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 – COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

(B.Tech. CSE - AI & DS)

Students admitted from 2025 -26 onwards

JOY UNIVERSITY
semper paratus

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 & DS) are:

GA 1 Apply appropriate knowledge in Computer Science and Engineering to identify, formulate, analyze, and solve complex engineering problems in order to reach substantive conclusions.

GA 2 Self-learn and engage in use of advanced computing tools.

GA 3 Develop sustainable computing solutions in broader economic, societal and environmental contexts

GA 4 Think critically, creatively and analytically as a computer scientist, whilst being able to work effectively, independently and collaboratively as part of a team in research, technology development and entrepreneurial ventures.

GA 5 Apply evolving ethics and privacy laws across various domains and territories.

GA 6 Effectively communicate engineering concepts and ideas to peers in written or oral forms

GA 7 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 (Artificial Intelligence & Data Science) 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 engineeringproblems 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 theengineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverseteams, 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 independentand life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO 1: Understanding of ethical considerations and societal impacts related to AI/DS systems, ensuring responsible and fair use of technology.

PSO 2: Proficiency in handling, cleaning, and preprocessing large datasets to extract meaningful insights and improve model predictions.

PSO 3: Ability to design, implement, and evaluate AI/DS models for real-world applications, optimizing performance and accuracy.

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.	Programming 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.	Project	–	–	–	–	–	_	02	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 & Data Science)

Semester – I

(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTDS111	**Core Course** Fundamentals of Computing	3	0	0	3	3
2.	25BTDS112	**Core Course** Introduction to Programming	3	0	0	3	3
3.	25BTDS113	**Applied Science** Mathematics – I	3	1	0	4	4
4.	25BTDS114	**Applied Science** Physics I	3	1	0	4	4
5.	25BTDS211	**Core Course** Fundamentals of Computing Lab	0	0	2	2	1
6.	25BTDS212	**Core Course** Introduction to Programming Lab	0	0	2	2	1
7.	25AEEN911	**Ability Enhancement Compulsory Course (AECC)** Effective Communication	3	0	0	3	3
8.	25BTDS911	**Value-Added Course** Performing Arts/Sports	3	0	0	3	1
		Total	**18**	**2**	**4**	**24**	**20**

Semester – II

(Total Credits: 21)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTDS121	**Core Course** Python Programming	3	0	0	3	3
2.	25BTDS122	**Applied Science** Probability, Statistics and Stochastic Processes	3	0	0	3	3
3.	25BTDS123	**Applied Science** Mathematics II	3	1	0	4	4
4.	25BTDS124	**Applied Science** Physics II	3	0	0	3	3
5	25BTDS125	**Core Course** Discrete Structures for Computer Science	3	0	0	3	3
6	25BTDS221	**Core Course** Python Programming Lab	0	0	2	2	1
7	25BTDS222	**Applied Science** Physics Lab	0	0	2	2	1
8	25BTDS223	**Skill Enhancement Course** Extended Reality and its Applications Lab	0	0	2	2	1
9	25EVST921	**Value Added Course** Environmental Science	2	0	0	2	2
		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.	25BTDS131	**Core Course** Artificial Intelligence	3	0	0	3	3
2.	25BTDS132	**Core Course** Signals and Systems	3	0	0	3	3
3.	25BTDS133	**Core Course** Digital Design	3	0	0	3	3
4.	25BTDS134	**Core Course** Data Structures and Algorithms	3	0	0	3	3
5.	25BTDS135	**Core Course** Object-Oriented Programming with Java	3	0	0	3	3
6.	25BTDS136	**Core Course** Professional Ethics	2	0	0	2	2
7.	25BTDS231	**Core Course** Digital Design Lab	0	0	2	2	1
8.	25BTDS232	**Core Course** Data Structures and Algorithms Lab	0	0	2	2	1
9.	25BTDS233	**Core Course** Object-Oriented Programming with Java Lab	0	0	2	2	1
10.	25BTDS931	**Value Added Course** Indian Constitution	1	0	0	1	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.	25BTDS141	**Core Course** Introduction to Data Science and Data Analytics	3	0	0	3	3
2.	25BTDS142	**Core Course** Database Management Systems	3	0	0	3	3
3.	25BTDS143	**Core Course** Computer Organization and Architecture	3	0	0	3	3
4.	25BTDS341 25BTDS342 25BTDS343	**Programme Specific Elective (PSE) I** Operating Systems Data Mining and Data Warehousing Social Network Analysis	3	0	0	3	3
5.	25BTDS344 25BTDS345 25BTDS346	**Programme Specific Elective (PSE) II** Full Stack Development Edge AI Design and Analysis of Algorithms	3	0	0	3	3
6	25BTDS241	**Core Course** Introduction to Data Science and Data Analytics Lab	0	0	2	2	1
7	25BTDS242	**Core Course** Database Management Systems Lab	0	0	2	2	1
8	25BTDS841	**Skill Enhancement Course** Engineering Economics and Foreign Trade	3	0	0	3	3
		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.	25BTDS151	**Core Course** Deep Learning	3	0	0	3	3
2.	25BTDS152	**Core Course** Computer Networks	3	0	0	3	3
3.	25BTDS153	**Core Course** Theory of Computation	3	1	0	4	4
4.	25BTDS351 25BTDS352 25BTDS353	**Programme Specific Elective (PSE) III** Software Engineering Nature Inspired Computing Fuzzy sets, Logics and Systems	3	0	0	3	3
5.	25BTDS354 25BTDS355 25BTDS356	**Programme Specific Elective (PSE)) IV** Quantum Machine Learning Cognitive Computing Natural Language Processing	3	0	0	3	3
6	25BTDS251	**Core Course** Deep Learning Lab	0	0	2	2	1
7	25BTDS252	**Core Course** Computer Networks Lab	0	0	2	2	1
8	25BTDS851	**Skill Enhancement Course** Principles of Management	3	0	0	3	3
9	25BTDS051 25BTDS052 25BTDS053	**Open Elective I (Generic)** Artificial Intelligence Python Programming Computer Networks	3	0	0	3	3
		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.	25BTDS161	**Core Course** Predictive Analysis	3	0	0	3	3
2.	25BTDS162	**Core Course** Complier Design	3	0	0	3	3
3.	25BTDS163	**Core Course** Cryptography and Network Security	3	0	0	3	3
4.	25BTDS361 25BTDS362 25BTDS363	**Programme Specific Elective (PSE) V** Applied Artificial Intelligence Neuromorphic Computing Computer Vision	3	0	0	3	3
5.	25BTDS364 25BTDS365 25BTDS366	**Programme Specific Elective (PSE) VI** Applied Machine Learning Internet of Things Data Visualization	3	0	0	3	3
6.	25BTDS261	**Core Course** Predictive Analysis Lab	0	0	2	2	1
7.	25BTDS262	**Core Course** Compiler Design Lab	0	0	2	2	1
8.	25BTDS061 25BTDS062 25BTDS063	**Open Elective II (Generic)** AI Tools Internet of Things Cybersecurity	3	0	0	3	3
		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.	25BTDS171	**Core Course** High Performance Computing	3	0	0	3	3
2.	25BTDS172	**Core Course** Ethics, Policy, Laws and Standards in AI	3	0	0	3	3
3.	25BTDS371 25BTDS372 25BTDS373	**Programme Specific Elective (PSE) VII** Systems Engineering Evolutionary Computation Digital Marketing	3	0	0	3	3
4.	25BTDS374 25BTDS375 25BTDS376	**Programme Specific Elective (PSE) VIII** Pattern Recognition Augmented Intelligence Computational and Systems Biology	3	0	0	3	3
5	25BTDS271	**Core Course** High Performance Computing Lab	0	0	2	2	1
6	25BTDS471	Industrial Internship	0	0	0	0	2
7	25BTDS571	Mini Project	0	0	0	0	2
8	25BTDS071 25BTDS072 25BTDS073	**Open Elective III** Advanced Python Programming Optimization Algorithms Computing (Latest)	3	0	0	3	3
		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.	25BTDS581	Capstone Project	0	0	0	0	15
2.	25BTDS381 25BTDS382 25BTDS383	**Programme Specific Elective (PSE) IX** Game Theory for Machine Learning Semantic Web Technology GPU Computing	3	0	0	3	3
3.	25BTDS384 25BTDS385 25BTDS386	**Programme Specific Elective (PSE) X** Resource Constrained Artificial Intelligence Web Data Mining Generative AI	3	0	0	3	3
		Total	**06**	**0**	**0**	**06**	**21**

Semester I

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS111	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 for:

- To have a comprehensive understanding of a foundational understanding of computer systems.
- To learn about various number systems including decimal, binary, octal, and hexadecimal
- To develop a comprehensive grasp of how computers function, the types of software used and the significance of networking in today's digital world.
- To explore various types of software applications including operating systems, word processors, database management systems and Internet

UNIT	TOPICS	HOURS
I	**Introduction to Computer** Evolution of Computers, Generations of Computers, Classification of Computers, The Computer System, Computing Concepts, Applications of Computers. **Memory and storage systems** Computer Software and Hardware components and its requirements-Storage Devices, **Computer Viruses** 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.	9
II	**Microsoft software** 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** Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, SystemManagement Programs , Standard Application Programs , Unique Application Programs, Problem Solving, Structuring the Logic	9

IV	**Memory management** Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, ProvidingUser Interface, Popular Operating Systems.	9
V	**THE INTERNET AND WORLD WIDE WEB** 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. **DATA COMMUNICATIONS AND NETWORKS** Introduction-Data Communication Using Modem-Computer Networks-Network Topologies-Network Protocols and Software-Applications of Network.	9

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 theirimpact 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	1	0	0	0	2	0	0	0	1	3	2	0	0
CO2	3	3	0	2	3	0	0	0	0	0	1	3	2	0	0
CO3	3	3	3	2	2	0	0	0	0	0	3	3	2	1	1
CO4	2	3	1	3	2	0	0	0	0	0	1	3	2	1	1
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS211	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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	1	1	0	0	0	2	0	0	0	1	3	2	0	0
CO2	3	3	0	2	3	0	0	0	0	0	1	3	2	0	0
CO3	3	3	3	2	2	0	0	0	0	0	3	3	2	1	1
CO4	2	3	1	3	2	0	0	0	0	0	1	3	2	1	1
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS112	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 for:

- To learn the fundamental concepts of programming, including algorithms,flowcharts, and the logical approach to problem solving that is applicable to any programming language.
- To acquire comprehensive understanding of the syntax, semantics and the basic constructs of C language
- Learn to use of pointers, Arrays, and dynamic memory allocation which are key to understanding data structure, memory management .
- Build a foundation for advanced programming and software development. 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 typesand 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, ControlFlow programs with control flow	9
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 applypointers to solve complex problems.

CO5 : Develop modular programs using control structures, unions

Text Book

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 publishers, 1998.

Reference Books

1. E. Balagurusamy, Programming in ANSI C, 3rd 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, 4th edition , 2017

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	2	3	2	1	0	0	0	0	1	3	0	0	0
CO2	3	3	0	0	0	0	1	0	0	0	0	3	1	0	0
CO3	3	2	2	0	0	1	1	0	0	0	0	3	0	1	1
CO4	3	2	2	0	0	0	0	0	0	0	0	3	1	0	1
CO5	3	3	2	2	2	0	0	0	0	0	0	3	3	0	1

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS
Course Code	25BTDS212	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 marksusing 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 tosolve complex problems.
CO5	Develop modular programs using control structures, unions

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	2	3	2	1	0	0	0	0	1	3	0	0	0
CO2	3	3	0	0	0	0	1	0	0	0	0	3	1	0	0
CO3	3	2	2	0	0	1	1	0	0	0	0	3	0	1	1
CO4	3	2	2	0	0	0	0	0	0	0	0	3	1	0	1
CO5	3	3	2	2	2	0	0	0	0	0	0	3	3	0	1

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

Programme	B. Tech. CSE (AI&DS)	Programme Code	BTDS
Course Code	25BTDS113	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 for:

- To recall and remember basics of matrices, complex numbers, and differential calculus.
- To understand the concepts of basic mathematical methods for matrices, complex numbers and differential calculus.
- To apply methods to solve engineering problems.
- To analyze engineering problems and evaluate.
- 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.	12
III	**Sequence:** Real number system, Convergence of sequence and series, Tests for convergence	8
IV	**Series:** Power series, Taylor's series, Series for exponential,trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.	8
V	**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	10
VI	**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	12

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, 10th 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, 11th 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

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

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS114	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:

- To impart knowledge on the basics of the vector and scalar representation of forces and moments with Special reference to differentiation and integration methods
- To acquire knowledge on moment of inertia and angular momentum
- 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 coordinatesystems	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, 2nd edition, 2006.

Reference Books:

2. 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	0	0	0	0	0	0	0	2	0	0	2
CO2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	2
CO3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	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&DS)	Programme Code	BTDS		
Course Code	25AEEN911	Number of Hours/Week	3		
Semester	1	Max. Marks	100		
Year	1	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 to

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

UNIT	TOPICS	HOURS
I	**Introduction to Communication** 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 Overcoming Barriers	10
II	**Listening and Speaking:** 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	10
III	**Reading and Writing:** 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	13
IV	**Presentation Skills** Planning: Occasion, Audience, Purpose, Thesis Statement, Material, Outlining and Structuring, Guidelines for Effective Delivery, Strategies for Reducing Stage Fright	8
V	**Practice:** Grammar Bites, English Fluency Drills	4

COURSE OUTCOMES:

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

CO1: Analyse 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 written communication.

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

Text Books

1. Kumar, Sanjay and Pushp Lata. *Communication Skills*. 2nd. 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.* 6th ed., Pentice Hall Publications, 1976.
3. Rose, William. *GNVQ Core Skills Communication*. 2nd. 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	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0
CO2	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0
CO3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS121	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 for:

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

UNIT	TOPICS	HOURS
I	**Introduction to python programming** 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;	9
II	**Python datatypes** 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;	9
III	**Loop and function** 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;	9
IV	**OOPs in python** 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;	9
V	**Python machine learning tools** 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;	9

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

	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	1	1
CO2	3	3	2	3	1	2	0	2	1	1	0	2	1	1	2
CO3	3	2	3	2	3	1	1	0	0	1	0	2	2	2	2
CO4	3	2	3	2	1	2	1	0	1	1	0	1	2	1	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&DS)	Programme Code	BTDS		
Course Code	25BTDS221	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 for:

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 pythonprogramming
2	Implement string manipulations problems using python
3	Implement problems using python datatypes such astuple, list, dictionary etc.
4	Implement problems for python loops, conditionalstatements and functions
5	Implement object oriented programming concepts inpython to solve different problems
6	Implement problems for python file manipulations
7	Implement standard machine learning algorithms usingpython frameworks such as TensorFlow, PyTorch etc.
8	Implement adavanced problems using python tools in avirtual 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&DS)	Programme Code	BTDS		
Course Code	25BTDS122	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:

- **Understand fundamental probability concepts** and their applications in real-world scenarios.
- Analyze data using descriptive statistics **such as mean, variance, and standard deviation.**
- Apply probability distributions **(e.g., binomial, normal) to model and solve problems.**
- Conduct hypothesis testing and confidence intervals **to make informed statistical inferences.**
- 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.	7
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.	9

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.	**9**
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: Analyse 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	2	1	1	2	1	2	1	0	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	1	1	2	0	0	2	0	2
CO4	2	2	1	2	0	2	2	1	0	0	1	1	2	2	2
CO5	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&DS)	Programme Code	BTDS
Course Code	25BTDS123	Number of Hours/Week	4
Semester	II	Max. Marks	100
Year	I	Credits	4
Applied Science Course			
Course Title	MATHEMATICS II	L: 3	T: 1 P: 0

COURSE OBJECTIVES:

- To develop a strong understanding of vector spaces, subspaces, basis, and dimension, as well as how linear transformations relate to matrices and their properties.
- To gain proficiency in solving systems of linear equations using techniques like Gaussian elimination, matrix operations, and determinants.
- To compute eigenvalues and eigenvectors, and apply them to diagonalize matrices, a critical tool for solving differential equations.
- To solve first-order and second-order ordinary differential equations (ODEs) with applications to physical, biological, and engineering problems.
- 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.	12
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.	12
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.	12
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	14

COURSE OUTCOMES:

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

CO1: 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.

CO2; Understand linear spaces, its basis and dimension with corresponding applications in the field of computerscience.

CO3: Apply the concept of eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in innerproduct spaces for understanding physical and engineering problems.

CO4: Understand the first- and second-order ordinary differential equations (ODEs), both analytically and numerically, with applications to real-world phenomena.

CO5: Develop the skills to model physical systems using differential equations and linear algebra.

