feamster, J. Rexford, and E. Zegura, The Road to SDN: An Intellectual History of Programmable Networks, ACM SIGCOMM, August 2020.


**Reference Books:**


1. W. Stallings, *Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud*, Addison-Wesley, April 2016.
2. T. Erl, *Cloud Computing: Concepts, Technology & Architecture*, Pearson, April 2017.
3. P. Goransson and C. Black, *Software Defined Networks: A Comprehensive Approach*, 2nd Ed., Morgan Kaufmann, June 2018.
4. H. Kim and N. Feamster, *Improving Network Management with SDN and ML*, IEEE Communications Magazine, Vol. 57, No. 10, October 2021.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | – | – | – | – | – | 2 | – | 2 | 3 | 2 | – |
| CO2 | 3 | 3 | 2 | 2 | 2 | – | – | – | – | 3 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | – | – | – | – | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | – | – | – | 1 | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | – | – | – | 1 | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT061 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Generic Elective II (Open Elective)**

| Course Title | AI Tools | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To understand various Artificial Intelligence tools used in different domains.
2. To learn the functionalities and applications of popular AI platforms.
3. To explore cloud-based and open-source AI tools for model building and deployment.
4. To gain practical exposure in using AI tools for data preprocessing, model training, and evaluation.
5. To develop skills in selecting appropriate AI tools for solving real-world problems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO AI TOOLS**<br><br>Overview of AI, ML, and Deep Learning frameworks, Open-source AI tools: TensorFlow, PyTorch, Keras, Scikit-learn, Cloud-based AI tools: Google Colab, AWS SageMaker, Microsoft Azure AI, AI tool selection criteria: scalability, deployment, and application suitability, Installation, environment setup, and basic functionality. | 8 |
| II | **MACHINE LEARNING TOOLS**<br><br>**Supervised and unsupervised learning** libraries, Regression, classification, clustering, and dimensionality reduction, Feature selection, preprocessing, and pipeline creation, Model training, evaluation metrics, and visualization., Using Scikit-learn and Pandas for ML workflows. | 9 |

| | | |
|---|---|---|
| **III** | **DEEP LEARNING TOOLS**<br><br>Neural network basics: MLP, CNN, RNN, Frameworks: TensorFlow and PyTorch basics, Model building: layers, activation functions, and optimization, Training, validation, and testing procedures, Transfer learning and pre-trained models. | **9** |
| **IV** | **CLOUD AND EDGE AI TOOLS**<br><br>Cloud AI platforms: Google Cloud AI, AWS, Azure ML Studio., Training and deploying models in cloud environments, Edge AI tools: TensorFlow Lite, OpenVINO, NVIDIA Jetson AI, Resource optimization for AI on cloud and edge devices, Case studies: AI applications in healthcare, IoT, and smart systems. | **9** |
| **V** | **AI TOOL INTEGRATION AND APPLICATIONS**<br><br>Integrating AI tools with real-world applications, AI for computer vision, natural language processing, and predictive analyticAutomation and scripting using AI tools, Performance comparison of AI tools., Emerging trends: AutoML, MLOps, and AI pipelines. | **8** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the architecture and components of commonly used AI tools and frameworks. |
| **CO2** | Apply open-source AI tools (like TensorFlow, PyTorch, Scikit-learn) for machine learning and deep learning tasks. |
| **CO3** | Develop and evaluate AI models using cloud-based tools such as Google Colab and AWS SageMaker. |
| **CO4** | Analyze the performance of AI tools in various real-time applications. |
| **CO5** | Select and integrate suitable AI tools for domain-specific intelligent system design. |

**Text Books:**


***1.*** S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th Ed., Pearson, Jan. 2021.

2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, 3rd Ed., O'Reilly Media, June 2022.

3. François Chollet, *Deep Learning with Python*, 2nd Ed., Manning Publications, March 2021.

**Reference Books:**

**1.** Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, Nov. 2016.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning*, Springer, 2Ed., 2017.

*3.* Anirudh Koul, Siddha Ganju, Meher Kasam, *Practical Deep Learning for Cloud, Mobile, and Edge*, O'Reilly Media, 2019.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 2 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | |
| CO5 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT062 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Generic Elective II (Open Elective)**

| Course Title | Cyber security | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours** **T-Tutorial Hours** **P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce fundamental concepts and principles of cyber security.
2. Explore cryptography, authentication, and access control mechanisms.
3. Analyze network security threats, vulnerabilities, and attacks.
4. Examine security solutions for web, cloud, and IoT systems.
5. Develop skills to design secure systems and implement best practices in cyber defense.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO CYBER SECURITY**<br><br>Overview of cyber security: concepts, goals, and importance, Types of threats: malware, phishing, ransomware, social engineering, Security principles: confidentiality, integrity, availability, non-repudiation, Risk management and security policies, Cyber ethics and legal frameworks. | 8 |
| II | **CRYPTOGRAPHY AND ACCESS CONTROL**<br><br>Symmetric and asymmetric cryptography, Public Key Infrastructure (PKI) and digital certificates, Hash functions and digital signatures, Authentication protocols and access control models (DAC, MAC, RBAC), Key management and cryptanalysis basics. | 9 |

| | | |
|---|---|---|
| **III** | **NETWORK SECURITY**<br><br>Firewalls, VPNs, and intrusion detection/ prevention systems (IDS/IPS), Network protocols vulnerabilities (TCP/IP, DNS, HTTP/ HTTPS), Security mechanisms: SSL/TLS, IPsec, SSH, Wireless network security (Wi-Fi, Bluetooth, IoT networks), Threat detection and mitigation strategies. | **9** |
| **IV** | **SYSTEM AND APPLICATION SECURITY**<br><br>Secure software development practices, Operating system security: authentication, authorization, patch management, Malware analysis and anti-virus tools, Web application security: SQL injection, XSS, CSRF, OWASP Top 10, Cloud security: identity management, virtualization security, container security. | **9** |
| **V** | **EMERGING TRENDS IN CYBER SECURITY**<br><br>AI and ML for threat detection and prevention, Blockchain-based security and smart contracts, Security for IoT and Industrial Control Systems, Security auditing, penetration testing, and ethical hacking, Future trends and standards in cyber security. | **8** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals of cyber security, threats, and vulnerabilities. |
| **CO2** | Apply cryptography, authentication, and access control mechanisms. |
| **CO3** | Analyze network security threats and implement defensive measures. |
| **CO4** | Design and evaluate secure systems using firewalls, IDS/IPS, and security protocols. |
| **CO5** | Assess emerging cyber security technologies and best practices for cloud, IoT, and web applications. |

**Text Books:**


**1.** W. Stallings, Cryptography and Network Security: Principles and Practice, 8th Ed., Pearson, **2020 (Jan)**.

2. William Easttom, Computer Security Fundamentals, 4th Ed., Pearson, **2021 (March)**.

3. J. Andress, The Basics of Cyber Security: Understanding the Fundamentals of InfoSec in Theory and Practice, 3rd Ed., Syngress, **2020 (July)**.


**Reference Books:**


**1.** C. P. Pfleeger and S. L. Pfleeger, Security in Computing, 5th Ed., Pearson, **2015 (Aug)**. R. Anderson, Security Engineering: A Guide to Building Dependable Distributed Systems, 3rd Ed., Wiley, **2020 (Dec)**.

2. E. Amoroso, Cyber Attacks: Protecting National Infrastructure, 2nd Ed., Butterworth-Heinemann, **2017 (Nov)**.

3. N. Scaife, Cyber Security for Beginners, Independently Published, **2021 (May)**.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | – | – | – | – | 1 | 2 | – | 2 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | – | – | – | 1 | 3 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | – | – | – | 2 | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | – | – | – | 2 | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | – | – | – | 2 | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT063 | Number of Hours/ Week | 3 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credits | 3 |

**Generic Elective II (Open Elective)**

| Course Title | Data Visualization | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours** **T-Tutorial Hours** **P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. Introduce fundamental principles of data visualization and information design.
2. Explore different visualization tools and libraries for effective data representation.
3. Enable students to create interactive and analytical visualizations using modern software.
4. Teach techniques for interpreting and analyzing large datasets visually.
5. Develop skills to present insights from data in clear and compelling formats for decision-making.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO DATA VISUALIZATION**<br><br>Importance of data visualization in data analysis and decision-making, Basic principles of information visualization and visual perception, Types of data: categorical, numerical, temporal, spatial, Common chart types: bar, line, scatter, pie, histogram, Data visualization workflow: data acquisition, preprocessing, visualization, and interpretation. | 8 |
| II | **DATA VISUALIZATION TOOLS AND LIBRARIES**<br><br>Introduction to Python libraries: Matplotlib, Seaborn, Introduction to R libraries: ggplot2, plotly, Tableau basics: charts, filters, dashboards, Data cleaning and preprocessing for visualization, Best practices for tool selection and effective plotting. | 9 |

| | | |
|---|---|---|
| **III** | **ADVANCED VISUALIZATION TECHNIQUES**<br><br>Multi-dimensional visualization: heatmaps, bubble charts, tree maps, Geospatial visualization and mapping, Time series visualization, Interactive visualizations using Plotly and Dash, Color theory and aesthetics in visualization. | **9** |
| **IV** | **INTERACTIVE DASHBOARDS AND REPORTS**<br><br>Dashboard design principles, Creating interactive dashboards in Tableau and Power BI, Integrating multiple visualizations and data sources, Real-time data visualization and monitoring, Case studies in business analytics and scientific visualization. | **9** |
| **V** | **EVALUATION AND BEST PRACTICES**<br><br>Evaluating effectiveness of visualizations, Storytelling with data and narrative visualization, Visualization for decision-making and presentation, Ethical issues in data visualization: bias, misrepresentation, Emerging trends: VR/AR visualization, 3D visualization, AI-assisted visualization. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the principles and techniques of data visualization. |
| **CO2** | Apply visualization tools and libraries (like Matplotlib, Seaborn, Plotly, Tableau) to represent data effectively. |
| **CO3** | Analyze datasets to create meaningful visual insights and comparisons. |
| **CO4** | Design interactive dashboards and reports using modern visualization platforms. |
| **CO5** | Evaluate and select suitable visualization methods for different types of data and audience requirements. |

**Text Books:**


1. M. Ward, G. Grinstein, and D. Keim, Interactive Data Visualization: Foundations, Techniques, and Applications, 2nd Ed., CRC Press, 2015 (March).