Text Books:

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

Reference Books:

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

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	2	1	0	1	0	0	0	0	0	0	2	2	1	1
CO2	2	1	1	2	1	2	1	0	1	2	1	2	1	2	1
CO3	2	0	2	2	2	2	2	1	1	2	0	0	2	0	2
CO4	2	2	1	2	0	2	2	1	0	0	1	1	2	2	2
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS124	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:

- To understand the working principle of various lasers, fibre optics and its applications.
- To impart knowledge on acoustics and ultrasonics and its applications.
- 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	9
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	9
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	9
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	9
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.	9

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 ServicesPvt. 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 andCompany 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	2	2	0	0
CO2	2	0	0	3	0	0	0	0	0	0	0	0	1	0	0
CO3	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
CO4	2	1	0	0	0	0	0	0	0	0	0	0	2	0	0
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS222	Number of Hours/Week	2		
Semester	II	Max. Marks	100		
Year	I	Credits	1		
Applied Science Course					
Course Title	PHYSICS 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	1	0	0	0	0	0	0	2	0	0	2
CO2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2
CO3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
CO4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS125	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:

- To get familiar and understand the fundamental notions in discrete structures focusing on aspects of computer science
- To describe binary relations between two sets, combine relations using set operations and composition.
- To understand and demonstrate the basic concept of algorithm and its application in combinatorial mathematics.
- 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.
- To classify the basic properties of graphs and trees and model simple applications.

UNIT	TOPICS	HOURS
I	**Set Theory and Logic** Sets – Functions – Relations - Equivalence Relation – Poset - Functions Logic: Propositional logic - Truth Tables – Tautologies - Resolution Proof System - Predicate Logic	9
II	**Induction and Combinatorics** Peano's Axioms - Mathematical Induction - Pigeon-Hole Principle - Principle of Inclusion and Exclusion - Review of Permutations and Combinations - Distribution Problems - Derangements - Bijection Principle.	9
III	**Algebraic Structures** 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** 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** 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

CO1: Understand the fundamental aspects of discrete and continuous mathematical structures.

CO2: Demonstrate the principles of mathematical induction to prove statements.

CO3: Differentiate between various algebraic structures and analyze their properties.

CO4: Apply logical reasoning and mathematical techniques to solve problems in set theory, algebra and graphtheory.

CO5: Construct new mathematical models thereby generating solutions to complex recurrence relations andgraph 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	1	2	0	0	0	0	1	2	0	0	3
CO2	1	2	1	1	1	0	0	0	0	0	1	0	0	1	3
CO3	2	1	1	2	0	0	0	0	0	0	1	1	0	0	2
CO4	2	2	1	1	0	0	0	0	0	0	2	2	1	1	1
CO5	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&DS)	Programme Code	BTDS		
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 to:

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

UNIT	TOPICS	HOURS
I	**Introduction to Environmental studies** 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** 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 energy needs, case studies.	6
III	**Biodiversity and Conservation** Levels of biological diversity- genetic, species and ecosystem diversity, Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots.	6
IV	**Environmental Pollution** 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.	6

V	**Human Communities and the Environment** Human population growth: Impacts on environment, human health and welfare- Resettlement and rehabilitation of project affected persons, Disaster management: floods, earthquake, cyclones and landslides, Environmental movements- Chipko, Silent valley, Bishnoi's of Rajasthan	**6**

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 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0
CO2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
CO3	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS131	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Year	II	Credits	3		
Core Course					
Course Title	ARTIFICIAL INTELLIGENCE		L	T	P
			3	0	0

COURSE OBJECTIVES:

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

- To explore history and revolution of artificial intelligence
- To formulate artificial intelligence problem by defining intelligent agent and its environment
- To learn problem solving approaches through state space search and its different algorithms.
- 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** 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;	9
II	**Intelligent agent and state space search** 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;	9
III	**Uninformed and Informed Searches** 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;	9
IV	**Local search and adversarial search** 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;	9
V	**Constraint satisfaction and Knowledge representation** 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	9

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&DS)	Programme Code	BTDS		
Course Code	25BTDS132	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:

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding 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.
- Development of 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, timeshifting, 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	9

	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.	
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.	**9**

COURSE OUTCOMES:

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

CO1 : To Understand different types of signals-continuous and discrete, odd and ever,periodic and aperiodic etc

CO2 : Be able to classify systems based on their properties

CO3 : To familiarize the concepts of transform based continuous time and discrete time

CO4 : Analyze continuous time and discreet time signals and systems by using appropriate mathematical tools

CO5 : Determine 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 Book

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1
CO2	2	2	2	1	2	2	2	1	0	1	0	2	2	1	1
CO3	2	1	3	3	2	2	2	1	2	0	2	1	2	2	2
CO4	2	2	2	2	2	3	2	1	2	0	2	1	2	0	1
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS133	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.	12
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, parallel-in serial-out (PISO) registers; applications of shift registers.	12
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 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

	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&DS)	Programme Code	BTDS		
Course Code	25BTDS134	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:

- To Comprehensive understanding of fundamental data structures and algorithms.
- To equip algorithms with the skills to analyze and implement various computational techniques.
- Learn 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.

UNIT	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,	9
II	**Elementary data structures** Stacks and Queues, linked lists and its operations, Hash Tables - Direct and Open addressing- **Tree data structure** Tree- Tree Traversals-Binary Search Trees-Red Black Trees - Red-black trees and its operations. B-Tree-Insertion-Deletion.	9
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	9
IV	**Introducing spanning trees**, Minimum spanning tree, algorithms,Kruskal, Prims, Bellman-Ford algorithm, Single source shortest path in directed acyclic graphs, Dijkstra's algorithms, Floyd-Warshall algorithm	9
V	**NP-Completeness** Polynomial time, Verification algorithms, NP-Complete, NP-Hard	9

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	PO10	PO11	PO12	PSO1	PSO2	PSO3
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&DS)	Programme Code	BTDS		
Course Code	25BTDS135	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:

- 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.

UNIT	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** Reading and writing files using FileReader, FileWriter, BufferedReader, and BufferedWriter. Byte and character streams. Serialization and deserialization.	9
V	**GUI Programming and Event Handling** 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	PO10	PO11	PO12	PSO1	PSO2	PSO3
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&DS)	Programme Code	BTDS		
Course Code	25BTDS136	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 to

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

UNIT	TOPICS	HOURS
I	**Human Values** 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.	6
II	**Engineering Ethics** Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – 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.	6
III	**Engineering as Social Experimentation** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	6
IV	**Safety, Responsibilities and Rights** 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.	6
V	**Global issues** 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	6

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 professional life.

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

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

CO4: Assess risk and safety issues, including intellectual property and employee rights in engineering 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 International Limited 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&DS)	Programme Code	BTDS		
Course Code	25BTDS231	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&DS)	Programme Code	BTDS		
Course Code	25BTDS232	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:

- To implement basic data structures like arrays linked lists, stacks, and queues.
- To develop skills in implementing algorithms for searching and sorting.
- To gain hands-on experience with tree and graph data structures.
- To apply recursion and dy`namic memory management in problem-solving.
- 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	PO10	PO11	PO12	PSO1	PSO2	PSO3
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&DS)	Programme Code	BTDS		
Course Code	25BTDS233	Number of Hours/Week	2		
Semester	III	Max. Marks	100		
Year	II	Credits	1		
Core Course					
Course Title	OBJECT ORIENTED 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 for:

- 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.

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	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

Semester IV

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS
Course Code	25BTDS141	Number of Hours/Week	3
Semester	IV	Max. Marks	100
Year	II	Credits	3

Core Course

Course Title	INTRODUCTION TO DATE SCIENCE AND DATA ANALYTICS	L	T	P
		3	0	0

COURSE OBJECTIVES:

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

- Understand the Foundations of Data Science
- Develop Skills in Data Collection and Pre-processing
- Master Exploratory Data Analysis Techniques
- Build and Evaluate Predictive Models
- Evaluate Model Performance and Address Overfitting/Underfitting

UNIT	TOPICS	HOURS
I	**Introduction** Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.	9
II	**Data Collection and Data Pre-Processing** Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.	9
III	**Exploratory Data Analytics** Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.	9
IV	**Model Development** Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.	9
V	**Model Evaluation** Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search.	9

COURSE OUTCOMES:

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

CO1 : Identify key concepts in Data Science such as stages in a Data Science project, data security issues, and roles in a Data Science team.

CO2 : Explain various data collection strategies and preprocessing techniques, including data cleaning, integration, transformation, reduction, and discretization.

CO3 : Perform exploratory data analysis using descriptive statistics, box plots, pivot tables, and heat maps, and calculate measures such as mean, standard deviation, skewness, and kurtosis.

CO4 : Evaluate the effectiveness of predictive models using residual plots, distributionplots, and in-sample evaluation techniques like simple and multiple regression, and polynomial regression pipelines.

CO5 : Assess model performance through cross-validation, generalization error analysis,and out-of-sample evaluation metrics, and select appropriate models to avoid overfitting or underfitting, using techniques such as Ridge regression and Grid Search.

Text Books:

1. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.

Reference Books:

1. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
2. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global,2014.

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	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS241	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 for:

- To practice fundamental concepts in machine learning
- To introduce mathematical tools in machine learning
- To introduce various framework for machine learning
- To implement neural networks, CNN for applications
- To implement research topic as part of ML project

List of experiments:

S.NO	TITLE
1	Implement Least square problem, eigen valuedecomposition, singular value decomposition
2	Implement Linear regression and ridge regression usinggradient descent and normal equation
3	Implement logistic regression with sigmoid function
4	Implement support vector machine and kernel functionwith KKT tools
5	Implement guassian discriminant analysis and naïvebayes 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 andbackpropagation algorithm for training
8	Implement convolutional neural network for computervision tasks
9	Implement research topic as part of ML project

Course outcome:

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	0	1	0	0	0	1	0	2	0	0	2
CO2	3	2	2	2	0	0	0	0	0	2	1	1	2	0	3
CO3	3	3	3	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	2	2	3	3	3	2	2	2	3	1	2	2	1	3
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS142	Number of Hours/Week	3		
Semester	IV	Max. Marks	100		
Year	II	Credits	3		
Core Course					
Course Title	DATABASE MANAGEMENT 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 for:

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques
- To understand the concept of Database Design in Normalization techniques
- To know the manipulation of SQL Queries

UNIT	TOPICS	HOURS
I	**Unit I** Data base System Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models , the ER Model , Relational Model , Other Models , Database Languages , DDL , DML , database Access for applications Programs, data base Users and Administrator , Transaction Management , data base Architecture, Storage Manager , the Query Processor Data base design and ER diagrams , ER Model, Entities, Attributes and Entity sets , Relationships and Relationship sets , ER Design Issues, Concept Design , Conceptual Design for University Enterprise. Introduction to the Relational Model, Structure, Database Schema, Keys, Schema Diagrams.	9
II	**Unit II** Relational Query Languages, Relational Operations. Relational Algebra, Selection and projection set operations, renaming , Joins , Division , Examples of Algebra overviews , Relational calculus , Tuple relational Calculus , Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions , GROUPBY , HAVING, Nested Sub queries, Views, Triggers.	9
III	**Unit III** Normalization, Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms , dependency preservation, Boyee/Codd normal form. Higher Normal Forms ,Introduction, Multi,valued dependencies and Fourth normal form, Join dependencies and Fifth normal form	9

IV	**Unit IV** Transaction State, Implementation of Atomicity and Durability,Concurrent, Executions, Serializability, Recoverability , Implementation ofIsolation , Testing for serializability, Lock ,Based Protocols , Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log Based Recovery , Recovery with ConcurrentTransactions , Buffer Management , Failure with loss of nonvolatile storage,Advance Recovery systems, Remote Backup systems.	**9**
V	**Unit V** File organization, various kinds of indexes. Query Processing, Measures of query cost , Selection operation , Projection operation, , Join operation , set operation and aggregate operation , Relational Query Optimization , Transacting SQL queries , Estimating the cost , Equivalence Rules.	**9**

COURSE OUTCOMES:

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

CO1: Install, configure, and interact with a relational database management system

CO2: Master the basics of SQL and construct queries using SQL

CO3: Design and develop a large database with optimal query processing

CO4: Develop efficient storage scheme of saving and retrieving Records and Files

CO5: Design the database with normalization techniques

Text Books

1. Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition, 2010
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill Third Edition, 2003

Reference Books

1. Fundamentals of Database Systems, Elmasri Navathe Pearson Education, 2015
2. An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition,2019.

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	0	2	2	0	0	0	0	0	0	0	0	0	0	2
CO2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	3
CO3	2	0	3	3	2	3	0	1	2	0	2	1	0	0	3
CO4	2	2	2	2	2	3	0	1	2	0	2	1	2	0	1
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS241	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Year	II	Credits	1		
Core Course					
Course Title	INTRODUCTION TO DATA SCIENCE AND DATA ANALYTICS 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:

- Understand the fundamentals of Data Science
- Acquire practical skills in data collection and data preprocessing
- Develop competency in exploratory data analysis
- Build and interpret predictive models
- Evaluate and validate data-driven models

Programs

1. Study the evolution of Data Science and identify different Data Science roles. Prepare a brief report explaining responsibilities and skills required for each role.
2. Analyze the stages involved in a Data Science project by selecting a real-world problem and mapping each stage from data collection to decision making.
3. Demonstrate different data collection strategies by loading datasets from CSV, Excel, and online sources using Python.
4. Perform an overview of data pre-processing by inspecting a raw dataset and identifying missing values, noise, and inconsistencies.
5. Clean a given dataset by handling missing values, removing duplicate records, and correcting inconsistent data.
6. Integrate multiple datasets and apply data transformation techniques such as normalization and standardization.
7. Compute descriptive statistics such as mean, standard deviation, skewness, and kurtosis, and interpret the results.
8. Create box plots for numerical attributes and identify outliers and data distribution patterns.
9. Generate pivot tables and heat maps to study relationships and trends in the dataset.
10. Perform correlation analysis and ANOVA to examine relationships among variables and test statistical significance.
11. Develop simple and multiple linear regression models and interpret the regression

coefficients and predictions.

12. Evaluate regression models using visualization techniques such as residual plots and distribution plots, and analyze in-sample evaluation measures.

COURSE OUTCOMES:

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

CO1: **Understand** the evolution of Data Science, various Data Science roles, and the stages of a Data Science project.

CO2: **Develop skills** in data collection from multiple sources and perform data preprocessing, cleaning, integration, and transformation.

CO3: **Apply** exploratory data analysis techniques using statistical measures and visualization tools to analyze datasets.

CO4: **Build** simple and multiple linear regression models for prediction and decision making.

CO5: **Evaluate** regression models using visualization techniques and in-sample performance measures.

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	0	2	2	0	0	0	0	0	0	0	0	0	0	2
CO2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	3
CO3	2	0	3	3	2	3	0	1	2	0	2	1	0	0	3
CO4	2	2	2	2	2	3	0	1	2	0	2	1	2	0	1
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS242	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Year	II	Credits	1		
Core Course					
Course Title	DATABASE MANAGEMENT SYSTEMS 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:

- Understand and Apply SQL DDL and DML Commands
- Utilize SQL Functions and Operators Effectively
- Implement SQL Joins and Advanced Clauses
- Work with Constraints, Views, and Subqueries in SQL
- Master Database Management and PL/SQL Concepts

1. DDL commands of SQL with suitable examples
   Create table
   Alter table
   Drop Table

2. DML commands of SQL with suitable examples
   Insert
   Update
   Delete

3. Different types of function with suitable examples
   Number function
   Aggregate Function
   Character Function
   Conversion Function
   Date Function

4. Different types of operators in SQL
   Arithmetic Operators
   Logical Operators
   Comparison Operator
   Special Operator
   Set Operation

5. Different types of Joins
   Inner Join
   Outer Join Natural
   Join etc..

6. Study and Implementation of
   Group By & having clause
   Order by clause
   Indexing

7. Study & Implementation of
   Sub queries
   Views

8. Different types of constraints

9. Database Backup & Recovery commands.
 Rollback, Commit, Savepoint.

10. Creating Database /Table Space
Managing Users: Create User, Delete User
Managing roles:-Grant, Revoke

11. PL/SQL

12. SQL Triggers

COURSE OUTCOMES:

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

CO1: Understand and apply SQL Data Definition Language (DDL) commands.

CO2: Understand and execute SQL Data Manipulation Language (DML) commands.

CO3: Apply different SQL functions to manipulate and retrieve data.

CO4: Understand and apply different types of constraints in SQL.

CO5: Design and implement SQL triggers for automated actions.

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	0	2	2	0	0	0	0	0	0	0	0	0	0	2
CO2	2	2	0	0	0	0	0	0	0	0	0	0	1	1	3
CO3	2	0	3	3	2	3	0	1	2	0	2	1	0	0	3
CO4	2	2	2	2	2	3	0	1	2	0	2	1	2	0	1
CO5	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 & DS)	Programme Code	BTDS
Course Code	25BTDS143	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** 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** 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** 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** 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** 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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	2
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&DS)	Programme Code	BTDS		
Course Code	25BTDS341	Number of Hours/Week	3		
Semester	IV (PSE I)	Max. Marks	100		
Year	II	Credits	3		
Programme Specific Elective					
Course Title	OPERATING 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:

- To explore fundamental concepts in operating system
- To understand essential functions of operating system
- To equip process synchronization problems in real life applications
- To acquire memory and file maanagent concepts in operating system.

UNIT	TOPICS	HOURS
I	**Introduction to Operating System** Introduction, operating system operations, process management, memory management, storage management, protection and security, distributed systems, Operating system services and systems calls, system programs, operating system structure, operating systems generations.	9
II	**Process Management and Concurrency** Process concepts, process state, process control block, scheduling queues, process scheduling, multithreaded programming, threads in UNIX, comparison of UNIX and windows, Process synchronization,critical section problem,Peterson's solution, synchronization hardware, semaphores, classic problems of synchronization, readers and writers problem, dining philosophers problem, monitors.	9
III	**Deadlocks and Memory Management** System model, deadlock characterization, deadlock prevention,detection and avoidance, recovery from deadlock banker's algorithm. Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, allocation of frames, thrashing	9
IV	**File System** Concept of a file, access methods, directory structure, file system mounting, file sharing, protection. File system implementation: file system structure, file system implementation, directory implementation, allocation methods, free-space management, efficiency and performance	9
V	**I/O System** Mass storage structure - overview of mass storage structure, disk structure, disk attachment, disk scheduling algorithms, swap space management, stable storage implementation, tertiary storage structure. I/O: Hardware, application I/O interface, kernel I/O subsystem, transforming I/O requests to hardwareoperations, streams, performance.	9

COURSE OUTCOMES:

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

CO1	Differentiate basic functionalities in operating system
CO2	Solve process synchronization and scheduling problems
CO3	Implement mutual exclusion principles in real applications
CO4	Develop system model to handle deadlock situations
CO5	Design file and I/O system to improve performance

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 9th edition, Wiley India Private Limited, New Delhi, 2012.

Reference Books:

1. Andrew S. Tanenbaum, Herbert Bos, Modern Operating Systems, 4th edition, Prentice Hall of India, India, 2016.

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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS342	Number of Hours/Week	3		
Semester	IV (PSE I)	Max. Marks	100		
Year	II	Credits	3		
Programme Specific Elective					
Course Title	DATA MINING AND DATA WAREHOUSING		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 understanding of data warehousing, data mining, and advanced analytics techniques essential for effective business decision-making.
- To learn how to build, manage, and utilize data warehouses and apply various data mining techniques for insightful analysis.

UNIT	TOPICS	HOURS
I	**Data Warehousing and Business Analysis:** Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis	9
II	**Data Mining:** Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems	9
III	**Association Rule Mining:** Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining	9
IV	**Classification and Prediction:** Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section	9
V	**Cluster Analysis:** Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis	9

COURSE OUTCOMES:

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

CO1	Understand Data Warehousing Concepts.
CO2	Apply data extraction, cleanup, and transformation tools effectively and utilize metadata in reporting and querying applications.
CO3	Analyze Data Using OLAP and Create and interpret reports that utilize OLAP Capabilities.
CO4	Apply Data Mining Techniques and explain the functionalities of data mining and the processes of data preprocessing, cleaning, integration, and transformation.
CO5	Evaluate Data Analysis Techniques and assess the accuracy of classifiers and predictors through appropriate evaluation metrics.Utilize ensemble methods for improved prediction accuracy.

Text Book:

1. Jiawei Han, Micheline Kamber and Jian Pei "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011

Reference Books

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.

2. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

3. G. K. Gupta "Introduction to Data Mining with Case Studies", 3rd Edition, Prentice Hall of India, 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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS343	Number of Hours/Week	3		
Semester	IV (PSE I)	Max. Marks	100		
Year	II	Credits	3		
Programme Specific Elective					
Course Title	SOCIAL NETWORK ANALYSIS		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:

- Explain the evolution of the Semantic Web, its limitations, and the role of social web platforms in network analysis.
- Apply ontology-based knowledge representation and advanced modelling techniques to social network data.
- Analyse and extract insights from web communities and study their evolution using archival data.
- Evaluate human behaviour in social networks and address privacy, trust, and reputation challenges.
- Utilize visualization techniques and graph theory to analyse and interpret social networks in practical scenarios.

UNIT	TOPICS	HOURS
I	**INTRODUCTION** Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web.Emergence of the Social Web – Social Network analysis: Development of Social Network.Analysis – Key concepts and measures in network analysis – Electronic sources for network.	9
II	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION** Ontology and their role in the Semantic Web: Ontology-based knowledge Representation –Language – Modelling and aggregating social network data: State-of-the-art in network data.social relationships – Aggregating and reasoning with social network data – Advanced.Representations.	9
III	**EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS:** Extracting evolution of Web Community from a Series of Web Archive – Detecting.	9
IV	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS** Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation –Visualizing online social networks, visualizing social networks with matrix-based.representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications –Cover networks – Community welfare – Collaboration networks – Co-Citation networks.	9

V	**PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES** Understanding and predicting human behaviour for social communities – User data management.– Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust modelsbased on subjective logic – Trust network analysis – Trust transitivity analysis – Combining Trust and reputation – Trust derivation based on trust comparisons.	**9**

COURSE OUTCOMES:

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

CO1	Illustrate the Evolution of the Semantic Web and Social Web Platforms
CO2	Apply Ontology-Based Knowledge Representation and Modeling Techniques
CO3	Extract Insights from Web Communities and Evaluate Evolution
CO4	Assess Human Behavior and Address Privacy, Trust, and Reputation Challenges
CO5	Employ Graph Theory and Visualization Techniques for Social Network Analysis

Text Books:

1. **Semantic Web for the Working Ontologist**: Effective Modeling in RDFS and OWL, **Authors**: Dean Allemang, James Hendle, **Publisher**: Morgan Kaufmann, **Edition**: 2nd Edition (2011)

Reference Books:

1. **The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management**, **Authors**: Tim Berners-Lee, James Hendler, Ora Lassila, **Publisher**: Morgan Kaufmann, **Edition**: 1st Edition (2001)

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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS344	Number of Hours/Week	3		
Semester	IV (PSE II)	Max. Marks	100		
Year	II	Credits	3		
Programme Specific Elective					
Course Title	FULL STACK DEVELOPMENT		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 various components of full stack development
- To learn Node.js features and applications
- To develop applications with MongoDB
- To understand the role of Angular and Express in web applications
- To develop simple web applications with React

UNIT	TOPICS	HOURS
I	**Basics Of Full Stack:** Understanding the Basic Web Development Framework – User – Browser – Webserver – Backend Services – MVC Architecture – Understanding the different stacks –The role of Express – Angular – Node – Mongo DB – React	9
II	**Node JS:** Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers – Call backs – Handling Data I/O – Implementing HTTP services in Node.js	9
III	**Mongo DB:** Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications	9
IV	**Express And Angular:** Implementing Express in Node.js – Configuring routes – Using Request and Response objects Angular – Typescript – Angular Components – Expressions – Data binding – Built-in directives	9
V	**React:** MERN STACK – Basic React applications – React Components – React State – Express REST APIs – Modularization and Web pack – Routing with React Router – Server-side rendering	9

COURSE OUTCOMES:

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

CO1	Understanding of full-stack development, including front-end, back-end, and database integration using popular technologies.
CO2	Develop practical knowledge of Node.js, including installation, using npm, creating applications, and handling asynchronous operations with events, callbacks, and timers.
CO3	Master MongoDB and NoSQL concepts, from database setup to collection management, and connecting MongoDB with Node.js applications.
CO4	Learn how to build dynamic web applications using Angular, including components, directives, data binding, and Typescript.
CO5	Acquire hands-on experience with the MERN stack to build full-stack applications with React, Express, and REST APIs, including routing and server-side rendering.

Text Book:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019.

Reference Books

1. Full-Stack JavaScript Development by Eric Bush.
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki
3. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
4. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS345	Number of Hours/Week	3		
Semester	IV (PSE II)	Max. Marks	100		
Year	II	Credits	3		
Programme Specific Elective					
Course Title	EDGE 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 to:

- Understand the fundamentals of AI and its execution on edge devices.
- Learn the principles and workflows of TinyML development.
- Explore hardware and software platforms used in Edge AI applications.
- Analyze model optimization techniques for deploying ML models on constrained devices.
- Implement real-time ML applications using microcontrollers and sensors.

UNIT	TOPICS	HOURS
I	**Introduction to Edge AI and TinyML:** Edge AI – Need for on-device intelligence – Applications of Edge AI – TinyML – TinyML vs Traditional ML – Key constraints (power, memory, latency) – Overview of Edge AI pipeline	9
II	**ML Workflow and Model Building for Edge:** Dataset collection – Data preprocessing – Feature engineering – Model training and evaluation – ML algorithms for Edge: Decision Trees, SVM, kNN, Tiny Neural Networks	9
III	**Hardware and Software Platforms:** Microcontrollers (Arduino, STM32, ESP32) – Sensor interfacing – Operating systems (FreeRTOS, TFLite Micro) – Toolchains (Edge Impulse, TensorFlow Lite, CMSIS-NN) – Edge deployment lifecycle	9
IV	**Model Optimization and Deployment:** Quantization, Pruning, Knowledge Distillation – Memory and compute optimization – Converting models to TFLite – Deployment using Arduino IDE, TFLite Micro runtime	9
V	**Applications and Case Studies:** Real-time projects: keyword spotting, gesture recognition, vibration analysis – Integrating TinyML with IoT – Power management – Privacy and security in Edge AI	9

COURSE OUTCOMES:

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

CO1	Explain the basics of Edge AI and the need for TinyML.
CO2	Apply machine learning workflows to develop small-scale models.
CO3	Compare edge hardware platforms and deployment pipelines.
CO4	Use model compression and optimization for resource-constrained devices.
CO5	Build and test TinyML applications using real-world sensors and microcontrollers.

Text Book

1. **Pete Warden & Daniel Situnayake**, *TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers*, O'Reilly, 2020.
2. **Ajit Jaokar**, *AI on the Edge: Powerful Machine Learning on Tiny Devices*, Packt Publishing, 2021.

Reference Books

1. Laurence Moroney, *AI and Machine Learning for On-Device Development*, O'Reilly, 2021.
2. Arm Education, *Machine Learning on Arm Cortex-M Microcontrollers*, Arm Education Media, 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	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&DS)	Programme Code	BTDS
Course Code	25BTDS346	Number of Hours/Week	3
Semester	IV (PSE II)	Max. Marks	100
Year	II	Credits	3

Programme Specific Elective

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P
		3	0	0

COURSE OBJECTIVES:

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

- To prove correctness of algorithms
- To analyse algorithms asymptotically
- To demonstrate the efficieny of algorithms by using in existing problems
- To utilize advanced algorithms and data structures in complex problems

UNIT	TOPICS	HOURS
I	**Algorithm analysis and height balanced BST** Analysis of algorithms – introduction; solving recurrences – substitutions, recursion tree, and master method; binary search tree (BST) – insertion, deletion; BST applications – runway reservation;height balanced BSTs; AVL Tree – rotations, insertions, deletions;	9
II	**Divide and Conquer and Hashing** Interval or activity scheduling; Divide and Conquer approach – Strassen's algorithm for matrix multiplication; randomized algorithms, median and order statistics, Hashing – direct address tables, hash tables, chaining; Hash function; Universal hashing; Open addressing – linear probing, quadratic probing and double hashing;	9
III	**Dynamic and Greedy algorithms** Dynamic and greedy algorithms, Matrix-chain multiplication, Longest common subsequence; Huffman codes; B Trees – searching, search, insertion, deletion; Data structures for disjoint sets – linked list representation, tree representation, union by rank and path compression;	9
IV	**Graph Algorithms** Graph algorithms – depth first search, breadth first search, topological sort, strongly connected components, Kruskal and Prim algorithm for minimum spanning tree; Single source shortest paths – Bellman-Ford algorithm, Single-source shortest path in directed acyclic graphs; Dijkstra's algorithm;	9
V	**P and NP Problems** NP-Completeness – polynomial time, verification, NP-Completeness and reducibility, NP-Complete problems; Naïve string matching algorithm, Rabin-Karp algorithm;	9

COURSE OUTCOMES:

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

CO1 : Write correctness proofs for algorithms

CO2 : Analyse asymptotic performance of algorithms

CO3: Implement efficient algorithms in engineering applications

CO4 : Demonstrate the familiarity with advanced algorithms and data structures

CO5 : Design algorithms in terms of asymptotic performance

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms, Third Edition. The MIT Press, 3rd edition, 2009

ReferenceBooks:

1. Thomas H. Cormen. Algorithms Unlocked. The MIT Press, 2013
2. Ellis Horowitz, Sartaj Sahni, and SanguthevarRajasekaran. Fundamentals of Computer Algorithms (Computer software engineering series). Galgotia Publications, new edition edition, 2001

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	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	2
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&DS)	Programme Code	BTDS		
Course Code	25BTDS841	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:

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

UNIT	TOPICS	HOURS
I	**Introduction** 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.	9
II	**Consumer and Producer Behaviour** 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	9
III	**Product and Factor Market** 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** 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.	9

V	**Foreign Trade** 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 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, New Delhi, 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

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

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

Semester V

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS151	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** 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)** 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)** 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)** 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)** 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

CO1:	To introduce the foundational concepts of deep learning, including neural networks, activation functions, and optimization techniques.
CO2:	To explore various deep learning architectures such as feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs).
CO3:	To study advanced topics like generative adversarial networks (GANs), transfer learning, and deep reinforcement learning.
CO4:	To provide hands-on experience in implementing deep learning models for real-world applications in computer vision, natural language processing (NLP), and speech recognition.
CO5:	To emphasize model evaluation, regularization techniques, and strategies for improving the efficiency and scalability of deep learning models.

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	PO10	PO11	PO12	PSO1	PSO2	PSO3
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&DS)	Programme Code	BTDS		
Course Code	25BTDS152	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** 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.	7
II	**DATA LINK LAYER** 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.	12
III	**NETWORK LAYER** 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** 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** Application Layer protocols: HTTP - FTP - Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP.	7

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:

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

Reference Books:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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&DS)	Programme Code	BTDS		
Course Code	25BTDS153	Number of Hours/Week	4		
Semester	V	Max. Marks	100		
Year	III	Credits	4		
Core Course					
Course Title	THEORY OF COMPUTATION		L	T	P
			3	1	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 give an overview of the theoretical foundations of computer science from the perspective of formal languages.
- To illustrate finite state machines to solve problems in computing
- To familiarize Regular grammars and Context Free Grammar.
- To solve various problems by normal form techniques, Push Down Automata and Turing Machines.

UNIT	TOPICS	HOURS
I	**Introduction-Finite Automata** Introduction to Computation and Formal Languages- Syntax and Semantics- Finite Automata- Alphabets - Strings and Languages - Automata and Grammars - Deterministic Finite Automata (DFA) - Formal Definition - Simplified notation: State transition graph - Transition table - Language of DFA - Nondeterministic Finite Automata (NFA) - NFA with epsilon transition - Language of NFA - Equivalence of NFA and DFA - Minimization of Finite Automata - Distinguishing one string from other - Myhill-Nerode Theorem.	12
II	**Regular Expression (RE)** Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleen's Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.	12
III	**Context Free Grammar (CFG) and Context Free Languages** Definition - Examples - Derivation - Derivation trees - Ambiguity in Grammar - Inherent ambiguity - Ambiguous to Unambiguous CFG - Useless symbols - Simplification of CFGs - Normal forms for CFGs: CNF and GNF - Closure properties of CFLs - Decision Properties of CFLs: Emptiness - Finiteness and Membership - Pumping lemma for CFLs.	12
IV	**Push Down Automata (PDA)** Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.	12

V	**Turing Machines (TM) and Undecidability** Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Church's Thesis - Recursive and recursively enumerable languages - Halting problem - Introduction to Undecidability - Undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of post correspondence problem - Introduction to recursive function theory.	**12**

COURSE OUTCOMES:

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

CO1 :	Design finite automata or regular expression for any tokenization task
CO2 :	Construct a context free grammar for parsing any language
CO3 :	Design Turing machine for any language
CO4 :	Conclude the decidable / undecidable nature of any language
CO5 :	Apply mathematical and formal techniques for solving real-world problems

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education, India, 2007

Reference Books:

1. K. L. P Mishra, N. Chandrashekaran, Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India, 2003

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	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS351	Number of Hours/Week	3		
Semester	V (PSE III)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	SOFTWARE ENGINEERING		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 nature of the software
- To understand the different types of process models, agile developments and aspects of software engineer
- To gain knowledge about the requirements stage and development of the software
- To analyze the different types of architectural designs of the software
- To evaluate different testing strategies of the software and Develop the software.