2. K. Healy, Data Visualization: A Practical Introduction, 2nd Ed., Princeton University Press, 2021 (June).

3. A. Kirk, Data Visualization: A Handbook for Data Driven Design, 2nd Ed., Sage Publications, 2019 (May).

**Reference Books:**

1. W. S. Cleveland, The Elements of Graphing Data, Hobart Press, 1994 (Jan).
2. J. W. Tukey, *Exploratory Data Analysis*, Addison-Wesley, 1977 (Nov).
3. B. Yau, *Data Points: Visualization That Means Something*, Wiley, 2013 (Feb).
4. R. Kosara, *Visualization Criticism: The Missing Link Between InfoVis and HCI*, IEEE Computer Graphics & Applications, Vol. 36, No. 3, May 2016.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | – | – | – | – | – | 2 | – | 2 | 3 | 2 | – |
| CO2 | 3 | 3 | 2 | 2 | 2 | – | – | – | – | 3 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | – | – | – | – | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | – | – | – | 1 | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | – | – | – | 1 | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT261 | Number of Hours/ Week | 2 |
| Semester | VI | Max. Marks | 100 |
| Year | III | Credit | 1 |

| Course Title | Reinforcement Learning Lab | L | T | P |
|---|---|---|---|---|
| | | 0 | 0 | 2 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide hands-on experience with Reinforcement Learning (RL) algorithms and Natural Language Processing (NLP) techniques.
2. To enable students to implement RL agents for sequential decision-making tasks.
3. To teach practical NLP applications such as text preprocessing, sentiment analysis, and sequence modeling.
4. To expose students to modern frameworks like Python, TensorFlow, PyTorch, and OpenAI Gym.
5. To develop skills to evaluate and compare the performance of RL and NLP models.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| | **List of Experiments**<br><br>**Reinforcement Learning Experiments (1–6)**<br><br>1. Implement **Multi-armed Bandit Problem** using ε-greedy strategy.<br>2. Implement **Grid World Environment** using Q-learning.<br>3. Implement **SARSA Algorithm** for a simple environment.<br>4. Implement **Policy Gradient Methods** for RL tasks.<br>5. RL agent for **CartPole balancing** using OpenAI Gym.<br>6. RL agent for **FrozenLake environment** and reward optimization.<br><br>**NLP Experiments (7–12)**<br><br>7. Text preprocessing: tokenization, stopword removal, stemming, and lemmatization.<br>8. Feature extraction: Bag-of-Words, TF-IDF, and Word2Vec embeddings.<br>9. Sentiment analysis using Naive Bayes classifier.<br>10. Text classification using LSTM/GRU neural networks.<br>11. Named Entity Recognition (NER) using spaCy or NLTK.<br>12. Chatbot implementation using sequence-to-sequence models. | |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Implement basic Reinforcement Learning algorithms like Q-learning, SARSA, and Policy Gradients. |
| **CO2** | Develop NLP pipelines for text preprocessing, tokenization, and vector representation. |
| **CO3** | Apply RL agents to real-world environments using OpenAI Gym or similar platforms. |
| **CO4** | Design NLP models for sentiment analysis, text classification, and sequence modeling. |

| | |
|---|---|
| **CO5** | Evaluate and analyze the performance of RL and NLP models using metrics and visualization. |

**Tools & Frameworks:**

1. Programming Languages: Python **Libraries:** TensorFlow, PyTorch, OpenAI Gym, NLTK, spaCy, Scikit-learn, Pandas
2. **Platforms:** Google Colab, Jupyter Notebook

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | – | 2 | – | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | – | 1 | 1 | – | 2 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | – | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | – | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | – | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT262** | **Number of Hours/ Week** | **2** |
| **Semester** | **VI** | **Max. Marks** | **100** |
| **Year** | **III** | **Credit** | **1** |

| | | | | |
|---|---|---|---|---|
| **Course Title** | **Cloud & Edge Computing for IoT lab** | **L** | **T** | **P** |
| | | **0** | **0** | **2** |

**L-Lecture Hours. T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide practical exposure to cloud and edge computing platforms for IoT applications.
2. To develop skills in deploying IoT devices and sensors on cloud and edge frameworks.
3. To implement IoT data acquisition, processing, and visualization using cloud services.
4. To understand performance optimization and latency issues in edge computing.
5. To integrate IoT devices with cloud platforms for real-time applications and analytics.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| | **List of Experiments**<br><br>**Cloud Computing Experiments (1–6)**<br><br>1. Setup of IoT devices and sensors for data collection.<br>2. Data storage and retrieval using cloud services (AWS IoT, Azure IoT Hub).<br>3. Implement data visualization dashboards on cloud platforms.<br>4. Simulate IoT device communication using MQTT protocol over cloud.<br>5. Cloud-based analytics for IoT sensor data (temperature, humidity, motion).<br>6. Integration of multiple IoT devices with cloud service for a smart application.<br><br>**Edge Computing Experiments (7–12)**<br><br>7. Setup of edge devices (Raspberry Pi, Arduino) for local data processing.<br>8. Implement edge-based data preprocessing and filtering.<br>9. Real-time data monitoring and visualization using edge devices.<br>10. Latency measurement and optimization for edge computing IoT applications.<br>11. Integration of edge and cloud computing for hybrid IoT solutions.<br>12. Performance analysis of cloud-edge IoT systems for scalability and reliability. | **24** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand cloud and edge computing platforms, architectures, and services. |
| **CO2** | Deploy IoT devices and simulate sensor networks in cloud and edge environments. |
| **CO3** | Implement data acquisition, storage, and analytics using cloud services. |
| **CO4** | Design and optimize real-time IoT applications with low latency using edge computing. |

| | |
|---|---|
| **CO5** | Evaluate performance and scalability of IoT solutions in cloud-edge environments. |

**Tools & Platforms:**

- **IoT Devices:** Raspberry Pi, Arduino, ESP32
- **Cloud Platforms:** AWS IoT, Azure IoT Hub, Google Cloud IoT
- **Protocols & Libraries:** MQTT, HTTP, Node-RED, Python libraries (paho-mqtt, pandas, matplotlib)
- **Edge Platforms:** Raspberry Pi, Jetson Nano, TensorFlow Lite
-
- **Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | – | – | – | 1 | – | 2 | – | 2 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | – | – | 1 | – | 3 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | – | – | 1 | – | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | – | – | 1 | – | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | – | – | 1 | – | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

# Semester VII

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT171 | Number of Hours/ Week | 3 |
| Semester | VII | Max. Marks | 100 |
| Year | IV | Credits | 3 |

| Course Title | Cybersecurity for IoT | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce students to cybersecurity challenges in IoT systems.
2. To understand IoT-specific threats, vulnerabilities, and attack vectors.
3. To explore cryptographic techniques, authentication, and access control mechanisms for IoT.
4. To design secure IoT architectures integrating cloud and edge platforms.
5. To analyze real-world IoT security cases and emerging standards.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO IOT SECURITY**<br><br>Overview of IoT architecture, components, and communication protocols, Security challenges in IoT devices and networks, Threat modeling and risk assessment in IoT, Security goals: confidentiality, integrity, availability, authentication, and non-repudiation. | 8 |
| II | **IOT VULNERABILITIES AND ATTACKS**<br><br>Network-level attacks: DDoS, Man-in-the-Middle (MITM), eavesdropping, Device-level attacks: firmware tampering, malware, side-channel attacks, Application-level attacks: injection attacks, buffer overflows, insecure APIs, Case studies: IoT botnets (Mirai), smart home attacks, industrial IoT attacks. | 9 |

| | | |
|---|---|---|
| **III** | **CRYPTOGRAPHY AND SECURE COMMUNICATION IN IOT**<br><br>Symmetric and asymmetric cryptography in IoZ, Lightweight cryptography for resource-constrained IoT devices, Key management and distribution techniques, Secure communication protocols: TLS/SSL, DTLS, MQTT with security extensions. | **9** |
| **IV** | **ACCESS CONTROL AND SECURE ARCHITECTURES**<br><br>Authentication, authorization, and identity management in IoT, Role-based and attribute-based access control models, Secure IoT architectures: edge security, cloud-edge integration, IoT security frameworks and compliance standards (ISO/IEC, NIST). | **9** |
| **V** | **EMERGING TRENDS AND SECURITY SOLUTIONS**<br><br>Blockchain-based IoT security, AI/ML-based anomaly detection for IoT, IoT security auditing and penetration testing, Privacy, ethical issues, and GDPR compliance for IoT, Future trends and research directions in IoT cybersecurity. | **10** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand IoT architecture, components, and associated cybersecurity risks. |
| **CO2** | Analyze IoT vulnerabilities and common attack vectors (network, device, and application level). |
| **CO3** | Apply cryptography, authentication, and secure communication protocols for IoT systems. |
| **CO4** | Design secure IoT systems with edge, cloud integration, and access control mechanisms. |
| **CO5** | Evaluate IoT security solutions and emerging trends, standards, and best practices. |

**Text Books:**


1. H. Suo, J. Wan, C. Zou, and J. Liu, Security in the Internet of Things: A Survey, Springer, 2012.

2. F. B. Schneider, Principles of Security for IoT Systems, Wiley, **2018 (March)**.

3. D. Evans, IoT Security: Advances in Authentication, Privacy, and Data Protection, CRC Press, **2020 (May)**.

**Reference Books:**

**1.** A. K. Das, Security and Privacy in Internet of Things (IoT): Models, Algorithms, and Implementations, Springer, **2017, (Dec)**.

2. J. Granjal, E. Monteiro, and J. S. Silva, *Security for the Internet of Things: A Survey of Existing Protocols and Open Research Issues*, IEEE Communications Surveys & Tutorials, **2015**.

3. R. Roman, P. Najera, and J. Lopez, *Securing the Internet of Things*, Computer, IEEE, **2011**.

*4.* K. Zhao and L. Ge, *A Survey on the Internet of Things Security*, IEEE Internet of Things Journal, **2013**.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | – | – | – | 1 | – | 2 | – | 2 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | – | – | 1 | – | 3 | – | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | – | – | 1 | – | 3 | – | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | – | – | 1 | – | 3 | – | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | – | – | 1 | – | 3 | – | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT172** | **Number of Hours/Week** | **3** |
| **Semester** | **VII** | **Max. Marks** | **100** |
| **Year** | **IV** | **Credits** | **3** |

| | | | | |
|---|---|---|---|---|
| **Course Title** | **IoT with 5G Technology** | **L** | **T** | **P** |
| | | **3** | **0** | **0** |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce students to the integration of IoT systems with 5G networks.
2. To understand the 5G architecture, protocols, and features supporting massive IoT deployments.
3. To analyze IoT communication requirements and network slicing in 5G.
4. To explore edge computing and low-latency IoT applications in 5G environments.
5. To evaluate security, scalability, and performance aspects of IoT over 5G networks.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **INTRODUCTION TO 5G AND IOT**<br><br>Overview of 5G technology: key features, spectrum, and architecture, IoT fundamentals and types of IoT networks (Narrowband-IoT, LPWAN, etc.), 5G enhancements for IoT: eMBB, URLLC, mMTC, Integration of IoT and 5G: requirements, challenges, and use cases, Examples: smart cities, autonomous vehicles, industrial IoT. | **8** |
| II | **5G NETWORK ARCHITECTURE AND PROTOCOLS**<br><br>5G NR (New Radio) architecture and components: gNB, 5G Core (5GC), 5G protocol stack for IoT communication, Radio access network (RAN) and backhaul considerations, Network slicing and virtualization for IoT services, Quality of Service (QoS) and resource allocation in 5G IoT. | **9** |

| | | |
|---|---|---|
| **III** | **COMMUNICATION TECHNOLOGIES FOR IOT OVER 5G**<br><br>Low Power Wide Area Networks (LPWAN) for IoT, Narrowband IoT (NB-IoT) and LTE-M integration with 5G, Edge and fog computing support in 5G-IoT ecosystems, Device-to-device (D2D) communication and mesh networks, Protocols: MQTT, CoAP, HTTP/2, and 5G-specific transport protocols. | **9** |
| **IV** | EDGE COMPUTING AND LOW-LATENCY APPLICATIONS<br><br>Edge computing principles and architectures for IoT, Data processing and analytics at the network edge, Low-latency IoT applications: autonomous vehicles, AR/VR, smart grids, Resource management and orchestration in edge computing, Case studies: industrial automation, remote healthcare monitoring. | 8 |
| **V** | **SECURITY, SCALABILITY, AND PERFORMANCE**<br><br>Security challenges in 5G-IoT networks, Authentication, encryption, and privacy techniques for IoT devices, Scalability and device management in massive IoT deployments, Performance evaluation metrics: latency, throughput, reliability, Future trends: AI-enabled 5G-IoT, network intelligence, and 6G perspectives. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand 5G network architecture, protocols, and their relevance to IoT. |
| **CO2** | Analyze IoT communication requirements and 5G features for massive IoT deployments. |
| **CO3** | Apply network slicing, QoS, and resource allocation techniques for IoT over 5G. |
| **CO4** | Design low-latency, high-throughput IoT applications using edge computing in 5G networks. |
| **CO5** | Evaluate security, scalability, and performance of IoT systems over 5G networks. |

**Text Books:**


**1.** W. Saad, M. Bennis, and M. Chen, A Vision of 6G Wireless Systems: Applications, Trends, Technologies, and Open Research Problems, IEEE Network, 2019.

2. J. G. Andrews, Fundamentals of 5G Mobile Networks, Cambridge University Press, **2020 (Jan)**.

3. S. R. Chowdhury, M. Shahjalal, M. Hasan, Internet of Things (IoT) and 5G Networks, CRC Press, **2021 (Feb)**.

**Reference Books:**


**1.** F. Adelantado et al., Understanding the Limits of LoRaWAN, IEEE Communications Magazine, **2017**.

2. M. Agiwal, A. Roy, and N. Saxena, *Next Generation 5G Wireless Networks: A Comprehensive Survey*, IEEE Communications Surveys & Tutorials, **2016**.

3. H. Chen, *5G for the Internet of Things*, Springer, **2020 (March)**.

4. R. Li, Z. Zhao, *Edge Computing for 5G IoT: Architectures, Technologies, and Applications*, Wiley, **2021 (June)**.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 1 | 0 | 3 | 0 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 3 | 3 | 0 | 0 | 1 | 0 | 3 | 0 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT371 | Number of Hours/ Week | 3 | | |
| Semester | VI | Max. Marks | 100 | | |
| Year | III | Credits | 3 | | |
| Discipline Specific Elective VII | | | | | |
| Course Title | Real-Time Operating Systems (RTOS) | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To understand the fundamentals and architecture of Real-Time Operating Systems.
2. To analyze task scheduling, synchronization, and communication mechanisms in real-time systems.
3. To apply RTOS principles in designing embedded and control system applications.
4. To evaluate the performance and reliability of real-time systems.
5. To gain practical knowledge of RTOS through simulation or case studies.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Real-Time Systems**<br><br>Definition of Real-Time Systems – Types of Real-Time Systems – Characteristics and Applications – Real-Time Constraints – Real-Time vs General-Purpose Systems – Overview of Embedded Systems – Case Studies of Real-Time Systems. | 8 |
| II | **Real-Time Operating System Concepts**<br><br>Architecture of RTOS – Kernel and its Services – Tasks, Threads, and Processes – Task States and Life Cycle – Interrupt Handling – Preemptive and Non-preemptive Scheduling – Context Switching. | 9 |

| | | |
|---|---|---|
| **III** | **Task Scheduling and Synchronization**<br><br>Scheduling Algorithms: Rate Monotonic, Earliest Deadline First, Least Laxity First – Multiprocessor Scheduling – Priority Inversion and Inheritance – Task Synchronization and Mutual Exclusion – Semaphores, Mutexes, and Monitors. | **9** |
| **IV** | **Inter-Task Communication and Resource Management**<br><br>Inter-Process Communication (IPC) Mechanisms – Message Queues, Mailboxes, Pipes, Shared Memory – Memory Management in RTOS – Device Drivers – Real-Time Databases – Deadlocks and Handling Techniques. | **9** |
| **V** | **Case Studies and Applications**<br><br>Real-Time Performance Metrics – Reliability and Fault Tolerance – Power-Aware Scheduling – Real-Time Linux, VxWorks, FreeRTOS – RTOS-based Application Design: Automotive, Robotics, and IoT Systems. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals, architecture, and characteristics of Real-Time Operating Systems. |
| **CO2** | Analyze scheduling algorithms and resource management in real-time environments. |
| **CO3** | Apply synchronization, inter-task communication, and concurrency control in RTOS. |
| **CO4** | Design and develop small real-time applications using RTOS concepts. |
| **CO5** | Evaluate the performance and reliability of real-time systems in various applications. |

**Text Books:**


1. *Rajib Mall, Real-Time Systems: Theory and Practice, Pearson Education, 2nd Edition, 2017.*