UNIT	TOPICS	HOURS
I	**Unit I:** The Nature of Software - Software Engineering - Software Process.	9
II	**Unit II: Process Models:** Prescriptive Process Models - **Agile Development - Human Aspects of Software Engineering**	9
III	**Unit III: Understanding Requirements:** Requirements Engineering - Establishing the Groundwork Building the Analysis Model - Negotiating Requirements **Requirements Modeling: Scenario-Based Methods:** Requirements Analysis - Scenario-Based Modeling	9
IV	**Unit IV: Design Concepts:** Design within the Context of Software Engineering - The Design Process - Design Concepts **Architectural Design:** Software Architecture - Architectural Genres - Architectural Styles - Architectural Considerations - Architectural Decisions - Architectural Design	9
V	**Unit V:User Interface Design:** The Golden Rules - User Interface Analysis and Design - Interface Analysis - Interface Design Steps - WebApp and Mobile Interface Design - Design Evaluation. **Software Testing Strategies -** Software Testing Fundamentals. **Maintenance and Reengineering.**	9

COURSE OUTCOMES:

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

CO1	Understand the nature of the software
CO2	Understand the different types of process models, agile developments and aspects of software engineer
CO3	Gain knowledge about the requirements stage and development of the software
CO4	Analyze the different types of architectural designs of the software
CO5	Evaluate different testing strategies of the software and Develop the software

Text Book

1. Roger S Pressman, **Software Engineering a Practioner's Approach**, 9th Edition, McGraw-Hill Higher Education, 2023.

Reference Books

1. Richard E.Fairly (2005), Software Engineering Concepts, Tata Mc Graw Hill Book Company.
2. Jawadekar (2004), Software Engineering,Tata Mc Graw-Hill Book Company.
3. Dr. Richard Hall Thayer and Dr. Merlin Dorfman(2012), Software Engineering Essentials, Volume I: The Development Process, Software Management Training; Fourth edition.

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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS352	Number of Hours/Week	3		
Semester	V (PSE III)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	NATURE INSPIRED 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 to:

- Understand the Fundamentals of Bio-Inspired Computing.
- Learn Evolutionary Models, Optimization Techniques and Explore Genetic Algorithms.
- Investigate the biological basis of ant colonies and how this inspires optimization algorithms.
- Explore variable-length PSO and its applications in optimization problems.
- Application-Oriented Learning and Explore Advanced Nature-Inspired Algorithms.

UNIT	TOPICS	HOURS
I	**Introduction:** From Nature-to-Nature Computing, – Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques- Optimisation Problems-Single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.	9
II	**Genetic Algorithms:** Genetic algorithms: Mathematical foundation, Genetic problem solving, crossover and mutation. Genetic algorithms and Markov process, applications of genetic algorithms.	9
III	**Optimization Algorithms:** Ant Colonies, hybrid ant system, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Variations of ACO.	9
IV	**Swarm Algorithms:** Particle Swarm algorithms - particles moves, particle swarm optimization, variable length PSO, applications of PSO. Artificial Bee Colony algorithms - ABC basics, ABC in optimization, multi-dimensional bee colony algorithms, applications of bee algorithms.	9
V	**Applications:** Selected nature inspired techniques - Bat algorithm- Cuckoo search algorithm. Deep Learning-Pattern recognition -Cybersecurity and its applications -Complex Network.	9

COURSE OUTCOMES:

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

CO1	Apply nature-inspired computational techniques to solve real-world optimization and problem-solving tasks.
CO2	Demonstrate the ability to Implement Genetic Algorithms for Optimization and apply them to practical scenarios.
CO3	Utilize Ant Colony Optimization Techniques and evaluate the effectiveness of ACO algorithms in comparison to other optimization techniques.
CO4	Apply Swarm Intelligence Algorithms and analyse their applicability in real-world optimization problems.
CO5	Encourage creative and innovative problem-solving approaches by applying nature-inspired algorithms in emerging fields such as artificial intelligence, machine learning, and data science.

Text Book:

1. Fundamentals of Natural Computing: Basic Concepts, Algorithms, and applications, L. N. de Castro (2006).

2. Leandro Nunes de Castro, Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications, Chapman & Hall/ CRC, Taylor and Francis Group, 2007

3. Evolutionary Optimization Algorithms, D. Simon (2013), Wiley

Reference Books:

1. Floreano D. and Mattiussi C., Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, MIT Press, Cambridge, MA, 2008.

2. Albert Y.Zomaya, Handbook of Nature-Inspired and Innovative Computing, Springer, 2006.

3. Marco Dorrigo, Thomas Stutzle, Ant Colony Optimization, PHI, 2005.

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	2	1	2	1	2	1	2	1	2	3	2	2
CO2	3	3	3	3	3	2	1	2	1	3	2	3	3	2	2
CO3	2	3	3	3	2	2	1	3	2	3	2	2	3	2	2
CO4	3	2	3	2	3	3	1	2	2	3	2	3	3	2	3
CO5	3	3	3	3	3	3	2	2	3	3	2	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS353	Number of Hours/Week	3		
Semester	V (PSE III)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	FUZZY SETS, LOGICS AND 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:

- To understand the fundamental concepts of fuzzy sets and fuzzy logic.
- To learn fuzzy inference systems and rule-based decision-making.
- To explore fuzzification, defuzzification, and ANFIS architecture.
- To apply fuzzy systems in machine learning and real-world applications.

UNIT	TOPICS	HOURS
I	**Introduction and Fuzzy Set Theory**: Introduction to Fuzzy Logic and Soft Computing - Classical vs. Fuzzy Sets - Membership Functions: Types and Properties - Set Theoretic Operations on Fuzzy Sets.	9
II	**Fuzzy Arithmetic and Fuzzy Relations:** Fuzzy Numbers and Arithmetic - Fuzzy Relations and Their Properties - Fuzzy Composition and Compatibility - Fuzzy Graphs and Clustering.	8
III	**Fuzzy Inference System:** Fuzzy If-Then Rules - Rule-Based Systems Linguistic Variables & Hedges - Fuzzy Rule-Based Models **Rule-Based Models**: Mamdani and Sugeno FIS - Wang and Mendel Model - Takagi-Sugeno-Kang (TSK) Model - Difference Between Mamdani and TSK Models.	9
IV	**Fuzzifiers, and Defuzzifiers:** Membership Function Design for Fuzzy Systems - Fuzzification & Defuzzification Techniques - Real-Time Defuzzification Applications. **ANFIS**: Introduction to Adaptive Neuro-Fuzzy Inference System (ANFIS) - ANFIS Architecture - Implementation and Examples.	10
V	**Fuzzy Systems in Machine Learning:** Fuzzy Systems in Pattern Recognition and Clustering - Neuro-Fuzzy Systems - Evolutionary Fuzzy Systems.	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	Define fuzzy sets, illustrate membership functions, and perform set operations.
CO2	Explain fuzzy arithmetic, classify fuzzy relations, and apply clustering techniques.
CO3	Compare fuzzy inference systems, analyze Mamdani, Sugeno, Wang-Mendel, and TSK models, and assess their effectiveness.
CO4	Evaluate fuzzification and defuzzification techniques, implement ANFIS architecture, and interpret results.
CO5	Identify fuzzy system applications, assess their role in machine learning, and differentiate between traditional and fuzzy-based approaches.

Text book:

1. Fuzzy logic with engineering applications, Ross, T. J., John Wiley and Sons, 2005.
2. Neuro-Fuzzy and Soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall, 1997.

References:

1. Uncertain Rule-Based Fuzzy Systems: Introduction and New Directions, Mendel, J. M., Springer, 2nd Edition, 2017.
2. Fuzzy Sets and Fuzzy Logic: Theory and Applications, Klir, G. J., & Yuan, B., Prentice Hall, 1995.

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	2	2	3	1	1	1	1	2	2	3	3	2	3
CO2	3	3	2	2	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO5	3	3	2	3	3	2	1	1	1	3	3	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS354	Number of Hours/Week	3		
Semester	V (PSE IV)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	QUANTUM MACHINE 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 introduce fundamental concepts of quantum computing and qubit operations.
- To differentiate classical machine learning from quantum machine learning approaches.
- To explore quantum circuit models, feature encoding, and variational algorithms.
- To implement supervised and unsupervised learning techniques in quantum environments using tools like Qiskit.
- To apply Quantum Neural Networks (QNNs), QGANs, and hybrid models to real-world datasets using quantum platforms.

UNIT	TOPICS	HOURS
I	**FUNDAMENTALS OF QUANTUM COMPUTING**: Introduction to Quantum Computing- Introduction to Superposition - Classical vs Quantum Superposition – Qubit - Mathematical Representation of Qubits - Bloch Sphere - Quantum Gates – Entanglement - Multi-Qubit States - CNOT Gate.	9
II	**CLASSICAL VS. QUANTUM MACHINE LEARNING:** Classical vs. Quantum ML - Examples of Typical ML Problems - The Three Ingredients of a Learning Problem - Risk Minimization in Supervised Learning - Training in Unsupervised Learning - Methods in Machine Learning - Linear Models - Neural Networks - Graphical and Kernel Methods	9
III	**QUANTUM ML: CIRCUITS AND ALGORITHMS:** Introduction to Quantum Machine Learning - Four Approaches to QML - Parameterized Quantum Circuits (PQC) - Quantum Information Encoding - Training Parameterized Quantum Circuits - Supervised Learning in QML - Quantum Variational Classification - Quantum Kernel Estimation - Quantum Feature Maps and Kernels - Quantum Support Vector Classification (QSVM)	9
IV	**UNSUPERVISED QML & PRACTICAL QISKIT:** Unsupervised Learning in QML - Principal Component Analysis (PCA) - Clustering Methods - Classifiers in QML - QML Programming Concepts in Qiskit - Problem-Solving Session using Qiskit - Analysis of Exercises from IBM Qiskit Summer School Challenges (2022 & 2023)	9
V	**QUANTUM NEURAL NETWORKS & GANs:** Introduction to Quantum Neural Networks (QNN) - Quantum Convolutional Neural Networks (QCNN) - Hybrid QNN - Problem Solving on a Real Dataset - Classical GANs - Quantum GANs (QGAN) - QGAN in Qiskit - Problem Solving with Pennylane and AWS Braket - Use Cases in Quantum Machine Learning	9

COURSE OUTCOMES:

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

CO1	Explain quantum computing principles including qubits, gates, and superposition.
CO2	Compare classical and quantum machine learning models and workflows.
CO3	Design quantum circuits for ML using PQC, feature maps, and QSVMs.
CO4	Implement supervised and unsupervised quantum learning models using Qiskit.
CO5	Apply QNNs, QGANs, and hybrid models to real-world problems using tools like Qiskit and Pennylane.

Text Books:

1. **Maria Schuld and Francesco Petruccione**, *Machine Learning with Quantum Computers*, Second Edition, Springer, 2021.
2. **M.A. Nielsen and I.L. Chuang**, *Quantum Computation and Quantum Information*, 10th Anniversary Edition, Cambridge University Press, 2010.

Reference Books:

1. Ciaran Hughes, Joshua Isaacson, Anastasia Perry, Ranbel F. Sun, Jessica Turner, *Quantum Computing for the Quantum Curious*, Springer, 2021.
2. Peter Wittek, *Quantum Machine Learning – What Quantum Computing Means to Data Mining*, Elsevier.
3. P. Kaye, R. Laflamme, and M. Mosca, *An Introduction to Quantum Computing*, Oxford University Press.
4. N. David Mermin, *Quantum Computer Science*, Cambridge University Press, 2007.
5. Qiskit Textbook – *Learn Quantum Computation using Qiskit*, IBM. https://qiskit.org/textbook
6. Qiskit Machine Learning Library Documentation**:** https://qiskit.org/documentation/machine-learning/

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	2	1	2	2	2	1	1	1	1	2	1	1	2	1
CO2	3	2	2	2	3	1	1	1	2	2	3	2	1	2	1
CO3	3	3	3	3	2	2	2	2	3	2	3	2	2	3	2
CO4	3	3	3	3	3	2	2	2	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS355	Number of Hours/Week	3		
Semester	V (PSE IV)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	COGNITIVE 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:

- To understand cognitive computing fundamentals and modeling techniques.
- To explore decision-making and learning models in cognitive systems.
- To analyze machine learning and NLP in cognitive computing.
- To study cognitive analytics and AI applications.
- To examine cognitive computing platforms and ethical considerations.

UNIT	TOPICS	HOURS
I	**Fundamentals of Cognitive Computing:** Basics of Cognitive Computing – Cognitive Psychology – Architecture of the Mind – Cognitive Architectures – Nature of Cognitive Psychology – Cognitive Processes – Cognitive Modeling Paradigms – Declarative / Logic-Based Computational Cognitive Modeling – Connectionist Models – Bayesian Models.	9
II	**Decision Support & Learning Models:** Intelligent Decision Making – Fuzzy Cognitive Maps – Learning Algorithms: Nonlinear Hebbian Learning (NHL), Data-Driven NHL – Hybrid Learning – Fuzzy Grey Cognitive Maps – Dynamic Random Fuzzy Cognitive Maps.	9
III	**Machine Learning & NLP in Cognitive Systems:** Machine Learning Techniques for Cognitive Decision-Making – Hypothesis Generation and Scoring – Natural Language Processing (NLP) – Representing Knowledge – Taxonomies and Ontologies – N-Gram Models – Applications.	9
IV	**Cognitive Analytics & AI Applications:** Predictive Analytics – Text Analytics – Image Analytics – Speech Analytics – AI in Cognitive Systems – Cognitive Assistant for Visually Impaired – AI for Cancer Detection.	8
V	**Cognitive Computing Platforms & Case Studies:** IBM Watson – Introduction to IBM's Power AI Platform – Google's TensorFlow Development Environment – Real-World Cognitive Computing Case Studies in Healthcare, Business, and Automation - Ethical Considerations in Cognitive AI.	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	Describe cognitive computing fundamentals, identify key aspects of cognitive psychology, and explain basic modeling techniques.
CO2	Compare decision-making models, differentiate learning algorithms, and examine their role in cognitive systems.
CO3	Apply machine learning models, use NLP techniques, and illustrate their role in decision-making.
CO4	Evaluate cognitive analytics methods, analyze AI applications, and discuss their industry impact.
CO5	Compare cognitive computing platforms, explore real-world use cases, and discuss ethical considerations.

Text book:

1. Cognitive Computing and Big Data Analytics, Judith S. Hurwitz, Marcia Kaufman, and Adrian Bowles, Wiley, 2015.

References:

1. Quantum Models of Cognition and Decision, erome R. Busemeyer and Peter D. Bruza, Cambridge University Press, 2nd Edition, 2024.
2. Cognitive Science: An Introduction, Neil A. Stillings, Steven E. Weisler, Christopher H. Chase, Mark H. Feinstein, Jay L. Garfield, and Edwina L. Rissland, MITPress, 2nd Edition, 1995.

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	2	2	3	1	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	2	1	2	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	2	3	3	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS356	Number of Hours/Week	3		
Semester	V (PSE IV)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	NATURAL LANGUAGE 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:

- Understand the Fundamentals of Lexical Analysis
- Explore Speech Processing Techniques
- Learn Parsing Techniques and Algorithms
- Develop Knowledge of Lexical Networks and Word Sense Disambiguation
- Apply Natural Language Processing in Real-world Applications

UNIT	TOPICS	HOURS
I	**Lexical Analysis** Lexical Analysis - Regular expression and Automata for string matching - Words and Word Forms - Morphology fundamentals - Morphological Diversity of Indian Languages - Morphology Paradigms - Finite State Machine / Transducers Based Morphology - Automatic Morphology Learning - Parts of Speech - N-gram Models - Hidden Markov Models.	9
II	**Speech Processing** Biology of Speech Processing - Place and Manner of Articulation - Word Boundary Detection - Argmax based computations - HMM and Speech Recognition - Text to Speech Synthesis - Rule Based-Concatenative based approach.	9
III	**Parsing** Theories of Parsing - Parsing Algorithms – Earley Parser - CYK Parser - Probabilistic Parsing - CYK - Resolving attachment and structural ambiguity - Shallow Parsing - Dependency Parsing - Named Entity Recognition - Maximum Entropy Models - Conditional Random Fields.	9
IV	**Lexical Knowledge Networks** Meaning: Lexical Knowledge Networks - Wordnet Theory - Indian Language Wordnets and Multilingual Dictionaries - Semantic Roles - Word Sense Disambiguation - WSD and Multilingualism - Metaphors - Coreference and Anaphora Resolution.	9
V	**Applications** Applications: Sentiment Analysis - Text Entailment - Machine Translation - Question Answering System - Information Retrieval - Information Extraction - Cross Lingual Information Retrieval (CLIR).	9

COURSE OUTCOMES:

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

CO1 :	Ability to Analyze Lexical Structures
CO2 :	Competence in Speech Processing Techniques
CO3 :	Proficiency in Parsing Algorithms
CO4 :	Understanding and Application of Lexical Knowledge Networks
CO5 :	Application of NLP Techniques in Various Domains

Text Book

1. Jurafsky Daniel, Martin James, Speech and Language Processing, Second Edition, Tenth Impression, Pearson Education, 2018.
2. Christopher Manning, Schutze Heinrich, Foundations of Statistical Natural Language Processing, MIT Press, 1999. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley publishers, Nineth edition, 2013.

Reference Books

1. Allen James, Natural Language Understanding, Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, Statistical Language Learning, MIT Press, 1993.
3. Foundations of Statistical Natural Language Processing, The MIT Press Cambridge, Massachusetts London, England,1999.

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	1	0	0	0	0	1	0	0	0	1	0	1	0	1
CO2	2	2	0	0	0	0	0	0	0	0	0	0	2	1	3
CO3	1	2	1	0	0	0	1	0	0	0	2	3	1	2	1
CO4	2	2	2	0	1	0	0	0	0	0	0	0	1	1	0
CO5	3	3	1	0	0	0	0	2	0	0	0	1	2	2	0

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS251	Number of Hours/Week	2		
Semester	V	Max. Marks	100		
Year	III	Credits	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

Unit I: Mathematical Building Blocks and Neural Networks

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.

Unit II: Foundations of Deep Neural Networks

5. **Implement a feedforward neural network (FNN).**
   - Use TensorFlow/Keras to create a simple FNN for MNIST digit classification.
6. **Backpropagation and gradient descent implementation.**
   - Write a Python program to implement backpropagation 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.

Unit III: Convolutional Neural Networks (CNNs)

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.

Unit IV: Recurrent Neural Networks (RNNs)

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.
15. **Perform sentiment analysis.**
    - Train a GRU-based model on a dataset like IMDB reviews.
16. **Time-series forecasting using LSTM.**
    - Use a dataset like stock prices or weather data for time-series prediction.

Unit V: Generative Models (GANs, VAEs, and Multi-modal Learning)

17. **Build a simple Generative Adversarial Network (GAN).**
    - Generate synthetic data (e.g., handwritten digits) using GAN.
18. **Implement a Variational Autoencoder (VAE).**
    - Train a VAE on the MNIST dataset and visualize the latent space.
19. **Perform image-to-image translation.**
    - Use a GAN model like CycleGAN to convert images from one domain to another (e.g., photos to sketches).
20. **Combine vision and text using multi-modal deep learning.**
    - Build a model that classifies images based on accompanying captions (e.g., using MS-COCO dataset).

Additional Exercises

- Explore optimization algorithms (SGD, Adam, RMSprop) and compare their performance on the same dataset.
- Evaluate models for overfitting and implement dropout regularization.

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS252	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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&DS)	Programme Code	BTDS		
Course Code	25BTDS851	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.	9
II	**Planning**: Concept, Objectives, Nature, Limitation, Process of planning, Importance, Forms, Techniques and Process of decision making.	9
III	**Organizing:** Concept, Objectives, Nature of organizing, Types of Organization, delegation of authority, Authority and responsibilities, Centralization and Decentralization, Span of control.	9
IV	**Directing:** Concept, Principles & Techniques of directing and Coordination Concept of leadership-Style. Importance, Styles, Supervision, Motivation, Importance Theory of Motivation, Communication.	9
V	**Controlling:** Concept, Principles, Process and Techniques of Controlling, Relationship between planning and controlling.	9

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 organizations.
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

Semester VI

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS161	Number of Hours/Week	3		
Semester	VI	Max. Marks	100		
Year	III	Credits	3		
Core Course					
Course Title	PREDICTIVE ANALYSIS		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 predictive analytics and differentiate it from other forms of data analytics, including descriptive and prescriptive analytics.
- To equip students with essential statistical and mathematical tools required to understand, build, and evaluate predictive models.
- To provide a strong foundation in supervised machine learning techniques used for prediction tasks, including regression, classification, and ensemble methods.
- To develop competency in time-series forecasting methods, enabling students to build models that can predict future values based on historical data.
- To offer practical exposure through real-world case studies and applications, helping students to apply predictive modeling techniques in diverse domains such as finance, healthcare, and marketing.
- To familiarize students with ethical considerations, model interpretability, and deployment strategies involved in the real-world use of predictive analytics systems.

UNIT	TOPICS	HOURS
I	**Introduction to Predictive Analytics:** Introduction to Analytics: Descriptive, Predictive, and Prescriptive Analytics- Predictive Modeling Process: Problem formulation, Data understanding, Data preparation- Types of Predictive Models: Classification, Regression, Time-series- Model evaluation: Overfitting, Underfitting, Bias-Variance tradeoff- Tools and platforms for predictive analytics (e.g., R, Python, SAS, RapidMiner)	8
II	**Statistical Foundations for Prediction:** Probability theory and distributions- Descriptive and inferential statistics- Hypothesis testing and confidence intervals- Correlation and causation- Feature selection techniques: Chi-square test, ANOVA, Mutual Information.	9
III	**Machine Learning for Predictive Modeling:** Supervised learning: Linear Regression, Logistic Regression, k-NN- Decision Trees and Ensemble Methods: Random Forests, Gradient Boosting- Support Vector Machines (SVM)- Model evaluation metrics: Accuracy, Precision, Recall, F1-score, ROC-AUC- Cross-validation and Hyper-parameter tuning.	10
IV	**Time Series Forecasting:** Time Series Components: Trend, Seasonality, Noise-Forecasting methods: Moving Average, Exponential Smoothing, ARIMA- Stationarity and Differencing-ACF and PACF plots-Introduction to advanced models: Prophet, LSTM (optional for advanced students)	8

V	**Applications and Case Studies:** Predictive analytics in real-world domains: Finance, Healthcare, Marketing, Supply Chain- Case study: Customer churn prediction / Credit scoring / Stock price forecasting-Ethics and Privacy in Predictive Modeling-Model deployment: Introduction to APIs and MLOps concepts- Project Work and Presentations.	**10**

COURSE OUTCOMES:

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

CO1	Understand the role of predictive analytics in the broader data science ecosystem.
CO2	Apply fundamental statistical techniques for data analysis and hypothesis testing.
CO3	Build regression and classification models for structured data prediction.
CO4	Understand the components of time-series data: trend, seasonality, and noise.
CO5	Analyze predictive models through real-world applications (e.g., churn, risk scoring).

Text Books:

1. Max Kuhn, Kjell Johnson, Applied Predictive Modeling, Publisher: Springer, 1st Edition, 2013, ISBN: 978-1461468486.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 2nd Edition, 2021, ISBN: 978-1071614174.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2nd Edition, 2019., ISBN: 978-1492032649.

Reference Books:

1. Francesca Lazzeri, Machine Learning for Time Series Forecasting with Python, Wiley, 1st Edition, July 2020, **ISBN:** 978-1119682363.
2. Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media, Updated Paperback Edition, 2020 (Reprint with updates), **ISBN:** 978-1098104023.

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	1	2	2	1	2	1	2	1	3	2	3	2
CO2	3	3	2	3	2	1	1	1	1	2	1	2	3	3	2
CO3	3	3	3	2	3	1	1	1	1	2	2	2	3	3	2
CO4	3	2	2	2	3	1	1	1	1	2	1	2	3	3	2
CO5	2	3	3	2	3	2	2	2	2	3	2	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS162	Number of Hours/Week	3		
Semester	VI	Max. Marks	100		
Year	III	Credits	3		
Core Course					
Course Title	COMPILER 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:

- To learn the various phases of compiler parsing techniques.
- To understand intermediate code generation and run-time environment.
- To learn to implement the front-end of the compiler.
- To learn to implement code generator.
- To learn to implement code optimization.

UNIT	TOPICS	HOURS
I	**Introduction To Compilers & Lexical Analysis** Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA – Language for Specifying Lexical Analyzers – Lex tool.	9
II	**Syntax Analysis:** Role of Parser – Grammars – Context-free grammars – Writing a grammar Top Down Parsing General Strategies – Recursive Descent Parser Predictive Parser-LL(1) – Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table – Introduction to LALR Parser Error Handling and Recovery in Syntax Analyzer-YACC tool – Design of a syntax Analyzer for a Sample Language	9
III	**Syntax Directed Translation & Intermediate Code Generation:** Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator – Type Systems-Specification of a simple type Checker Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching.	9
IV	**Run-Time Environment And Code Generation:** Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack, and Heap allocation – Parameter Passing-Symbol Tables – Dynamic Storage Allocation – Issues in the Design of a code generator – Basic Blocks and Flow graphs Design of a simple Code Generator – Optimal Code Generation for Expressions– Dynamic Programming Code Generation.	9

V	**Code Optimization:** Classification of optimization, Principle sources of optimization, Optimization of basic blocks, Peephole Optimization, Loops in flow graphs, Local optimization, Global optimization, Data flow analysis of flow graph.	**9**

COURSE OUTCOMES:

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

CO1	Learn Compiler phases, passes, and language translation mechanisms.
CO2	Understand the concept of token generation, parsing techniques, symbol table and intermediate code generation.
CO3	Apply syntax-directed translation to generate intermediate code representations, such as syntax trees and three-address code, and perform type checking.
CO4	Understand various types of errors and error handling techniques
CO5	Apply the code optimization algorithms.

Text Book:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Second Edition, Pearson Education, 2009.

Reference Books:

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, Compiler Design in C‖, Prentice-Hall Software Series, 1993.

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	1	2	2	1	1	3	2	2	1	3	2	1
CO2	2	3	2	1	3	2	3	1	2	3	1	2	2	3	2
CO3	3	2	3	2	2	3	1	1	2	2	3	2	3	2	2
CO4	2	3	2	3	2	1	2	2	3	3	2	3	2	1	3
CO5	1	1	2	3	1	2	3	3	1	1	3	2	1	2	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS163	Number of Hours/Week	3		
Semester	VI	Max. Marks	100		
Year	III	Credits	3		
Core Course					
Course Title	CRYPTOGRAPHY AND 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:

- To gain insights into security principles, legal aspects, and threat mitigation strategies.
- To explore encryption techniques and their role in ensuring data confidentiality.
- To understand cryptographic algorithms and key management in secure communication.
- To analyze authentication protocols and digital security measures for integrity.
- To study real-world cybersecurity practices, including intrusion detection and firewall defense.

UNIT	TOPICS	HOURS
I	**INTRODUCTION** Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography) - Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.	9
II	**SYMMETRIC CRYPTOGRAPHY** Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic- Euclids algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution	9
III	**PUBLIC KEY CRYPTOGRAPHY** Mathematics Of Asymmetric Key Cryptography: Primes – Primarily Testing –Factorization – Euler ‘s totient function, Fermat ‘s and Euler ‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.	9
IV	**MESSAGE AUTHENTICATION AND INTEGRITY** Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509	9

V	**SECURITY PRACTICE AND SYSTEM SECURITY** Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls	**9**

COURSE OUTCOMES:

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

CO1	Understand fundamental security concepts, threats, and classical encryption techniques
CO2	Apply symmetric and asymmetric cryptographic algorithms for secure communication
CO3	Implement authentication mechanisms, digital signatures, and hash functions for data integrity
CO4	Analyze network and system security threats, including malware, intrusion detection, and firewalls.
CO5	Explore security applications in email, web, and IP communication, ensuring end-to-end protection.

Text Book

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

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	2	2	1	2	2	1	3	3	2	2
CO2	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2
CO3	3	2	3	3	3	2	2	2	3	2	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3
CO5	2	2	2	3	3	3	2	2	2	3	2	3	3	2	2

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS261	Number of Hours/Week	2		
Semester	VI	Max. Marks	100		
Year	III	Credits	1		
Core Course					
Course Title	PREDICTIVE ANALYSIS 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 develop practical knowledge of predictive modeling techniques.
- To implement machine learning algorithms for real-world predictive tasks.
- To gain hands-on experience in data preprocessing, feature engineering, and model evaluation.
- To work with real-world datasets using modern tools and programming environments.

LIST OF EXPERIMENTS

Introduction & EDA

1. Loading datasets and performing basic EDA (using Pandas/Seaborn/Matplotlib).
2. Data preprocessing: handling missing data, encoding, normalization, etc.

Regression Techniques

3. Simple Linear Regression & Multiple Linear Regression.
4. Ridge, Lasso, and ElasticNet regression.
5. Model evaluation: RMSE, MAE, R^2, cross-validation.

Classification Techniques

6. Logistic Regression and performance metrics (Confusion Matrix, Precision, Recall, F1-score, ROC).
7. Decision Trees and Random Forest Classifier.
8. Support Vector Machines (SVM) and k-Nearest Neighbors (k-NN).

Ensemble and Advanced Methods

9. Bagging and Boosting (AdaBoost, Gradient Boosting, XGBoost).
10. Hyperparameter tuning with GridSearch CV / Randomized Search CV.

Time Series and Forecasting

11. Time series decomposition, ARIMA modeling using statsmodels.
12. Prophet or LSTM-based forecasting (optional for advanced students).

Capstone / Mini Project

13. End-to-end predictive modeling project using real-world datasets (e.g., from Kaggle, UCI, or Govt. datasets).

- Data cleaning, visualization, model selection, training, testing, and reporting.

COURSE OUTCOMES:

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

CO1	Build and evaluate predictive models using supervised learning algorithms.
CO2	Perform exploratory data analysis (EDA) and feature selection.
CO3	Understand and implement ensemble learning techniques.
CO4	Apply time series forecasting methods.
CO5	Use Python/R libraries like Scikit-learn, Pandas, NumPy, Statsmodels, etc.

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	2	3	1
CO2	3	3	3	2	3	1	1	1	1	2	2	3	3	3	2
CO3	2	3	2	3	3	1	2	1	2	2	2	3	3	2	2
CO4	3	2	3	3	3	1	2	1	2	2	2	3	3	3	2
CO5	2	2	3	3	3	2	2	2	2	2	3	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS262	Number of Hours/Week	2		
Semester	VI	Max. Marks	100		
Year	III	Credits	1		
Core Course					
Course Title	COMPILER DESIGN 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:

- Master lexical analysis tools – build both manual and Lex-based scanners to identify tokens accurately.
- Design and implement parsers – convert grammars to YACC specifications, construct ASTs, and resolve syntax errors.
- Apply semantic analysis – implement symbol tables, type checking, and control/data-flow analyses for semantic correctness.
- Simulate run-time behavior – experiment with storage-allocation strategies and DAG construction to support code generation.
- Introduce code optimisation techniques – perform basic-block, peephole, and global optimisations to improve compiled output efficiency.

LIST OF EXPERIMENTS

1. Implementation of Symbol Table

2. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)

3. Implementation of Lexical Analyzer using Lex Tool

4. Generate YACC specification for a few syntactic categories.

a) Program to recognize a valid arithmetic expression that uses operator +, - , * and /.

b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.

c)Implementation of Calculator using LEX and YACC

5. Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.

6. Implement type checking

7. Implement control flow analysis and Data flow Analysis

8. Implement any one storage allocation strategies (Heap, Stack)

9. Construction of DAG

10. Implementation of Simple Code Optimization Techniques.

COURSE OUTCOMES:

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

CO1	Implement Lexical Analysis: Construct accurate tokenizers for a subset of C both manually and with Lex.
CO2	Develop Syntax Analyzers: Write YACC grammars, resolve conflicts, and generate Abstract Syntax Trees for arithmetic expressions, variables, and calculators.
CO3	Perform Semantic Checks: Build symbol tables, enforce type-checking rules, and validate programs for semantic correctness.
CO4	Analyze Program Flow & Storage: Generate control- and data-flow graphs, construct DAGs, and experiment with stack vs. heap allocation to model run-time behavior.
CO5	Optimize Intermediate Code: Apply basic-block, peephole, and global data-flow optimizations to improve execution efficiency of compiled code.

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	3	3	1	1	1	1	2	2	3	3	2	3
CO2	3	3	2	3	3	1	1	1	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	3	3	3	3	3
CO5	3	3	2	3	3	2	1	1	1	3	3	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS361	Number of Hours/Week	3		
Semester	VI (PSE V)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	APPLIED ARTIFICIAL INTELLEGENCE		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 advanced concepts in artificial intelligence
- To formulate artificial intelligence model with knowledge representarion
- To learn problem solving approaches through decision processes
- To develop an AI model with the help of concepts such as searches, knowledge representation etc.