2. Qing Li and Caroline Yao, *Real-Time Concepts for Embedded Systems*, Elsevier, 2nd Edition, 2011.

**Reference Books:**


1. Jane W.S. Liu, *Real-Time Systems*, Pearson Education, 2008.

2. C.M. Krishna and Kang G. Shin, *Real-Time Systems*, McGraw Hill, 2014.

3. Hermann Kopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications, Springer, 2011.


## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 0 |
| CO2 | 3 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 1 | 0 |
| CO3 | 2 | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 1 |
| CO4 | 2 | 2 | 3 | 2 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 3 | 3 | 3 | 2 |
| CO5 | 2 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 2 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT372 | Number of Hours/Week | 3 | | |
| Semester | VII | Max. Marks | 100 | | |
| Year | IV | Credits | 3 | | |
| Discipline Specific Elective VII | | | | | |
| Course Title | Neuro- Symbolic AI | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamentals of symbolic AI and neural networks.
2. To understand how neuro-symbolic integration combines logic-based and data-driven approaches.
3. To study hybrid models for reasoning, learning, and knowledge representation.
4. To analyze case studies of neuro-symbolic systems in real-world domains.
5. To enable students to design and implement small-scale neuro-symbolic AI solutions.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to Neuro-Symbolic AI**<br><br>Overview of Artificial Intelligence – Symbolic AI vs Sub-symbolic AI – Knowledge Representation – Logical Reasoning and Expert Systems – Neural Networks Overview – Motivation for Neuro-Symbolic Integration. | 8 |
| II | **Symbolic Reasoning and Knowledge Representation**<br><br>Logic and Inference – Predicate Logic, Propositional Logic – Ontologies and Semantic Networks – Rule-Based Systems – Knowledge Graphs – Uncertainty Handling in Symbolic AI – Fuzzy Logic and Probabilistic Reasoning. | 9 |

| | | |
|---|---|---|
| **III** | **Neural Network Fundamentals**<br><br>Feedforward Neural Networks – Convolutional Neural Networks (CNNs) – Recurrent Neural Networks (RNNs) – Autoencoders – Backpropagation – Representation Learning – Limitations of Pure Neural Approaches. | **9** |
| **IV** | **Neuro-Symbolic Integration**<br><br>Concepts of Integration – Bridging Symbolic Reasoning with Deep Learning – Neuro-Symbolic Concept Learner (NS-CL) – Differentiable Logic and Reasoning – Graph Neural Networks for Symbolic Knowledge – Neuro-Symbolic Reinforcement Learning – Frameworks and Architectures. | **9** |
| **V** | **Applications and Case Studies**<br><br>Natural Language Understanding – Visual Question Answering – Robotics and Planning – Explainable AI using Neuro-Symbolic Methods – Healthcare, Finance, and Cognitive Systems – Emerging Trends and Research Directions. | **8** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the foundational principles of symbolic AI and neural networks. |
| **CO2** | Apply reasoning and representation techniques for AI problem-solving. |
| **CO3** | Analyze neural models and their role in cognitive and perceptual tasks. |
| **CO4** | Integrate symbolic reasoning with neural learning approaches. |
| **CO5** | Evaluate neuro-symbolic frameworks and apply them to real-world intelligent systems. |

**Text Books:**


1. *Artur S. d'Avila Garcez, Luis C. Lamb, Dov M. Gabbay, Neural-Symbolic Cognitive Reasoning, Springer, 2019.*
2. Pascal Hitzler, *Foundations of Semantic Web Technologies*, CRC Press, 2nd Edition, 2021.

**Reference Books:**


***1.*** Luc De Raedt, *Statistical Relational Artificial Intelligence: Logic, Probability, and Computation*, Morgan & Claypool, 2016.

2. Yann LeCun, Yoshua Bengio, Geoffrey Hinton, *Deep Learning*, Nature, Vol. 521, pp. 436–444, May 2015.

*3.* Gary Marcus & Ernest Davis, *Rebooting AI: Building Artificial Intelligence We Can Trust*, Pantheon, 2019.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 0 |
| CO2 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 1 |
| CO3 | 2 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT373 | Number of Hours/ Week | 3 | | |
| Semester | VII | Max. Marks | 100 | | |
| Year | IV | Credits | 3 | | |
| Discipline Specific Elective VII | | | | | |
| Course Title | ARM and RISC Architectures | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To understand the evolution and design philosophy of Reduced Instruction Set Computer (RISC) architectures.
2. To study the ARM processor architecture, instruction sets, and programming model.
3. To analyze pipeline concepts, memory organization, and performance optimizations in RISC processors.
4. To gain knowledge of ARM-based system design and applications in embedded systems.
5. To develop programming and interfacing skills using ARM processors for real-world applications.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to RISC and CISC Architectures**<br><br>Introduction to CPU Architectures – RISC vs CISC Comparison – Design Principles of RISC – Instruction Formats and Addressing Modes – Evolution of RISC Architectures – Overview of ARM Architecture Family. | 8 |
| II | ARM Processor Architecture: ARM Core Architecture – Register Organization – Program Status Registers – Modes of Operation – ARM Pipeline Architecture – Memory Organization – Exception and Interrupt Handling – ARM Cortex Series Overview. | 9 |
| III | **ARM Instruction Set and Programming**<br><br>ARM and Thumb Instruction Sets – Data Processing Instructions – Load/Store Instructions – Branch, Call, and Return Instructions – Stack and Subroutines – Conditional Execution – Simple ARM Assembly Language Programs. | 9 |

| | | |
|---|---|---|
| **IV** | **ARM System Design and Interfacing**<br><br>Memory Systems – Bus Architecture (AMBA, AHB, APB) – Timer, UART, GPIO, and Interrupt Controller – Peripheral Interfacing – Power Management – ARM in Embedded and IoT Applications. | **9** |
| **V** | **Advanced RISC Features and Applications**<br><br>Pipeline Optimization Techniques – Superscalar and Out-of-Order Execution – ARMv8-A 64-bit Architecture – Security Extensions (TrustZone) – Case Studies: Raspberry Pi, Smartphone Processors, and Automotive Systems. | **8** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the principles and design features of RISC architectures. |
| **CO2** | Explain the internal architecture and functional units of ARM processors. |
| **CO3** | Develop assembly language programs using ARM instruction sets. |
| **CO4** | Analyze ARM system design concepts including bus architecture and interfacing. |
| **CO5** | Evaluate ARM and RISC processor performance for real-world embedded applications. |

**Text Books:**


1. Steve Furber, *ARM System-on-Chip Architecture*, Addison-Wesley, 2nd Edition, 2015.

2. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Elsevier, 2004.


**Reference Books:**


1. David A. Patterson and John L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface (ARM Edition)*, Morgan , Kaufmann, 2017.

2. William Hohl and Christopher Hinds, *ARM Assembly Language: Fundamentals and Techniques*, CRC Press, 2nd, Edition, 2014.

3. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*, Newnes, 3rd Edition, 2014.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 0 |
| CO2 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 1 | 1 |
| CO3 | 2 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT |
|---|---|---|---|
| Course Code | 25BTAT374 | Number of Hours/ Week | 3 |
| Semester | VII | Max. Marks | 100 |
| Year | IV | Credits | 3 |

**Discipline Specific Elective VIII**

| Course Title | Advanced Digital Signal Processing with AI | L | T | P |
|---|---|---|---|---|
| | | 3 | 0 | 0 |

**L-Lecture Hours** **T-Tutorial Hours** **P-Practical Hours.**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To review the fundamentals of digital signal processing (DSP) and its real-time applications.
2. To understand adaptive and multirate signal processing techniques.
3. To explore AI and machine learning algorithms in signal processing.
4. To analyze modern DSP architectures and their use in audio, image, and biomedical domains.
5. To design and implement intelligent signal processing systems using AI-based techniques.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Fundamentals of Advanced Digital Signal Processing**<br><br>Review of Discrete-Time Signals and Systems – Z-Transform and Fourier Analysis – DFT, FFT Algorithms – FIR and IIR Filter Design – Implementation of DSP Systems – Real-Time Constraints in DSP Applications. | 8 |
| II | **Multirate and Adaptive Signal Processing**<br><br>Multirate Processing: Decimation, Interpolation, and Polyphase Structures – Adaptive Filters: LMS, NLMS, RLS Algorithms – Applications in Noise Cancellation, Echo Suppression, and Channel Equalization – Spectrum Estimation Methods. | 9 |
| III | **AI and Machine Learning in Signal Processing**<br><br>Introduction to AI/ML for DSP – Supervised and Unsupervised Learning – Feature Extraction and Dimensionality Reduction – Neural Networks for Signal Classification – Support Vector Machines – K-means and PCA-based Signal Analysis. | 9 |

| | | |
|---|---|---|
| **IV** | **Deep Learning Architectures for Signal Processing**<br><br>CNNs and RNNs for Time-Series Data – Audio Signal Classification – Speech and Image Processing using Deep Networks – Autoencoders for Feature Learning – Generative Models for Signal Synthesis – Integration with DSP Hardware. | **9** |
| **V** | **Applications and Case Studies**<br><br>Biomedical Signal Processing (ECG, EEG) – Radar and Communication Signal Analysis – IoT Sensor Data Analysis – Fault Detection in Industrial Systems – AI-driven DSP Tools and Frameworks – Research Trends and Challenges. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the theoretical foundations and techniques of advanced DSP. |
| **CO2** | Apply multirate and adaptive algorithms to real-time signal processing. |
| **CO3** | Integrate AI and ML methods for signal classification and pattern recognition. |
| **CO4** | Analyze deep learning architectures for intelligent signal processing. |
| **CO5** | Design and evaluate AI-enabled DSP systems for real-world applications. |

**Text Books:**


***1.*** Monson H. Hayes, *Statistical Digital Signal Processing and Modeling*, Wiley, 2nd Edition, 2017.

2. S. Haykin, *Adaptive Filter Theory*, Pearson, 5th Edition, 2014.

*3.* S. Haykin and B. Widrow, *Least-Mean-Square Adaptive Filters*, Wiley, 2003.


**Reference Books:**


**1.** Li Deng and Dong Yu, *Deep Learning for Signal Processing Applications*, Springer, 2019.

2. A. Cichocki and S. Amari, *Adaptive Blind Signal and Image Processing: Learning Algorithms and Applications*, Wiley, 2003.

3. Fa-Long Luo, *Machine Learning for Signal Processing*, IEEE-Wiley, 2018.

4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 0 |
| CO2 | 3 | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 1 |
| CO3 | 2 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT375** | **Number of Hours/Week** | **3** |
| **Semester** | **VII** | **Max. Marks** | **100** |
| **Year** | **IV** | **Credits** | **3** |

**Discipline Specific Elective VIII**

| **Course Title** | **Ethics, Policy, Law and Standards in AI** | **L** | **T** | **P** |
|---|---|---|---|---|
| | | **3** | **0** | **0** |

**L-Lecture Hours** **T-Tutorial Hours** **P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To understand the ethical, social, and legal implications of Artificial Intelligence.
2. To analyze AI governance frameworks, standards, and regulations.
3. To apply responsible AI principles in the design and deployment of AI systems.
4. To evaluate policy and ethical challenges in real-world AI applications.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Introduction to AI Ethics**<br>Ethical concerns in AI – Bias, fairness, accountability, and transparency – Social and cultural implications – Case studies on ethical dilemmas – Role of AI ethics in modern society. | 8 |
| II | **Legal and Policy Frameworks**<br>Overview of AI-related laws and regulations – Data protection and privacy (GDPR, India's DPDP Act) – Intellectual property rights and AI – Liability in autonomous systems – International AI policy developments. | 9 |
| III | **Standards and Governance**<br>AI standards and guidelines – IEEE, ISO, and NIST AI frameworks – Responsible AI principles – Trustworthy AI and explainability – Risk management and AI auditing. | 9 |
| IV | **Societal and Economic Implications**<br>Impact of AI on employment and economy – Ethical design in automation – AI in governance and decision-making – Human–machine collaboration – AI for social good and sustainability. | 9 |

| | | |
|---|---|---|
| **V** | **Case Studies and Future Directions**<br><br>Real-world case studies in AI misuse, bias, and governance failures – Ethical impact assessment – Emerging trends in AI regulation – Future of AI ethics and responsible innovation. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Explain the core ethical, legal, and policy issues in AI systems. |
| **CO2** | Analyze ethical challenges and biases in AI applications. |
| **CO3** | Evaluate existing AI governance models and international standar |
| **CO4** | Apply responsible AI principles in designing and assessing AI systems. |
| **CO5** | Discuss future trends in AI ethics, policy, and law. |

**Text Books:**


1. Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, 2019.
2. Markus D. Dubber, Frank Pasquale, and Sunit Das, The Oxford Handbook of Ethics of AI, Oxford University Press, 2020.
3. Luciano Floridi, The Ethics of Artificial Intelligence, Oxford University Press, 2021.


**Reference Books:**


1. European Commission, Ethics Guidelines for Trustworthy AI, 2019.
2. IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, Ethically Aligned Design, 2019.
3. UNESCO, Recommendation on the Ethics of Artificial Intelligence, 2021.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 0 | 0 | 2 | 3 | 3 | 0 | 2 | 0 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 0 | 0 | 3 | 3 | 3 | 0 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 0 | 3 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 0 | 3 | 0 | 2 | 3 | 3 | 3 |
| CO5 | 2 | 2 | 0 | 0 | 0 | 2 | 3 | 3 | 0 | 2 | 0 | 3 | 3 | 2 | 2 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT376** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Discipline Specific Elective VIII** | | | | | |
| **Course Title** | **Sensor Networks and Actuators** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamental concepts and architecture of sensor networks.
2. To understand various types of sensors and actuators used in IoT and industrial applications.
3. To explore network protocols and data communication mechanisms in sensor networks.
4. To analyze energy-efficient designs and fault-tolerant mechanisms.
5. To develop the ability to design smart sensing and actuation systems

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **ntroduction to Sensor Networks**<br><br>Overview of Wireless Sensor Networks (WSNs) – Components and architecture – Sensor node structure – Types of sensors – Characteristics of WSNs – Applications in environment, healthcare, and smart cities. | **8** |
| II | **Sensor Node Hardware and Software**<br><br>Sensor node architecture – Microcontroller and transceiver components – Sensor interfacing techniques – Operating systems for WSNs (TinyOS, Contiki) – Power management in sensor nodes. | **9** |
| III | **Network Protocols and Communication**<br><br>Communication architectures – MAC protocols – Routing protocols for WSNs (LEACH, PEGASIS, Directed Diffusion) – Data aggregation and fusion – Time synchronization – Quality of Service (QoS) issues. | **9** |

| | | |
|---|---|---|
| **IV** | **Actuators and Control Systems**<br><br>Introduction to actuators – Types of actuators: electrical, mechanical, pneumatic, and hydraulic – Working principles and characteristics – Actuator interfacing with microcontrollers – Feedback and control systems. | **9** |
| **V** | **Applications and Recent Trends**<br><br>Smart sensing and actuation systems – Industrial automation – Environmental monitoring – Smart agriculture – Integration with IoT and cloud platforms – Case studies on real-world sensor–actuator networks. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Describe the architecture, components, and functioning of sensor networks. |
| **CO2** | Analyze communication and networking protocols used in WSNs. |
| **CO3** | Explain the operation and interfacing of different types of actuators. |
| **CO4** | Design energy-efficient and reliable sensor–actuator systems. |
| **CO5** | Apply sensor and actuator integration in IoT-based real-world applications. |

**Text Books:**


**1.** Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley, 2005.

2. C. S. Raghavendra, Krishna M. Sivalingam, and Taieb F. Znati, *Wireless Sensor Networks*, Springer, 2006.

*3.* Clarence W. de Silva, *Sensors and Actuators: Engineering System Instrumentation*, CRC Press, 2015.


**Reference Books:**


1. Feng Zhao and Leonidas Guibas, *Wireless Sensor Networks: An Information Processing Approach*, Morgan Kaufmann, 2004.

2. Mohammad Ilyas and Imad Mahgoub, *Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems*, CRC Press, 2005.

3. Rajesh P. N. Rao, *Smart Sensors and Systems*, Springer, 2018.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 3 | 2 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT071 / | Number of Hours/Week | 3 | | |
| Semester | VII | Max. Marks | 100 | | |
| Year | IV | Credits | 3 | | |
| Generic Elective III (Open Elective) | | | | | |
| Course Title | Advanced Python Programming | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours. T-Tutorial Hours P-Practical Hours | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To enhance understanding of advanced Python features such as OOP, modules, and packages.
2. To explore Python libraries for data manipulation, visualization, and automation.
3. To develop efficient code using iterators, generators, decorators, and functional programming concepts.
4. To implement file handling, exception handling, and multithreading.
5. To gain practical exposure to database handling, APIs, and modern frameworks in Python.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Advanced Python Concepts**<br>Review of Python basics – Functions and scope – Advanced data types: lists, tuples, dictionaries, sets – Lambda functions – List and dictionary comprehensions – Iterators and generators – Decorators. | 8 |
| II | **Object-Oriented Programming**<br>Classes and objects – Constructors and destructors – Inheritance, polymorphism, and encapsulation – Operator overloading – Abstract classes and interfaces – Exception handling and custom exceptions. | 9 |
| III | **File and Database Handling**<br>File operations – Reading and writing text, CSV, and JSON files – Pickling and unpickling – Working with SQLite and MySQL databases – Performing CRUD operations – Introduction to Object Relational Mapping (ORM). | 8 |

| | | |
|---|---|---|
| **IV** | **Modules, Packages, and Libraries**<br><br>Creating and importing modules – Standard libraries (OS, SYS, MATH, DATETIME) – Numpy for numerical computing – Pandas for data analysis – Matplotlib and Seaborn for visualization – Introduction to SciPy. | **9** |
| **V** | **Advanced Topics and Applications**<br><br>Multithreading and multiprocessing – Regular expressions – Web scraping with BeautifulSoup and Requests – Working with APIs – Flask framework for web development – Case study: Data analysis or automation project. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Apply advanced programming constructs such as decorators, generators, and comprehensions. |
| **CO2** | Implement object-oriented principles and exception handling in Python. |
| **CO3** | Handle files and databases effectively using Python. |
| **CO4** | Utilize advanced Python libraries for numerical, data, and visualization tasks. |
| **CO5** | Develop real-world applications using multithreading, APIs, and frameworks. |

**Text Books:**


**1.** Mark Lutz, *Learning Python*, 5th Edition, O'Reilly Media, 2013.
2. David M. Beazley and Brian K. Jones, *Python Cookbook*, 3rd Edition, O'Reilly Media, 2013.
3. Luciano Ramalho, *Fluent Python*, 2nd Edition, O'Reilly Media, 2022.


**Reference Books:**


**1.** Reitz, K., and Schlusser, T., *The Hitchhiker's Guide to Python*, O'Reilly Media, 2016.

2. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media, 2016.