UNIT	TOPICS	HOURS
I	**Introduction to AI and searches** Introducing the structure and scope of the course; Brief introduction and history of AI; state space seaches; informed and uninformed searches; local searches; adversarial searches;	9
II	**Logic in AI** Different knowledge representation systems; syntax; semantics; forward chaining; Resolution; Reduction in satisfiability problems; SAT solvers; DPLL algorithms; Walk SAT algorithms	9
III	**Uncertainty in AI** Basics of probability; conditional independence and bayes rule; Bayesian networks – syntax, factorization, conditional independence and d-separation; inference using variable elimination; reducing 3-SAT to Bayes net; rejection sampling; likelihood weighing; MCMC with Gibbs sampling; maximum likelihood learning;	9
IV	**Decision Theory** Steps in decision theory; non-deterministic uncertainty; probabilistic uncertainty and value of perfect information; expected utility and expected value; Markov decision process – policy evaluation using system of linear equations, iterative policy evaluation, value iteration, policy iteration and applications, extensions of MDPs	9
V	**Reinforcement Learning** Background; Model based learning for policy evaluation; model free learning for policy evaluation; TD learning and computational neuroscience; Q Learning; Exploration vs Exploitation tradeoff; generalization in RL	9

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

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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS362	Number of Hours/Week	3		
Semester	VI (PSE V)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	NEUROMORPHIC 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 to:

- Understand the fundamental principles of neuromorphic computing and its biological inspirations. (Remembering, Understanding)
- Analyze different neuromorphic architectures, including spiking neural networks (SNNs) and hardware implementations. (Analyzing)
- Design and implement simple neuromorphic models using computational frameworks. (Applying, Creating)
- Evaluate the performance of neuromorphic systems in comparison to traditional computing paradigms. (Evaluating)
- Apply neuromorphic computing techniques to solve real-world problems in robotics, artificial intelligence, and edge computing. (Applying, Creating)

UNIT	TOPICS	HOURS
I	**Introduction to Neuromorphic Computing** Basics of Neuromorphic Computing, Differences between Neuromorphic, Conventional, and AI-based Computing, Biological Inspiration: The Human Brain and Neurons, Historical Development of Neuromorphic Engineering, Key Applications of Neuromorphic Computing.	9
II	**Neuromorphic Hardware and Architectures** Neuromorphic Processors: IBM TrueNorth, Intel Loihi, SpiNNaker, Analog vs Digital vs Mixed-Signal Neuromorphic Systems, Memristors and their Role in Neuromorphic Computing, Event-Driven Computing and Spiking Neural Networks (SNNs), Power Efficiency and Parallel Processing in Neuromorphic Chips.	9
III	**Spiking Neural Networks (SNNs) and Learning Models** Introduction to Spiking Neural Networks (SNNs), Biological vs Artificial Neurons, Leaky Integrate-and-Fire (LIF) Model and Hodgkin-Huxley Model, Spike Timing-Dependent Plasticity (STDP) and Hebbian Learning, Training and Simulation Tools for SNNs (NEST, BindsNET, Brian2).	9
IV	**Algorithms and Applications** Neuromorphic Vision and Auditory Processing, Brain-Inspired AI: Edge Computing and IoT Integration, Pattern Recognition and Sensor Fusion, Autonomous Robotics and Neuromorphic Control, Neuromorphic Computing in Medical Applications.	9

V	**Future Trends and Challenges in Neuromorphic Computing** Limitations and Current Challenges in Neuromorphic Hardware, Quantum Computing vs Neuromorphic Computing, Hybrid AI: Combining Neuromorphic Computing with Deep Learning, Ethical and Societal Implications, Future Research Directions in Neuromorphic Computing.	**9**

COURSE OUTCOMES:

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

CO1	Explain the biological foundations of neuromorphic computing and its role in AI development. (Remembering, Understanding)
CO2	Differentiate between conventional computing and neuromorphic paradigms in terms of architecture and efficiency. (Understanding, Analyzing)
CO3	Implement spiking neural networks (SNNs) using tools like NEST, Brian2, or SpiNNaker. (Applying)
CO4	Critically evaluate neuromorphic computing applications and assess their feasibility for various domains. (Evaluating)
CO5	Develop prototype neuromorphic solutions for tasks such as pattern recognition, real-time decision-making, and IoT applications. (Creating)

Text Books:

1. Mohamed, Khaled Salah. Neuromorphic Computing and Beyond. 2020.

Reference Books:

1. Anderson, James A., et al., eds. Neurocomputing. Vol. 2. MIT press, 1993.

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	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0
CO2	1	2	0	2	0	0	0	0	0	0	2	0	0	0	3
CO3	0	0	0	0	0	1	1	1	0	0	0	3	2	0	1
CO4	0	0	0	0	0	1	0	2	0	0	0	3	1	0	0
CO5	1	1	1	0	0	0	0	0	0	2	2	0	0	3	1

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS363	Number of Hours/Week	3		
Semester	VI (PSE V)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	COMPUTER VISION		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 fundamental concepts of computer vision, including image formation, feature extraction, and camera models.
- To develop an understanding of image processing techniques such as edge detection, image segmentation, and feature extraction.
- To study various algorithms for object detection, recognition, and tracking.
- To explore advanced topics in computer vision, including 3D vision, motion analysis, and image stitching.
- To apply computer vision methods to real-world applications, including robotics, augmented reality, and autonomous vehicles.

UNIT	TOPICS	HOURS
I	**Introduction to Computer Vision** Overview of Computer Vision-History, scope, and applications of computer vision-Computer vision vs. image processing-Basic concepts: image formation, camera models, and projection-Image Representation and Properties-Color models -Image transformations.	9
II	**Image Processing for Computer Vision** Image Preprocessing-Image enhancement -Image smoothing and filtering-Edge-Detection and Feature Extraction-Sobel, Canny, and Laplacian edge detection-Corner detection (Harris, FAST, SIFT, SURF)-Image Segmentation-Thresholding-Region-based segmentation -region growing, watershed-Clustering-based segmentation.	9
III	**Geometric Transformations and Camera Models** Geometric Transformations-Affine and projective transformations-Homography and its applications in image stitching.Camera Models and Calibration-Pinhole camera model-Camera calibration techniques-intrinsic and extrinsic parameters-Depth estimation using stereo vision	9
IV	**Object Detection and Recognition** Object Detection-Sliding window, Haar cascades, Histogram of Oriented Gradients features-Modern approaches -YOLO, SSD, Faster R-CNN-Object Recognition-Template matching, feature matching-Machine learning for object recognition -Deep learning-based recognition (CNNs)-Face Recognition-Eigenfaces, Fisherfaces-Deep learning approaches	9

V	**Motion Analysis and Tracking** Optical Flow-Horn-Schunck and Lucas-Kanade methods for optical flow estimation-Motion segmentation-Object Tracking-Tracking algorithms -Kalman filter, Mean-shift, and CAMShift-Multi-object tracking-Visual odometry and motion capture	**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 the core principles and techniques used in computer vision.
CO2:	Apply image processing algorithms for feature extraction, edge detection, and image segmentation.
CO3:	Implement object detection and recognition algorithms.
CO4:	Analyze motion in images and videos using optical flow and tracking techniques.
CO5:	Develop computer vision solutions for practical applications in robotics, augmented reality, and autonomous systems.

Text Books:

1. **Computer Vision: Algorithms and Applications** by Richard Szeliski Publisher: Springer. ISBN: 978-1848829343
2. **Computer Vision: A Modern Approach** by David A. Forsyth and Jean Ponce, Publisher: Pearson, ISBN: 978-0136085928
3. **Multiple View Geometry in Computer Vision** by Richard Hartley and Andrew Zisserman, Cambridge University Press, ISBN: 978-0521540513
4. **Deep Learning for Computer Vision** by Rajalingappaa Shanmugamani,Publisher: Apress,ISBN: 978-1484229577

Reference Books:

1. **Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library** by Adrian Kaehler and Gary Bradski, Publisher: O'Reilly Media, ISBN: 978-1491937996
2. **Programming Computer Vision with Python: Tools and algorithms for analyzing images** by Jan Erik Solem, Publisher: O'Reilly Media,ISBN: 978-1449316434

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	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&DS)	Programme Code	BTDS		
Course Code	25BTDS364	Number of Hours/Week	3		
Semester	VI (PSE VI)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	APPLIED MACHINE 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 explore classical and advanced concepts in machine learning
- To equip different optimization strategies in machine learning
- To construct an existing problem into standard machine learning paradigm
- To dealt with generative models for machine learning applications.

UNIT	TOPICS	HOURS
I	**Introduction and optimization** Introduction and its history; basics of optimization problems; convex sets and convex functions; strictly and strongly convex functions; implications of strong convexity; primal and dual optimization problems; slaters condition; analysis of gradient descent algorithm; KKT conditions	9
II	**Classical Machine Learning** Bias-variance tradeoff; regression; Bayesian decision theory; Bayesian belief networks; parameter estimation and maximum likelihood estimation; parameter estimation and Bayesian estimation; concepts of non-parametric techniques; density estimation by parzen window; parzen window and KNN algorithm	9
III	**Dimensionality reduction and Classification** Dimensionality problem; principal component analysis; eigen decomposition and singular value decomposition; linear discriminant analysis; ensemble classifiers; guassian mixture models and EM algorithm;	9
IV	**Deep Learning** Neural networks; multilayer perceptron; backpropagation algorithm; autoencoder – deep autoencoder, sparse auto encoder, denoising autoencoder; large ML models and architectures; issues in training deep neural networks;	9
V	**Generative models** Background; autoregressive models; maximum likelihood learning; variational auto encoders; normalizing flows; Generative adversarial networks; energy based models; score based models; diffusion models for discrete data;	9

COURSE OUTCOMES:

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

CO1	Infers basic optimizations in machine learning
CO2	Distinguish different ML concepts in terms of applications
CO3	Implement generative models forML applications
CO4	Validate the ML models to improve the performance
CO5	Develop an innovative ML model for existing problems

Text Books:

1. Gauri Joshi, Optimization Algorithms for Distributed Machine Learning SpringerLink, 2022.
2. Andrew Ng., Machine Learning Yearning. deeplearning.ai, 2018.
3. Stefano Ermon, Deep Generative models CS236 Fall 2023

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.

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	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS365	Number of Hours/Week	3		
Semester	VI (PSE VI)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific Elective					
Course Title	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:

- To understand the fundamentals, applications, and challenges of IoT.
- To explore IoT system design, architecture, and embedded systems.
- To analyze IoT communication protocols and networking techniques.
- To study IoT data analytics, cloud integration, and machine learning applications.
- To examine real-world IoT applications, security challenges, and future trends.

UNIT	TOPICS	HOURS
I	**Introduction to to IoT:** Basics of IoT – IoT Characteristics – IoT Applications – Challenges in IoT – Smart Homes – Healthcare – Agriculture – Industrial IoT – Security and Privacy in IoT – Best Practices in IoT System Design.	9
II	**IoT Architecture & Design Methodology:** IoT System Design – IoT Architecture Layers – Embedded Systems for IoT – Sensors & Actuators – Interfacing Techniques – Power Management in IoT Devices.	9
III	**IoT Communication & Networking:** Wireless Communication Protocols – Bluetooth – Wi-Fi – Zigbee – LoRa – 5G – IoT Protocol Stack – MQTT – CoAP – Data Transmission in IoT – Designing Low-Power and Scalable IoT Networks – Edge and Fog Computing.	9
IV	**IoT Data Analytics & Cloud Integration:** Data Collection & Storage – Cloud Computing for IoT – AWS IoT – IBM Watson – Google Cloud IoT – IoT Data Processing – AI & Machine Learning in IoT – Data Encryption & Secure Storage Methods.	9
V	**IoT Applications & Case Studies:** IoT in Smart Cities – IoT in Healthcare – Predictive Maintenance – IoT-Based Automation – Security & Ethical Issues in IoT – Legal and Privacy Considerations – Future Trends in IoT.	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	Define IoT fundamentals, classify IoT characteristics, and analyze security aspects.
CO2	Develop IoT systems, integrate embedded components, and configure sensors and actuators.
CO3	Implement IoT communication protocols, analyze networking techniques, and demonstrate their applications.
CO4	Deploy IoT solutions on cloud platforms, process IoT data, and assess system performance.
CO5	Compare IoT applications, assess security risks, and justify ethical considerations.

Text book:

1. Internet of Things for Architects, Perry Lea, Packt Publishing, 2018.

References:

1. Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry", Maciej Kranz, Wiley, 2016.
2. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, 2013.

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	3	2	1	1	1	2	2	3	3	2	3
CO2	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO4	3	3	3	3	3	2	1	1	2	2	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	2	3	3	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS366	Number of Hours/Week	3		
Semester	VI (PSE VI)	Max. Marks	100		
Year	III	Credits	3		
Programme Specific 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:

- To understand the various types of data, apply and evaluate the principles of data visualization
- Acquire skills to apply visualization techniques to a problem and its associated dataset
- To apply structured approach to create effective visualizations
- To learn how to bring valuable insight from the massive dataset using visualization
- To create interactive visualization for better insight using various visualization tools

UNIT	TOPICS	HOURS
I	**Introduction to Data Visualization** Overview of data visualization, Data Abstraction, Task Abstraction, Analysis: Four Levels for Validation	9
II	**Visualization Techniques** Scalar and point techniques, vector visualization techniques, multidimensional techniques, visualizing cluster analysis, matrixvisualization in Bayesian data analysis	9
III	**Visual Analytics** Networks and Trees, Heat Map, Map Color and Other channels, Manipulate View, Visual Attributes	9
IV	**Visualization Tools and Techniques** Introduction to various data visualization tools, Visualization using R, Diverse Types of Visual Analysis, Time, Series data visualization, Text data visualization, Multivariate data visualization and case studies	9
V	**Integration of Data Visualization & Recent Trends** Integration of visualization tools with Hadoop, Dashboard creation using visualizaiton tools for the use cases: Finance, marketing-insurance-healthcare etc., Recent trends	9

COURSE OUTCOMES:

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

CO1	Explain the concept of augmented intelligence and its distinction from traditional AI, along with its applications and ethical challenges.
CO2	Demonstrate the use of machine learning, natural language processing, and computer vision in the development of augmented intelligence systems.
CO3	Design human-centric AI solutions that enhance human decision-making through effective human-machine collaboration.
CO4	Evaluate the performance of augmented intelligence systems, focusing on model optimization, data integration, and system architecture.
CO5	Develop forward-thinking augmented intelligence solutions, incorporating emerging technologies and ethical practices to address future challenges.

Text Books:

1. Wilke CO. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media; 2019 Mar 18.

Reference Books:

1. Chen M, Hauser H, Rheingans P, Scheuermann G, editors. Foundations of data visualization. Cham, Switzerland: Springer International Publishing; 2020 Aug 11.
2. Healy K. Data visualization: a practical introduction. Princeton University Press; 2024 Sep 10.

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	0	2	0	0	0	0	0	0	0	0	1	0
CO2	0	2	0	1	1	0	2	0	3	0	1	2	2	1	3
CO3	0	0	0	1	0	0	2	0	0	0	0	0	2	3	1
CO4	0	2	2	0	1	2	0	0	3	0	0	1	1	0	0
CO5	3	0	2	0	0	0	0	0	1	1	0	0	1	2	3

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

Semester VII

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS171	Number of Hours/Week	3		
Semester	VII	Max. Marks	100		
Year	IV	Credits	3		
Core Course					
Course Title	HIGH PERFORMANCE 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:

- To understand high-performance computing (HPC) system architectures and various computational models.
- To learn the fundamentals of CUDA programming and its applications in parallel computing.
- To apply parallel execution models and methodologies for developing parallel programming and applications.
- To design and implement compute-intensive applications on HPC platforms for optimized performance.
- To explore advanced techniques and tools for improving efficiency in high-performance computing environments.

UNIT	TOPICS	HOURS
I	**Parallel Programming & Computing - Introduction** Era of Computing - Parallel Computing - Multiprocessors and Multicomputer Architectures - Scalar vs Vector Processing - Multivector and Superscalar Machines - Pipelined Processors - SIMD Computers - Conditions of parallelism - Program flow mechanisms - Types of Parallelism – ILP, PLP, LLP - Program partitioning and scheduling.	9
II	**Introduction to High Performance Computing** Era of Computing - Scalable Parallel Computer Architectures - Towards low-cost computing - Network of Workstations project by Berkeley - Cluster Computing Architecture – Components - Cluster Middleware and SSI - Need of Resource Management and Scheduling - Programming Environments	9
III	**Cluster Computing** Introduction to Cluster Computing - Basics and importance of cluster computing - Clustering Models and Architectures - Key architectures and factors affecting cluster design - Types of Clusters - High-performance, high-availability, and load-balancing clusters - Fault Detection and Handling - Heartbeats, Check Pointing, and Watchdog Timers - Failover and Recovery - Concepts of failover and failback.	9
IV	**High Speed Networks & Message Passing** Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster	9

V	**CUDA Programming** Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of shared memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, Memory Management, CUDA C on multiple GPUs - OpenMP: Parallel Programming using OpenMP.	**9**

COURSE OUTCOMES:

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

CO1	Understand the foundational concepts of computer architecture and modern processors.
CO2	Grasp the fundamental principles of access optimization and parallel computers
CO3	Explain the various parallel processing platforms utilized in high-performance computing
CO4	Design efficient and high-performance parallel programming solutions
CO5	Learn and implement parallel programming using the message-passing paradigm.

Text Books:

1. Laurence T.Yang, Minyi Guo – High Performance Computing Paradigm and Infrastructure, John Wiley.
2. Ahmar Abbas, Grid Computing: Practical Guide to Technology & Applications, Firewall Media, 2004.
3. Joshy Joseph and Craig Fellenstein , Grid Computing, Pearson Education, 2004.
4. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.

Reference Books:

1. Lan Foster, et al., The Open Grid Services Architecture, Version 1.5 (GFD.80). Open Grid Forum, 2006.
2. Rajkumar Buyya, High Performance Cluster Computing: Architectures and Systems. Prentice Hall India, 1999.
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions

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	1	2	3	2	3	2	3	1	3	2	1	3	2	3
CO2	2	3	1	2	3	2	3	1	3	2	3	2	1	3	2
CO3	1	2	3	2	1	3	2	3	2	3	1	3	2	3	1
CO4	3	2	1	3	2	1	3	2	3	1	2	3	3	1	2
CO5	2	3	2	1	3	2	1	3	2	3	2	1	3	2	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS172	Number of Hours/Week	3		
Semester	VII	Max. Marks	100		
Year	IV	Credits	3		
Core Course					
Course Title	ETHICS, POLICY, LAWS 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 for:

- **Understand** the fundamental ethical theories and principles relevant to Artificial Intelligence. *(Bloom's Level: Understand - Comprehension)*
- **Analyze** the societal and ethical implications of AI in various domains such as healthcare, finance, and criminal justice. *(Bloom's Level: Analyze - Analysis)*
- **Evaluate** the role of policies, laws, and regulatory frameworks governing AI technologies worldwide. *(Bloom's Level: Evaluate - Evaluation)*
- **Apply** ethical reasoning and legal compliance in AI design, development, and deployment. *(Bloom's Level: Apply - Application)*
- **Create** AI governance strategies and responsible AI frameworks that align with ethical and legal standards. *(Bloom's Level: Create - Synthesis)*.