3. Eric Matthes, *Python Crash Course*, 3rd Edition, No Starch Press, 2023.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| Programme | B.Tech CSE (AI & IoT) | Programme Code | BTAT | | |
|---|---|---|---|---|---|
| Course Code | 25BTAT072 | Number of Hours/Week | 3 | | |
| Semester | VII | Max. Marks | 100 | | |
| Year | IV | Credits | 3 | | |
| Generic Elective III (Open Elective) | | | | | |
| Course Title | Optimisation Algorithms | | L | T | P |
| | | | 3 | 0 | 0 |
| L-Lecture Hours | T-Tutorial Hours | P-Practical Hours | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the concepts of optimization and its importance in engineering and AI applications.
2. To study classical and modern optimization techniques for constrained and unconstrained problems.
3. To understand metaheuristic and evolutionary optimization algorithms.
4. To explore applications of optimization in machine learning, control systems, and signal processing.
5. To enable students to formulate and solve real-world optimization problems.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Fundamentals of Optimization**<br><br>Introduction to Optimization – Objective Function, Constraints, Decision Variables – Unconstrained vs Constrained Optimization – Convexity and Convex Sets – Optimality Conditions – Gradient and Hessian Concepts – Classical Methods: Gradient Descent, Newton-Raphson. | 9 |
| II | **Linear and Nonlinear Programming**<br><br>Linear Programming (LP) – Formulation, Simplex Method, Duality – Nonlinear Programming (NLP) – Lagrange Multipliers, KKT Conditions – Quadratic Programming – Sequential Quadratic Programming. | 8 |
| III | **Dynamic and Stochastic Optimization**<br><br>Dynamic Programming – Bellman's Principle – Applications in Resource Allocation and Control – Stochastic Optimization – Monte Carlo Methods – Simulated Annealing. | 9 |

| | | |
|---|---|---|
| **IV** | **Evolutionary and Metaheuristic Algorithms**<br><br>Genetic Algorithms (GA) – Particle Swarm Optimization (PSO) – Ant Colony Optimization (ACO) – Differential Evolution – Cuckoo Search and Firefly Algorithm – Multi-objective Optimization Techniques – Convergence Analysis. | **9** |
| **V** | **Applications and Case Studies**<br><br>Optimization in Machine Learning (Hyperparameter Tuning, Neural Network Training) – Signal Processing and Communication System Optimization – Resource Allocation in IoT Networks – Industrial Scheduling – Case Studies in Smart Grids and Robotics. | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals of optimization and classical methods. |
| **CO2** | Formulate and solve linear and nonlinear optimization problems. |
| **CO3** | Apply dynamic and stochastic optimization techniques to engineering problems. |
| **CO4** | Analyze and implement metaheuristic and evolutionary algorithms. |
| **CO5** | Design and evaluate optimization solutions for real-world applications. |

**Text Books:**


1. S.S. Rao, Engineering Optimization: Theory and Practice, 5th Edition, Wiley, 2019.
2. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2012.
3. Singiresu S. Rao, Applied Numerical Methods with MATLAB for Engineers and Scientists, 3rd Edition, Springer, 2017.


**Reference Books:**


1. *Edwin K. P. Chong and Stanislaw H. Zak, An Introduction to Optimization, 4th Edition, Wiley, 2013.*
2. James Kennedy and Russell Eberhart, *Swarm Intelligence*, Morgan Kaufmann, 2001.
3. Marco Dorigo and Thomas Stützle, *Ant Colony Optimization*, MIT Press, 2004.
4. Yang, X. S., *Nature-Inspired Optimization Algorithms*, Elsevier, 2024.


**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| **CO3** | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 3 | 3 | 2 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| **CO5** | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT073** | **Number of Hours/Week** | **3** |
| **Semester** | **VII** | **Max. Marks** | **100** |

| Year | IV | Credits | 3 | | |
|---|---|---|---|---|---|
| **Generic Elective III (Open Elective)** | | | | | |
| **Course Title** | **Computing (Latest)** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce emerging trends and technologies in modern computing.
2. To study recent advancements in cloud, edge, quantum, and neuromorphic computing.
3. To explore AI-driven and IoT-enabled computing systems.
4. To analyze security, scalability, and energy-efficiency challenges in modern computing.
5. To develop awareness of research directions and applications in cutting-edge computing technologies.

| UNIT | TOPICS | HOURS |
|---|---|---|
| I | **Cloud, Edge, and Fog Computing**<br>Overview of cloud computing trends – Edge and fog computing – Distributed computing models – Serverless computing – Resource allocation and load balancing – Cloud-native applications and containerization – Case studies: AWS, Azure, Google Cloud. | 9 |
| II | **AI-Driven and High-Performance Computing**<br>GPU/TPU acceleration – AI-based computing frameworks – Neural network accelerators – HPC architectures – Parallel and distributed computing techniques – Performance evaluation metrics. | 9 |
| III | **Quantum and Neuromorphic Computing**<br>Introduction to quantum computing – Qubits, quantum gates, and circuits – Quantum algorithms (Shor, Grover) – Neuromorphic computing – Brain-inspired architectures – Applications in optimization, simulation, and AI. | 8 |

| | | |
|---|---|---|
| **IV** | **IoT, Edge AI, and TinyML Computing**<br><br>IoT-enabled edge computing – TinyML and embedded AI devices – Resource-constrained AI deployment – Sensor networks and real-time processing – Case studies in smart homes, healthcare, and industrial IoT. | **9** |
| **V** | **Security, Blockchain, and Future Directions**<br><br>Cybersecurity trends – Blockchain-enabled computing – Privacy-preserving computation – Green computing and energy efficiency – Ethical and policy issues – Emerging trends: AI chips, optical computing, bio-computing. | **10** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand emerging trends and technologies in cloud, edge, and distributed computing. |
| **CO2** | Explain AI-driven, high-performance, and accelerator-based computing architectures. |
| **CO3** | Describe principles and applications of quantum and neuromorphic computing. |
| **CO4** | Apply IoT, Edge AI, and TinyML frameworks for resource-constrained environments. |
| **CO5** | Analyze security, blockchain, and ethical considerations in modern computing |

**Text Books:**


1. Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, 2nd Edition, Prentice Hall, 2018.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016.
3. Michael A. Nielsen and Isaac L. Chuang, *Quantum Computation and Quantum Information*, 10th Anniversary Edition, Cambridge University Press, 2010.


**Reference Books:**


1. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing, 2nd Edition, Morgan Kaufmann, 2012.
2. Rajkumar Buyya, Mastering Cloud Computing, McGraw Hill, 2013.
3. Peter W. Shor, Quantum Computing: An Introduction, American Mathematical Society, 1997.

4. X. S. Yang, Nature-Inspired Computing and Optimization, Elsevier, 2014.

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | |
|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** |
| **Course Code** | **25BTAT271** | **Number of Hours/Week** | **2** |
| **Semester** | **VII** | **Max. Marks** | **100** |
| **Year** | **IV** | **Credit** | **1** |
| | | | |

| Course Title | Cybersecurity for IoT- Lab | L | T | P |
|---|---|---|---|---|
| | | 0 | 0 | 2 |

**L-Lecture Hours T-Tutorial Hours P-Practical Hours**

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide hands-on experience in implementing security measures in IoT systems.
2. To understand vulnerabilities and threats in IoT networks.
3. To design and simulate secure communication protocols for IoT devices.
4. To implement authentication, encryption, and intrusion detection in IoT applications.
5. To familiarize students with cybersecurity tools and frameworks used in IoT environments.

| UNIT | TOPICS | HOURS |
|---|---|---|
| | **Experiments / Practical Exercises**<br>1. Study of IoT architecture and security threats.<br>2. Implementation of basic authentication in IoT devices.<br>3. Secure communication using symmetric and asymmetric encryption.<br>4. TLS/SSL configuration for MQTT protocol.<br>5. Network traffic analysis for IoT devices using Wireshark.<br>6. Implementation of intrusion detection for IoT networks.<br>7. Simulating denial-of-service attacks and countermeasures in IoT.<br>8. Integration of IoT security frameworks (e.g., lightweight cryptography).<br>9. Hands-on with VPNs and firewall configuration for IoT gateways.<br>10. Case study: Securing a smart home IoT network. | **22** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Identify vulnerabilities and threats in IoT systems |

| | |
|---|---|
| **CO2** | Implement authentication and encryption mechanisms in IoT devices. |
| **CO3** | Analyze network traffic and detect intrusions in IoT networks. |
| **CO4** | Design secure IoT systems using protocols and best practices. |
| **CO5** | Apply security frameworks and tools for real-world IoT applications. |

**Tools & Frameworks**

1. Python / MicroPython
2. Arduino / Raspberry Pi / ESP32 IoT boards
3. Wireshark (network traffic analysis)
4. OpenSSL / Cryptography libraries
5. MQTT / CoAP protocols with security extensions
6. VirtualBox / VMware for lab simulations

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 2 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

# Semester VIII

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT581** | **Number of Hours/ Week** | | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credit** | **15** | | |
| | | | | | |
| **Course Title** | **Capstone Project** | | **L** | **T** | **P** |
| | | | **0** | **0** | **2** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide students with the opportunity to apply theoretical knowledge to practical, real-world problems.
2. To develop problem-solving, design, and implementation skills through a comprehensive project.
3. To encourage teamwork, project management, and professional communication skills.
4. To integrate knowledge from multiple areas such as IoT, AI, Cloud, Cybersecurity, or other domain-specific technologies.
5. To prepare students for industry or research roles by completing a significant project.

| UNIT | TOPICS | HOURS |
|---|---|---|
| | **Course Structure / Guidelines**<br>1. **Project Identification:** Selection of a problem statement relevant to the field of study.<br>2. **Literature Review:** Study of existing solutions, technologies, and frameworks.<br>3. **Design & Implementation:** System design, architecture, and prototype development.<br>4. **Testing & Validation:** Functional testing, performance evaluation, and optimization.<br>5. **Report & Presentation:** Documentation, final report, and project demonstration. | |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Identify and formulate a real-world problem suitable for a capstone project. |
| **CO2** | Design and develop a comprehensive solution integrating multiple technologies. |
| **CO3** | Implement, test, and evaluate the developed solution effectively. |
| **CO4** | Communicate project objectives, design, results, and impact effectively. |

| | |
|---|---|
| **CO5** | Work collaboratively in a team environment and demonstrate professional project management skills. |

**Tools & Frameworks**

1. Programming Languages: Python, C/C++, Java, MATLAB
2. IoT & Embedded Platforms: Arduino, Raspberry Pi, ESP32
3. Cloud Platforms: AWS, Azure, Google Cloud
4. Data & AI Tools: TensorFlow, PyTorch, Scikit-learn, Pandas, Numpy
5. Database & Networking: MySQL, MongoDB, MQTT, REST APIs
6. Version Control & Project Management: Git, GitHub, Trello/Jira

## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT381** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Discipline Specific Elective IX** | | | | | |
| **Course Title** | **AI for Society, Innovation and Entrepreneurship** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce students to the societal impact of AI technologies.
2. To explore AI-driven innovations across industries and public services.
3. To foster entrepreneurial thinking using AI as a tool for problem-solving.
4. To understand ethical, social, and economic considerations in AI applications.
5. To develop skills for ideation, prototype development, and business modeling in AI-based ventures.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Introduction to AI and Society**<br><br>Overview of AI technologies: Machine Learning, NLP, Computer Vision, Robotics, Historical context and societal evolution with AI, AI applications in healthcare, education, smart cities, agriculture, and governance, Opportunities and challenges of AI adoption in society | **8** |
| **II** | **AI-driven Innovation**<br><br>Concept of innovation and its types, Role of AI in product and service innovation, Case studies: AI in autonomous vehicles, personalized healthcare, predictive analytics, Innovation frameworks and design thinking for AI solutions | **9** |
| **III** | **Entrepreneurship with AI**<br><br>Fundamentals of entrepreneurship: Ideation, Market Research, and Business Planning, Lean startup methodology for AI-based ventures, Business models and funding options for AI startups, Intellectual property, patents, and regulatory compliance in AI ventures | **9** |
| **IV** | **Ethics, Policy, and Social Responsibility**<br><br>Ethical considerations in AI: bias, fairness, accountability, transparency, AI policy frameworks and governance, Privacy, security, and data protection, Sustainable and socially responsible AI solutions | **9** |
| **V** | **AI Project and Case Studies**<br><br>Identifying societal problems solvable by AI, Hands-on prototyping of AI solutions, Market analysis and feasibility studies, Presentation of project ideas and business models, Case studies of successful AI startups impacting society | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the impact of AI on society and various industries. |
| **CO2** | Identify opportunities for AI-driven innovations and problem-solving. |
| **CO3** | Develop AI-based solutions addressing real-world societal problems. |
| **CO4** | Evaluate ethical, policy, and social implications of AI applications. |
| **CO5** | Apply entrepreneurial skills to plan AI-based |

**Text Books:**

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.

2. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, 2nd Edition, Wiley, 2016.

3. Ashok N. Srivastava, AI for Everyone: Bridging the Gap Between AI and Society, 2020.

**Reference Books:**

1. Vijay Kumar, *AI and Society: Ethics, Policy, and Governance*, Springer, 2021.

2. Nils J. Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann, 1998.

3. Tom Kelley, *The Art of Innovation*, 2nd Edition, Crown Business, 2001.

**Tools & Frameworks**

1. Python, R, or MATLAB
2. AI/ML frameworks: TensorFlow, PyTorch, Scikit-learn
3. Data visualization tools: Tableau, Power BI
4. Cloud platforms for AI deployment: AWS, Azure, Google Cloud
5. Business modeling tools: Business Model Canvas, LeanStack

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT382** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Discipline Specific Elective IX** | | | | | |
| **Course Title** | **Distributed Systems** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the fundamental concepts, principles, and architecture of distributed systems.
2. To understand communication, synchronization, and coordination among distributed processes.
3. To study distributed resource management, fault tolerance, and security mechanisms.
4. To analyze design issues, algorithms, and protocols in distributed environments.
5. To explore modern distributed systems applications like cloud computing and blockchain.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Introduction to Distributed Systems**<br><br>Definition, goals, and characteristics of distributed systems, Architectural models: client-server, peer-to-peer, and multi-tier architectures, Advantages, challenges, and types of distributed systems, Case studies: Google File System, Hadoop Distributed File System | **8** |
| **II** | **Communication in Distributed Systems**<br><br>Interprocess communication: message passing, remote procedure call (RPC), remote method invocation (RMI), Sockets, RPC semantics, and middleware, Communication models: synchronous and asynchronous communication, Group communication and multicast | **9** |
| **III** | **Synchronization and Coordination**<br><br>Logical clocks and Lamport timestamps, Vector clocks and causal ordering, Mutual exclusion in distributed systems: centralized, decentralized, and token-based algorithms, Election algorithms and distributed deadlock detection | **8** |
| **IV** | **Resource Management & Fault Tolerance**<br><br>Distributed file systems and naming services, Distributed shared memory, Consistency models and replication strategies, Fault tolerance: checkpointing, recovery, and consensus algorithms, Security in distributed systems | **9** |
| **V** | **Advanced Topics & Applications**<br><br>Distributed databases and transactions, Cloud computing and distributed storage systems, Blockchain and decentralized applications, Case studies of modern distributed systems | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamental concepts, architecture, and design of distributed systems. |
| **CO2** | Explain communication mechanisms and protocols used in distributed environments. |
| **CO3** | Apply synchronization and coordination algorithms for distributed processes. |
| **CO4** | Analyze resource management, fault tolerance, and security techniques in distributed systems. |
| **CO5** | Design and evaluate distributed systems for real-world applications. |

**Text Books:**


1. Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems: Principles and Paradigms, 3rd Edition, Pearson, 2016.

2. George Coulouris, Jean Dollimore, Tim Kindberg, *Distributed Systems: Concepts and Design*, 5th Edition, Pearson, 2011.


**Reference Books:**


**1.** *Mukesh Singhal, Niranjan G. Shivaratri, Advanced Concepts in Operating Systems, McGraw Hill, 2012.*

2. Sape Mullender, *Distributed Systems*, Addison-Wesley, 1993.

3. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, *Distributed and Cloud Computing*, 2nd Edition, Morgan Kaufmann, 2012.


*Tools & Frameworks*

1. Java / Python for distributed programming
2. MPI (Message Passing Interface)
3. Hadoop / Spark
4. Docker / Kubernetes
5. MongoDB / Cassandra (for distributed databases)

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT383 /** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Discipline Specific Elective IX** | | | | | |
| **Course Title** | **Data Warehousing & Data Mining** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To introduce the concepts of data warehousing and data mining.
2. To understand the architecture, design, and implementation of data warehouses.
3. To learn techniques for data preprocessing, mining, and knowledge discovery.
4. To analyze data mining algorithms for classification, clustering, and association.
5. To explore real-world applications of data mining in business, healthcare, and engineering.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Introduction to Data Warehousing**<br><br>Data warehousing concepts, benefits, and architecture, OLTP vs OLAP, Data warehouse design: star schema, snowflake schema, fact and dimension tables, ETL process (Extract, Transform, Load), Metadata, data marts, and warehouse implementation | **8** |
| **II** | **Data Mining Fundamentals**<br><br>Data mining concepts and knowledge discovery process, Data preprocessing: cleaning, integration, transformation, reduction, Types of data: structured, semi-structured, and unstructured, Data mining applications and challenges | **9** |
| **III** | **Association Rule Mining & Classification**<br><br>Frequent itemset mining: Apriori, FP-Growth algorithms, Association rules, support, confidence, lift, Classification techniques: Decision Trees, Naive Bayes, K-Nearest Neighbor, Evaluation metrics for classifiers: accuracy, precision, recall, F1-score | **8** |
| **IV** | **Clustering & Advanced Techniques**<br><br>Clustering algorithms: K-Means, Hierarchical, DBSCAN, Cluster evaluation metrics, Outlier detection, anomaly detection, Introduction to text mining, web mining, and time-series mining | **8** |
| **V** | **Data Mining Applications & Case Studies**<br><br>Data mining in business, healthcare, finance, and IoT, Big Data integration with data warehousing, Tools and frameworks for data mining: Weka, RapidMiner, Python libraries, Case studies on real-world datasets | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the concepts of data warehousing and OLAP systems. |
| **CO2** | Apply data preprocessing and integration techniques for mining datasets. |
| **CO3** | Analyze association rules and classification models for knowledge discovery. |
| **CO4** | Evaluate clustering techniques and advanced mining approaches. |
| **CO5** | Apply data mining tools and frameworks to real-world problems. |

**Text Books:**

**1.** Jiawei Han, Micheline Kamber, Jian Pei, *Data Mining: Concepts and Techniques*, 3rd Edition, Morgan Kaufmann, 2011.

2. Ralph Kimball, Margy Ross, *The Data Warehouse Toolkit*, 3rd Edition, Wiley, 2013.

3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, *Introduction to Data Mining*, 2nd Edition, Pearson, 2018.