UNIT	TOPICS	HOURS
I	**Introduction to AI Ethics** Definition & Scope of AI Ethics, Key Ethical Theories & Their Relevance to AI (Utilitarianism, Deontology, Virtue Ethics, etc.), Ethical Dilemmas in AI (Bias, Privacy, Accountability, etc.), Historical Cases of AI Ethical Issues (Cambridge Analytica, Facial Recognition Bias, etc.	9
II	**Ethical Issues in AI Development and Deployment** Bias and Fairness in AI (Algorithmic Bias, Discrimination, Explainability), AI and Privacy Concerns (Surveillance, Data Protection, Consent), Transparency and Explainability in AI Systems, AI and Human Autonomy (Manipulation, Misinformation, Deepfakes), AI and Environmental Impact	9
III	**AI Laws, Policies, and Regulations** Global AI Regulations (GDPR, AI Act (EU), USA AI Executive Orders, etc.), Intellectual Property Rights & AI (Ownership of AI-generated Content), Liability and Accountability in AI Systems (Who is responsible for AI decisions?), AI in Criminal Justice & Law Enforcement (Predictive Policing, Sentencing Algorithms), Corporate AI Governance Policies.	9
IV	**AI Standards and Frameworks** IEEE and ISO Standards for AI, NIST AI Risk Management Framework, Fairness, Accountability, and Transparency (FAT) Guidelines, Ethical AI Principles by Organizations (UNESCO, OECD, Google, etc.), AI Auditing and Compliance.	9

V	**Future Challenges and Ethical AI Governance** AI and Job Displacement: Ethical & Policy Implications, Artificial General Intelligence (AGI) and Superintelligence Ethics, AI in Military & Autonomous Weapons, Regulatory Challenges in a Rapidly Evolving AI Landscape, Building Ethical AI: Best Practices for Researchers & Developers.	**9**

COURSE OUTCOMES:

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

CO1	Explain key ethical theories and principles applied to AI governance. (Bloom's Level: Understand - Comprehension)
CO2	Examine real-world case studies to identify ethical dilemmas and biases in AI systems. (Bloom's Level: Analyze - Analysis)
CO3	Assess the effectiveness of existing AI regulations, laws, and policies in different countries. (Bloom's Level: Evaluate - Evaluation)
CO4	Demonstrate ethical decision-making in AI system design considering legal and societal impacts. (Bloom's Level: Apply - Application)
CO5	Develop policy recommendations and AI ethics frameworks to ensure fair and accountable AI deployment. (Bloom's Level: Create - Synthesis)

Text Books:

1. Floridi, Luciano, ed. Ethics, governance, and policies in artificial intelligence. Cham: Springer, 2021.

Reference Books:

1. Tzimas, Themistoklis. Legal and ethical challenges of artificial intelligence from an international law perspective. Vol. 46. Springer Nature, 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	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0
CO2	2	0	0	1	0	1	1	0	0	0	2	0	0	1	0
CO3	0	0	0	0	0	1	2	1	0	0	2	3	1	0	0
CO4	1	0	0	0	0	1	1	0	0	2	0	0	0	3	0
CO5	2	0	0	0	1	1	0	0	0	2	1	0	0	1	1

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS371	Number of Hours/Week	3		
Semester	VII (PSE VII)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	SYSTEMS ENGINEERING		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 and methodologies of system engineering.
- Explore system design, development, and lifecycle management.
- Analyze system reliability, security, and performance considerations.
- To study risk assessment and mitigation strategies in system engineering.

UNIT	TOPICS	HOURS
I	**Introduction to System Engineering:** Definition, Scope, and Importance of System Engineering. System Engineering Lifecycle: Concept, Design, Development, and Deployment. Role of System Engineers in Cybersecurity and IT Infrastructure. System Thinking and Problem-Solving Approaches.	9
II	**System Design and Development:** Requirement Analysis and Specification Development. System Architecture and Modular Design. Prototyping and Simulation in System Engineering. Software and Hardware Integration in Complex Systems.	9
III	**System Reliability and Security:** Reliability Engineering Principles. Fault Tolerance and Redundancy Strategies. Cybersecurity Considerations in System Design. Access Control, Encryption, and Secure System Implementation.	9
IV	**Risk Assessment and Mitigation:** Risk Analysis Techniques: FMEA, Fault Tree Analysis. Threat Modeling and Attack Surface Analysis. Disaster Recovery and Business Continuity Planning. Incident Response and System Resilience Strategies**.**	9
V	**Case Studies and Applications:** Case Studies in Cyber-Physical System Security. System Engineering Applications in Network Security. AI and Machine Learning Integration in Secure Systems. Future Trends in System Engineering and Cybersecurity.	9

COURSE OUTCOMES:

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

CO1	Understand the fundamentals and applications of system engineering.
CO2	Apply system design and architecture principles in real-world scenarios.
CO3	Analyze system reliability, security, and performance issues
CO4	Develop risk assessment and mitigation strategies for complex systems.
CO5	Implement system engineering methodologies in cybersecurity applications.

Text Book

1. Benjamin S. Blanchard - *System Engineering Management*, Wiley, 2018.
2. Dennis M. Buede, William D. Miller - *The Engineering Design of Systems: Models and Methods*, Wiley, 2016.

Reference Books

1. Howard Eisner - *Essentials of Project and Systems Engineering Management*, Wiley, 2011.
2. Richard Stevens - *Systems Engineering: Coping with Complexity*, Pearson, 2005

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	3	1	2	1	1	2	1	2	1	2	3	1	3
CO2	3	2	1	0	2	2	0	2	1	1	1	0	3	0	2
CO3	2	0	3	3	3	3	0	1	1	3	2	3	2	3	2
CO4	2	3	1	3	0	3	1	0	0	1	0	0	2	2	2
CO5	3	2	3	1	3	2	1	3	2	2	2	0	3	1	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS372	Number of Hours/Week	3		
Semester	VII (PSE VII)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	EVOLUTIONARY COMPUTATION		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 fundamental principles of evolutionary computation and its applications.
- Develop and implement various evolutionary algorithms, including genetic algorithms, evolutionary programming, and genetic programming.
- Apply evolutionary computation techniques to solve optimization, search, and machine learning problems.
- Analyse the performance and behaviour of evolutionary algorithms.
- Explore advanced topics and recent trends in evolutionary computation.

UNIT	TOPICS	HOURS
I	**Introduction to Evolutionary Computation:** Introduction to optimization and search problems, biological evolution as inspiration, history and development of evolutionary computation, overview of evolutionary algorithms, basic terminology (population, fitness, selection, crossover, mutation).	9
II	**Genetic Algorithms (GAs):** Representation schemes (binary, real-valued, permutation), selection methods (roulette wheel, tournament selection), crossover operators (one-point, two-point, uniform), mutation operators (bit-flip, Gaussian), GA implementation and parameter tuning.	9
III	**Evolutionary Programming (EP) and Genetic Programming (GP):** Evolutionary programming: representation, mutation, and selection. Genetic programming: tree-based representation, function and terminal sets, crossover and mutation operators, applications of GP.	9
IV	**Advanced Evolutionary Algorithms and Optimization:** Particle swarm optimization (PSO), ant colony optimization (ACO), differential evolution (DE), multi-objective optimization (MOO), constraint handling techniques, applications in engineering optimization problems.	9
V	**Applications and Advanced Topics:** Evolutionary machine learning, neuroevolution, evolutionary robotics, parallel and distributed evolutionary algorithms, recent trends and research directions, case studies and real-world applications.	9

COURSE OUTCOMES:

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

CO1	Understand the fundamental principles and concepts of evolutionary computation.
CO2	Implement and apply genetic algorithms to solve optimization and search problems.
CO3	Develop and utilize evolutionary programming and genetic programming techniques.
CO4	Apply advanced evolutionary algorithms like PSO, ACO, and DE to complex optimization tasks
CO5	Analyze and apply evolutionary computation to emerging areas like machine learning and robotics, and understand current research trends.

Text Book:

1. Eiben, A. E., & Smith, J. E. (2015). From evolutionary computation to computational evolution: Evolving artificial life. Springer.
2. Engelbrecht, A. P. (2007). Computational intelligence: an introduction. John Wiley & Sons.
3. Mitchell, M. (1998). An introduction to genetic algorithms. MIT press.

Reference Books:

1. Goldberg, D. E. Genetic algorithms in search, optimization, and machine learning. Addison-Wesley Professional, 1989.
2. Fogel, D. B., Evolutionary computation: toward a new philosophy of machine intelligence. John Wiley & Sons, 2006
3. Kennedy, J., Eberhart, R. C., & Shi, Y. Swarm intelligence. Morgan Kaufmann, 2001.
4. Dorigo, M., & Stützle, T. Ant colony optimization. MIT press, 2004.
5. Back, T., Fogel, D. B., Michalewicz, Z., Handbook of Evolutionary Computation. Oxford University Press, 1997.

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	3	2	3	2	1	1	1	2	2	1	3	3	2	1
CO2	3	3	3	3	3	2	2	1	2	3	2	2	3	3	1
CO3	3	3	3	3	3	2	2	1	2	3	3	2	3	3	2
CO4	2	3	3	3	3	2	1	1	2	2	3	2	3	2	1
CO5	2	2	3	3	3	2	2	1	2	3	3	3	3	3	2

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS
Course Code	25BTDS373	Number of Hours/Week	3
Semester	VII (PSE VII)	Max. Marks	100
Year	IV	Credits	3

Programme Specific Elective

Course Title	DIGITAL MARKETING	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:

- Comprehend the Fundamentals of Digital Marketing.
- Develop Effective Content Marketing Strategies and Email Marketing Campaigns.
- Understand and Implement Social Media Marketing Techniques and Display Marketing.
- Develop Expertise in Search Engine Marketing (SEM) and Utilize Mobile Marketing.
- Apply Analytics to Optimize Digital Marketing Strategies.

UNIT	TOPICS	HOURS
I	**Introduction to Digital Marketing:** Fundamentals of Digital marketing & Its Significance, Traditional marketing Vs Digital Marketing, Evolution of Digital Marketing. Opportunities for building Brand Website – Planning and Creation – Marketing strategies for the digital world-latest practices.	9
II	**Content and Email Marketing:** Content Marketing: Step-by-step Content Marketing, Developing a content marketing strategy. Email Marketing: Types of Emails in email marketing- Email Automation-Integrating Email with social media and Mobile.	9
III	**Social Media Marketing and Display Marketing:** Social Media Marketing- Social Media Marketing Channels-Leveraging media for brand conversations and buzz. Successful/benchmark social media campaigns. Display Advertising: Working of Display Advertising; Benefits and challenges; Overview of Display ad Process.	9
IV	**Search Engine and Mobile Marketing:** Introduction of SEM: How Search Engine works - SEM components. Search Engine Optimization: Keyword Strategy- SEO Strategy- SEO success factors-On Page Techniques-Off Page Techniques -PPC advertising. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.	9
V	**Digital Innovation and Trends:** The contemporary digital revolution, digital transformation and Channel Attribution, security and privatization issues with digital marketing. Analytics- Ad-words, Email, Mobile, social media, Web Analytics – Changing your strategy based on analysis- Recent trends in Digital marketing.	9

COURSE OUTCOMES:

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

CO1	Understand the Fundamentals and Evolution of Digital Marketing
CO2	Develop and Implement Content and Email Marketing Techniques.
CO3	Leverage Social Media Marketing for Brand Growth and Gain Expertise in Display Advertising.
CO4	Develop Skills in Search Engine Marketing (SEM) and Utilize Mobile Marketing Techniques.
CO5	Understand Digital Innovation and Emerging Trends

Text Books:

1. Moutsy Maiti: Internet Marketing, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).
4. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).
5. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
3. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.

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	1	2	2	2	1	3	2	1	3	2	2	1
CO2	2	2	2	1	3	2	3	2	2	3	2	2	3	3	2
CO3	3	2	3	2	1	2	3	2	3	3	2	3	2	3	3
CO4	3	2	3	3	3	3	2	3	3	3	3	3	3	3	2
CO5	3	3	3	2	3	3	3	2	3	3	2	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS374	Number of Hours/Week	3		
Semester	VII (PSE VIII)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	PATTERN RECOGNITION		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 fundamental concepts of pattern recognition and machine learning.
- To explore various feature extraction, classification, and clustering techniques.
- To understand probabilistic models and deep learning approaches in pattern recognition.
- To apply pattern recognition techniques to real-world problems.

UNIT	TOPICS	HOURS
I	**Introduction to Pattern Recognition** Definition and applications of Pattern Recognition-Design cycle of pattern recognition systems-Supervised vs. Unsupervised learning-Probability and statistical decision theory-Bayes Decision Theory and minimum error classification	9
II	**Feature Extraction and Dimensionality Reduction** Feature types: Geometric, statistical, and symbolic features-Feature extraction techniques -PCA, LDA, ICA-Feature selection and ranking-Discriminant analysis and manifold learning-Introduction to Kernel methods	9
III	**Classification Techniques** Nearest Neighbor Classifier (KNN)-Bayesian Classifiers -Naïve Bayes, Gaussian Bayes-Decision Trees and Random Forests-Support Vector Machines (SVM) Deep learning-based classification -CNNs, RNNs	9
IV	**Clustering and Unsupervised Learning** Partition-based clustering: K-Means, K-Medoids-Hierarchical clustering: Agglomerative and Divisive-Density-based clustering: DBSCAN-Gaussian Mixture Models (GMM) and Expectation-Maximization (EM)-Self-Organizing Maps (SOM) and Fuzzy clustering	9
V	**Applications of Pattern Recognition** Optical Character Recognition (OCR)-Speech and Face Recognition-Biometric Authentication -Fingerprint, Iris, Palm-print-Image-based object detection and recognition-Real-time applications in healthcare, finance, and security	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 the fundamentals of pattern recognition and its real-world applications.
CO2	Perform feature extraction and dimensionality reduction techniques.
CO3	Implement classification techniques for supervised learning problems.
CO4	Apply clustering algorithms for unsupervised learning and pattern discovery.
CO5	Develop and evaluate pattern recognition models for industrial applications.

Text Books:

1. **Pattern Recognition and Machine Learning** – Christopher M. Bishop
2. **Pattern Classification** – Richard O. Duda, Peter E. Hart, and David G. Stork
3. **Introduction to Machine Learning** – Ethem Alpaydin

Reference Books:

1. **Computer Vision: Algorithms and Applications** – Richard Szeliski
2. **Deep Learning** – Ian Goodfellow, Yoshua Bengio, and Aaron Courville

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	3	2	1	1	2	1	3	3	2	2	3
CO2	3	3	3	3	3	2	2	2	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	3	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&DS)	Programme Code	BTDS
Course Code	25BTDS375	Number of Hours/Week	3
Semester	VII (PSE VIII)	Max. Marks	100
Year	IV	Credits	3

Programme Specific Elective

Course Title	AUGMENTED INTELLIGENCE	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 fundamental concepts and evolution of augmented intelligence and its applications in various industries.
- Analyze the enabling technologies such as machine learning, natural language processing, and computer vision for building augmented intelligence systems.
- Apply principles of human-computer interaction and collaborative systems to design user-friendly augmented intelligence solutions.
- Evaluate different architectures and methodologies for developing, deploying, and maintaining augmented intelligence systems.
- Create innovative augmented intelligence solutions by leveraging emerging technologies and addressing ethical considerations.