**Reference Books:**

**1.** K. C. Laudon, J. P. Laudon, *Management Information Systems*, 15th Edition, Pearson, 2020.

2. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, 4th Edition, Morgan Kaufmann, 2016

3. Sam Anahory, Dennis Murray, Data Warehousing in the Real World, 2nd Edition, Pearson, 2005.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT384** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Programme Specific Elective X** | | | | | |
| **Course Title** | **Network Security** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide an understanding of fundamental concepts of network security.
2. To study encryption, decryption, and authentication techniques for secure communication.
3. To explore security protocols for networks and applications.
4. To learn about threats, attacks, and defense mechanisms in computer networks.
5. To gain hands-on knowledge of implementing and evaluating security solutions.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Introduction to Network Security**<br><br>Security goals: Confidentiality, Integrity, Availability, Types of attacks: Passive and active, internal and external, Security services and mechanisms, Network security architecture and models, Overview of firewalls and intrusion detection systems | **9** |
| **II** | **Cryptography Fundamentals**<br><br>Classical cryptography and modern symmetric encryption: DES, AES, Asymmetric encryption: RSA, ECC, Key management and exchange protocols, Hash functions and digital signatures, Public Key Infrastructure (PKI) | **8** |
| **III** | **Network Security Protocols**<br><br>Secure Socket Layer (SSL) / Transport Layer Security (TLS), IP Security (IPSec) and VPNs, Wireless network security: WEP, WPA, WPA2, Authentication protocols: Kerberos, CHAP, Email and application layer security | **9** |
| **IV** | **Network Attacks & Defense Mechanisms**<br><br>Denial-of-Service (DoS) and Distributed DoS (DDoS) attacks, Malware: viruses, worms, trojans, ransomware, Sniffing, spoofing, and man-in-the-middle attacks, Intrusion detection systems (IDS) and intrusion prevention systems (IPS), Security policies, auditing, and compliance | **9** |
| **V** | **Advanced Topics & Applications**<br><br>Cloud security and secure cloud storage, IoT security challenges and solutions, Blockchain for network security, Emerging trends in network security, Case studies of real-world network attacks and defenses | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals of network security, threats, and attacks. |
| **CO2** | Apply cryptographic techniques for secure communication. |
| **CO3** | Analyze network security protocols and mechanisms. |
| **CO4** | Evaluate network threats and implement defense mechanisms. |
| **CO5** | Design secure network solutions for real-world applications. |

**Text Books:**


1. William Stallings, Network Security Essentials: Applications and Standards, 6th Edition, Pearson, 2020.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, McGraw-Hill, 2016.

**Reference Books:**


1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in a Public World, 2nd Edition, Pearson, 2002.
2. Richard E. Smith, Internet Cryptography, 2nd Edition, Addison-Wesley, 2003.
3. Eric Cole, Network Security Bible, 2nd Edition, Wiley, 2017.


## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT385** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Programme Specific Elective X** | | | | | |
| **Course Title** | **Bioinformatics & Computational Biology** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours T-Tutorial Hours P-Practical Hours** | | | | | |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students:

1. To introduce the fundamental concepts of bioinformatics and computational biology.
2. To understand biological databases, sequence analysis, and genome annotation.
3. To explore computational methods for protein structure prediction and functional genomics.
4. To apply bioinformatics tools and algorithms for real-world biological data analysis.
5. To develop skills for integrating computational and biological approaches in research.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Introduction to Bioinformatics**<br><br>Overview of bioinformatics and computational biology, Biological data types: DNA, RNA, and proteins, Introduction to genomics, proteomics, and systems biology, Sequence alignment and comparison, Biological databases: GenBank, PDB, UniProt | **8** |
| **II** | **Biological Databases & Data Retrieval**<br><br>Nucleotide and protein sequence databases, Genome and proteome databases, Data retrieval tools: BLAST, FASTA, Entrez, Ensembl, Database query and analysis techniques, Sequence annotation and functional prediction | **9** |
| **III** | **Sequence Analysis & Alignment**<br><br>Pairwise and multiple sequence alignment, Dynamic programming approaches: Needleman-Wunsch, Smith-Waterman, Scoring matrices: PAM, BLOSUM, Motif finding and pattern discovery, Phylogenetic tree construction and analysis | **8** |
| **IV** | **Computational Methods in Structural Biology**<br><br>Protein structure prediction: homology modeling, threading, ab initio methods, Molecular docking and drug design basics, RNA structure prediction, Comparative genomics and functional genomics, Gene expression analysis | **9** |
| **V** | **Bioinformatics Applications & Case Studies**<br><br>Bioinformatics in disease analysis and drug discovery, Next-generation sequencing (NGS) data analysis, Systems biology and network analysis, Integrative case studies using bioinformatics tools, Hands-on use of tools: ClustalW, MEGA, PyMOL, Cytoscape | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals of bioinformatics and computational biology. |
| **CO2** | Retrieve and analyze biological data from various databases. |
| **CO3** | Apply sequence alignment and phylogenetic analysis techniques. |
| **CO4** | Evaluate computational methods for protein structure and functional genomics. |
| **CO5** | Integrate bioinformatics tools for research and real-world biological problem-solving. |

**Text Books:**

**1.** Arthur M. Lesk, *Introduction to Bioinformatics*, 5th Edition, Oxford University

Press, 2019.

2. Pevsner, J., *Bioinformatics and Functional Genomics*, 3rd Edition, Wiley-Blackwell, 2015.

3. Baxevanis, Andreas D., B. F. Francis Ouellette, *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*, 33rd Edition, Wiley, 2005.

**Reference Books:**

**1.** *Mount, David W., Bioinformatics: Sequence and Genome Analysis, 2nd Edition, Cold Spring Harbor Laboratory Press, 2004.*

2. Baldi, P., Brunak, S., *Bioinformatics: The Machine Learning Approach*, 2nd Edition, MIT Press, 2001.

3. Rastogi, S.C., *Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery*, PHI Learning, 2010.

**Mapping of Course Outcomes (CO's) with PO's & PSO's**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

| | | | | | |
|---|---|---|---|---|---|
| **Programme** | **B.Tech CSE (AI & IoT)** | **Programme Code** | **BTAT** | | |
| **Course Code** | **25BTAT86** | **Number of Hours/Week** | **3** | | |
| **Semester** | **VIII** | **Max. Marks** | **100** | | |
| **Year** | **IV** | **Credits** | **3** | | |
| **Programme Specific Elective X** | | | | | |
| **Course Title** | **Analog and Mixed Signal Design** | | **L** | **T** | **P** |
| | | | **3** | **0** | **0** |
| **L-Lecture Hours** | **T-Tutorial Hours** | **P-Practical Hours** | | | |

**COURSE OBJECTIVES:**

**The main learning objective of this course is to prepare the students:**

1. To provide knowledge of analog and mixed-signal circuit design concepts.
2. To study operational amplifier circuits, analog filters, and data converters.
3. To understand design techniques for mixed-signal systems integrating analog and digital blocks.
4. To explore layout considerations and performance optimization in mixed-signal ICs.
5. To prepare students to design, simulate, and analyze real-world analog and mixed-signal systems.

| UNIT | TOPICS | HOURS |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Analog Circuit Design Basics**<br><br>Review of analog circuits: MOSFETs, BJTs, and small-signal models, Operational amplifiers: characteristics, configurations, and applications, Analog building blocks: current mirrors, differential amplifiers, voltage references, Stability, bandwidth, and noise considerations in analog circuits | **9** |
| **II** | **Analog Filters and Signal Conditioning**<br><br>Passive and active filters: low-pass, high-pass, band-pass, band-stop., Filter design techniques: Butterworth, Chebyshev, Bessel, Analog signal conditioning: amplifiers, buffers, and level shifters., Practical considerations: offset, linearity, and dynamic range. | **9** |
| **III** | **Data Converters**<br><br>Analog-to-Digital Converters (ADC): flash, successive approximation, pipeline, sigma-delta, Digital-to-Analog Converters (DAC): weighted resistor, R-2R ladder, current-steering, Performance metrics: resolution, sampling rate, SNR, ENOB, Applications in communication and instrumentation systems | **8** |
| **IV** | **Mixed-Signal Design Techniques**<br><br>Mixed-signal system architecture: ADC/DAC interfaces, digital control of analog circuits, Design challenges: noise coupling, clock jitter, layout issues, Timing considerations and synchronization between analog and digital domains, Low-power design and calibration techniques | **9** |
| **V** | **Practical Applications & Case Studies**<br><br>Mixed-signal IC design in communication systems and sensor interfaces, Data acquisition systems, biomedical instrumentation, Phase-locked loops (PLLs) and frequency synthesizers, Design and simulation case studies using SPICE and MATLAB/Simulink | **9** |

**COURSE OUTCOMES:**

**On successful completion of this course, the student will be able to**

| | |
|---|---|
| **CO1** | Understand the fundamentals of analog circuit design and operational amplifiers |
| **CO2** | Apply design techniques for analog filters and signal conditioning circuits. |
| **CO3** | Analyze and design ADC and DAC circuits with required performance metrics. |
| **CO4** | Design mixed-signal systems integrating analog and digital circuits. |
| **CO5** | Evaluate and simulate practical mixed-signal applications in real-world systems. |

**Text Books:**


**1.** Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw-Hill, 2016.

2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, *Analysis and Design of Analog Integrated Circuits*, 5th Edition, Wiley, 2009.

*3.* Muhammad H. Rashid, *Analog and Digital Signal Processing*, 2nd Edition, Pearson, 2017.


**Reference Books:**


**1.** Franco Maloberti, *Analog and Mixed-Signal System Design*, Wiley, 2007.

2. Douglas A. Pucknell, *Basic VLSI Design*, 3rd Edition, PHI Learning, 2008.

3. Jim Williams, *Analog Circuit Design*, Elsevier/Newnes, 2002.


## Mapping of Course Outcomes (CO's) with PO's & PSO's

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | 2 | 0 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 3 | 1 | 3 | 3 | 3 | 3 |

3 – high, 2 – Average, 1 - Low , 0-Null

**Thank You...**