UNIT	TOPICS	HOURS
I	**Introduction to Augmented Intelligence** Overview and Evolution - Definition, history, and evolution of augmented intelligence - Human-Centric AI - Difference between AI and augmented intelligence; role in enhancing human decision-making. **Applications**: Healthcare, finance, education, customer service, and other industries - Ethics and Challenges: Ethical considerations, biases in AI, data privacy, and security issues.	9
II	**Enabling Technologies for Augmented Intelligence** Machine Learning (ML) - Supervised, unsupervised, and reinforcement learning - Natural Language Processing (NLP) - Text processing, sentiment analysis, and conversational AI - Computer Vision: Image recognition, object detection, and augmented reality - Data Analytics: Big data technologies, real-time analytics, and predictive modeling.	9
III	**Human-Machine Collaboration** Human-Computer Interaction (HCI) - Principles of HCI, user experience (UX) design, and usability - Collaborative Systems - Tools and platforms for human-machine collaboration - Cognitive Augmentation: Enhancing cognitive tasks with AI tools - Case Studies- Examples of successful human-machine collaboration in different sectors.	9
IV	**Designing and Developing Augmented Intelligence System** System Architecture - Components and architecture of augmented intelligence systems - Data Collection and Integration - Data sources, data integration, and preprocessing - Model Training and Optimization: Training ML models, hyperparameter tuning, and performance evaluation -Deployment and Maintenance: Deploying AI systems, monitoring performance, and continuous improvement.	9

V	**Future Trends and Innovations** Emerging Technologies - Trends in AI, ML, IoT, and edge computing - Augmented Intelligence in Industry 4.0 - Role in smart manufacturing, automation, and supply chain optimization - Ethical AI - Ensuring fairness, accountability, transparency, and inclusivity - Future Directions: Research directions, potential innovations, and societal impact.	**9**

COURSE OUTCOMES:

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

CO1	Explain the concept of augmented intelligence and its distinction from traditional AI, along with its applications and ethical challenges.
CO2	Demonstrate the use of machine learning, natural language processing, and computer vision in the development of augmented intelligence systems.
CO3	Design human-centric AI solutions that enhance human decision-making through effective human-machine collaboration.
CO4	Evaluate the performance of augmented intelligence systems, focusing on model optimization, data integration, and system architecture.
CO5	Develop forward-thinking augmented intelligence solutions, incorporating emerging technologies and ethical practices to address future challenges.

Text Books:

1. Jena OP, editor. Augmented Intelligence: Deep Learning, Machine Learning, Cognitive Computing, Educational Data Mining. Bentham Science Publishers; 2022 Jul 29.

Reference Books:

1. Geroimenko V, editor. Augmented Reality and artificial intelligence: the Fusion of advanced technologies. Springer Nature; 2023 Apr 29.

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	0	0	0	0	1	2	0	0	0	3	2	0	0	0
CO2	0	0	0	0	1	2	0	0	0	2	2	3	0	1	2
CO3	1	2	0	0	1	1	2	0	0	0	1	1	0	0	3
CO4	2	0	0	0	1	3	0	0	0	2	1	0	2	0	1
CO5	3	0	0	0	0	1	2	0	0	3	0	0	1	2	1

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS376	Number of Hours/Week	3		
Semester	VII (PSE VIII)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	COMPUTATIONAL AND SYSTEMS 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 to:

- Explain fundamental concepts of computational and systems biology, including modeling, simulation, and analysis of biological systems. (Understanding)
- Utilize computational tools and programming languages (e.g., Python, R, MATLAB) to analyze biological datasets and develop predictive models. (Applying)
- Deconstruct complex biological networks and pathways to identify key components, interactions, and emergent behaviors. (Analyzing)
- Critically assess computational models and algorithms used in systems biology, comparing their effectiveness and limitations in biological research. (Evaluating)
- Design and implement a computational model to simulate a biological process, integrating experimental data for validation. (Creating)**.**

UNIT	TOPICS	HOURS
I	**Introduction to Computational and Systems Biology** Overview of Systems Biology- Definitions, scope, and importance, Computational Approaches in Biology- Bioinformatics vs. Systems Biology, Molecular Networks- Genetic, protein, and metabolic networks, Mathematical Foundations- Graph theory, probability, and dynamical systems, High-Throughput Data- Genomics, transcriptomics, and proteomics, Tools & Software- Introduction to MATLAB, Python (Biopython, NumPy, SciPy), and R	9
II	**Mathematical and Computational Modeling of Biological Systems** Deterministic Models- Ordinary Differential Equations (ODEs) for gene regulation and metabolic pathways, Stochastic Models- Master equation, Gillespie algorithm for stochastic gene expression, Boolean Networks and Logical Models- Gene regulatory networks modeling, Parameter Estimation & Sensitivity Analysis- Optimization techniques (Gradient Descent, MCMC), Simulating Biological Systems- MATLAB/Python-based simulations	9
III	**Omics Data Analysis and Machine Learning in Biology** Next-Generation Sequencing (NGS) Data Analysis- RNA-Seq, ChIP-Seq, and variant calling, Gene Expression Analysis- Microarrays, clustering, and PCA, Machine Learning in Biology- Classification and clustering of biological data, Deep Learning Applications- Convolutional Neural Networks (CNNs) for bioimage analysis, Network Inference- Bayesian networks, correlation networks, and network reconstruction	9

IV	**Biological Networks and Systems Dynamics** Types of Biological Networks- Protein-protein interaction (PPI), gene regulatory, metabolic pathways, Network Analysis Techniques- Degree distribution, centrality measures, clustering, Dynamic Network Models- Time-series analysis of networks, Systems Biology Applications- Drug-target interaction prediction, disease modeling, Case Studies- Cancer systems biology, metabolic network modeling	**9**
V	**Synthetic Biology and Computational Drug Discovery** Synthetic Biology Principles- Engineering biological circuits, CRISPR-based design, Computational Drug Discovery- Molecular docking, structure-based drug design, Pharmacokinetics and Pharmacodynamics (PK/PD) Modeling, Multi-Omics Integration- Combining genomics, transcriptomics, and metabolomics, Future Trends in Computational and Systems Biology- AI in biology, single-cell analysis, personalized medicine	**9**

COURSE OUTCOMES:

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

CO1	**Understand** fundamental concepts in computational and systems biology, including biological data analysis, modeling, and simulation.
CO2	**Apply** computational techniques and bioinformatics tools to analyze genomic, proteomic, and metabolomic data.
CO3	**Analyze** biological networks and systems dynamics using mathematical and computational models.
CO4	**Evaluate** different machine learning and statistical methods for biological data interpretation and decision-making.
CO5	**Create** computational models and simulations to study complex biological systems and predict biological behavior.

Text Books:

1. Raman K. An introduction to computational systems biology: systems-level modelling of cellular networks. Chapman and Hall/CRC; 2021 May 30.

Reference Books:

1. Huang T, MARTON, Computational Systems Biology. Huang T, editor. Springer Science+ Business Media, LLC, part of Springer Nature; 2018.

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	0	0	0	0	0	0	0	3	2	3
CO2	0	2	0	0	0	0	1	0	0	0	0	2	2	1	3
CO3	3	1	2	0	0	0	0	0	0	0	0	0	1	2	1
CO4	0	0	2	0	1	0	0	0	3	0	0	0	1	1	0
CO5	0	0	1	0	0	0	0	0	0	1	0	1	2	2	0

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS271	Number of Hours/Week	2		
Semester	VII	Max. Marks	100		
Year	IV	Credits	1		
Core Course					
Course Title	HIGH PERFORMANCE COMPUTING LAB		L	T	P
			0	0	2

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

COURSE OBJECTIVES:

- To provide an understanding of the fundamental concepts of parallel programming and computing architectures.
- To explore the principles and techniques of high-performance computing and cluster architectures.
- To enable students to work with high-speed networks and efficient resource management systems in cluster environments.
- To introduce CUDA programming for parallel processing and develop skills in shared memory and multi-GPU programming.
- To familiarize students with parallel programming tools like OpenMP for efficient parallel execution.

LIST OF EXPERIMENTS

1. Implementation of matrix vector multiplication using OPENMP.
2. Development of parallel matrix addition using MPI.
3. Configuration of cluster setup and testing communication.
4. Implementation of fault detection using heartbeat mechanisms and develop failover and recovery strategies in a cluster.
5. Simulation of resource management in cluster environments.
6. Development of CUDA program for vector addition.
7. Development of CUDA program with shared memory.
8. Implementation of load balancing algorithms.
9. Parallelization of numerical integration using OPENMP.
10. Implementation and testing of different network topologies.

COURSE OUTCOMES:

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

CO1	Demonstrate knowledge of parallel computing, architectures, and processing techniques like SIMD and pipelined processors.
CO2	Analyze the architecture and components of scalable parallel and cluster computing systems
CO3	Implement resource management, job scheduling, and fault-tolerant mechanisms in high-speed cluster networks
CO4	Develop CUDA-based parallel programs utilizing shared memory, thread cooperation, and multi-GPU support
CO5	Apply OpenMP and other parallel programming models to create efficient and scalable solutions for computational problems

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	1	2	3	2	3	2	3	1	3	2	1	3	2	3
CO2	2	3	1	2	3	2	3	1	3	2	3	2	1	3	2
CO3	1	2	3	2	1	3	2	3	2	3	1	3	2	3	1
CO4	3	2	1	3	2	1	3	2	3	1	2	3	3	1	2
CO5	2	3	2	1	3	2	1	3	2	3	2	1	3	2	3

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

Semester VIII

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS381	Number of Hours/Week	3		
Semester	VIII (PSE IX)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	GAME THEORY FOR MACHINE 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 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** 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 – discrete and continuous random variable; expectation, variance, covariance; Multivariable calculus basics	9
II	**Optimization** Unconstrained optimization; constrained optimization; numerical optimization; gradient descent; steepest descent numerical gradient calculation; stopping sriteria; linear regression; least squares; generalized function for linear regression; bias-variance trade off;	9
III	**Game theory in AI** Two player games; adversarial search; game tree; minimax search; utility function; search strategies; alpha-beta pruning in minimax search; types of games – cooperative and non-cooperative games, zero-sum and non-zero-sum games; simultaneous and sequential games; Nash equilibrium	9
IV	**Game theory in machine learning** Adversarial learning; minimax search; generative adversarial networks (GANs); generator; discriminator; multi-agent systems; reinforcement learning; competitive or cooperative approaches; fairness and resource allocation; Stackelberg games; multi-agent reinforcement learning; auction algorithms`	9
V	**Generative models for Games** Background; autoregressive models; maximum likelihood learning; variational auto encoders; normalizing flows; energy based models; score based models; diffusion models for discrete data; applications – autonomous vehicles and traffic systems, security systems and cyber security	9

COURSE OUTCOMES:

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

CO1	Infers 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.
3. Eva Tardos, Noam Nisan, Tim Roughgarden, Vijay V. Vazirani. Algorithmic Game Theory. Cambridge University Press. 2007.

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 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	3	3	1	3	0	1	0	0	0	1	0	3	1	2	1
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	3	1
CO3	3	2	2	3	3	2	3	0	0	2	0	2	3	2	2
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	3	3
CO5	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&DS)	Programme Code	BTDS		
Course Code	25BTDS382	Number of Hours/Week	3		
Semester	VIII (PSE IX)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	SEMANTIC WEB 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:

- To learn Web Intelligence.
- To learn Knowledge Representation for the Semantic Web.
- To learn Ontology Engineering.
- To learn Semantic Web Applications, Services and Technology.
- Apply Semantic Web Technologies in Real-World Applications

UNIT	TOPICS	HOURS
I	**Introduction:** Introduction to Semantic Web, the Business Case for the Semantic Web, XML and Its Impact on the Enterprise.	9
II	**Web Services:** Uses, Basics of Web Services, SOAP, UDDI, Orchestrating Web Services, Securing Web Services, Grid Enabled and Semantic Web of Web Services	9
III	**Resource Description Framework:** Features, Capturing Knowledge with RDF. XML Technologies: XPath, The Style Sheet Family: XSL, XSLT, and XSL FO, XQuery, XLink, XPointer, XInclude, XMLBase, XHTML, XForms, SVG	9
IV	**Taxonomies and Ontologies:** Overview of Taxonomies, Defining the Ontology Spectrum, Topic Maps, Overview of Ontologies, Syntax, Structure, Semantics, and Pragmatics, Expressing Ontologies Logically, Knowledge Representation.	9
V	**Semantic Web Application:** Semantic Web Services, e-Learning, Semantic Bioinformatics, Enterprise Application Integration, Knowledge Base. Semantic Search Technology: Search Engines, Semantic Search, Semantic Search Technology, Web Search Agents, Semantic Methods, Latent Semantic Index Search, TAP, Swoogle.	9

COURSE OUTCOMES:

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

CO1	Understand the characteristics of Semantic Web.
CO2	Apply SOAP and UDDI to web services
CO3	Handle multiple web services using Orchestration
CO4	Create documents using XML
CO5	Construct and use Ontologies

Text Books:

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley Interscience.

Reference Books:

1. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, Wiley Publishing
2. Semantic Web Technologies, Trends and Research in Ontology Based Systems, J.Davies, R.Studer, P.Warren, John Wiley & Sons
3. Semantic Web and Semantic Web Services - Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group)

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	2	2	3	2	1	2	2	3	2	3	2	1	1
CO2	3	3	3	3	3	2	2	2	3	2	2	2	3	2	3
CO3	3	3	2	2	3	2	3	3	3	3	3	3	2	2	2
CO4	2	3	3	2	3	2	2	2	2	3	2	3	2	3	2
CO5	3	3	2	3	3	3	3	3	3	3	2	3	3	3	3

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS383	Number of Hours/Week	3		
Semester	VIII (PSE IX)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	GPU 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 to:

- **Understand** the architecture and programming model of modern GPUs. (Remembering, Understanding)
- **Learn** parallel computing concepts and how to optimize performance using GPU acceleration. (Understanding, Applying)
- **Develop** CUDA-based parallel programs to solve computationally intensive problems. (Applying, Analyzing)
- **Analyze** the efficiency of parallel algorithms and their execution on GPU hardware. (Analyzing, Evaluating)
- **Optimize** and **implement** real-world applications using GPU computing techniques. (Evaluating, Creating).

UNIT	TOPICS	HOURS
I	**Introduction to GPU Computing** Evolution of parallel computing, Introduction to GPUs and their architecture, CPU vs GPU- Parallelism and Performance Benefits, Overview of CUDA and OpenCL, Applications of GPU computing in scientific computing, AI, and gaming.	9
II	**CUDA Programming Basics** Introduction to CUDA programming model, CUDA architecture- Threads, Blocks, and Grids, Memory hierarchy- Global, Shared, and Local memory, CUDA programming- Kernel functions and launching mechanisms, Synchronization and performance considerations.	9
III	**Advanced CUDA and Optimization** Memory optimization techniques, CUDA streams and concurrency, Use of shared memory for performance improvement, Profiling and debugging CUDA applications, Introduction to Thrust library.	9
IV	**OpenCL and Alternative GPU Frameworks** OpenCL architecture and execution model, Writing OpenCL kernels and host programs, Comparing CUDA and OpenCL, Introduction to Vulkan and Metal for GPU computing, Multi-GPU programming and interoperability.	9
V	**Applications and Emerging Trends** GPU acceleration in Deep Learning and AI (TensorFlow, PyTorch), Scientific computing and high-performance simulations, Real-time rendering and ray tracing, Introduction to Quantum Computing with GPUs, Future trends in GPU architectures.	9

COURSE OUTCOMES:

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

CO1	Describe the fundamentals of GPU architecture and parallel computing models.
CO2	Explain the CUDA programming model and its application in GPU computing.
CO3	Implement CUDA programs for solving parallelizable problems.
CO4	Evaluate the performance of GPU-accelerated programs and optimize computation efficiency.
CO5	**Design** and **develop** GPU-based solutions for real-world scientific and engineering applications.

Text Books:

1. Bandyopadhyay, Avimanyu. Hands-On GPU Computing with Python: Explore the capabilities of GPUs for solving high performance computational problems. Packt Publishing Ltd, 2019.

Reference Books:

1. Tuomanen, Brian. Hands-On GPU Programming with Python and CUDA: Explore high-performance parallel computing with CUDA. Packt Publishing Ltd, 2018.

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	0	2	0	2	0	0	1	0	0	0	1	0	0	0
CO2	1	2	0	0	0	1	2	0	3	0	1	2	2	1	3
CO3	2	0	0	0	0	0	2	0	0	0	0	1	2	2	1
CO4	2	2	2	0	1	2	0	0	3	0	0	1	1	0	0
CO5	2	0	2	0	0	1	0	1	0	0	0	0	0	2	1

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

Programme	B.Tech. CSE (AI&DS)	Programme Code	BTDS		
Course Code	25BTDS384	Number of Hours/Week	3		
Semester	VIII (PSE X)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	RESOURCE CONSTRAINED ARTIFICIAL INTELLIGENCE		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 advanced concepts in resource constrained AI
- To formulate artificial intelligence model with knowledge representarion
- To learn problem solving approaches through decision processes
- To develop resource constrained AI model with the help of concepts such as searches, knowledge representation etc

UNIT	TOPICS	HOURS
I	**Introduction to AI and state space searches** Introducing the structure and scope of the course; Brief introduction and history of AI; state space seaches; informed and uninformed searches; local searches; adversarial searches;	9
II	**Knowledge representation in AI** Different knowledge representation systems; syntax; semantics; forward chaining; Resolution; Reduction in satisfiability problems; SAT solvers; DPLL algorithms; Walk SAT algorithms	9
III	**Resource constrained AI** Resource constraints – computational limit, storage limits, lack of data; resource constrained classification; resource allocation optimization problem; AI in low power edge devices; asymmetric exponent method; neural networks inference optimization – pruning, quantization, dynamic parameter limitation	9
IV	**Cluster analysis and hardware-aware execution** Sparse partitioning aroung medoids; clustering of polygonal curves and time series; data aggregation for hierarchical clustering; matrix factorization with binary constraints; FPGA-based backpropagation engine for feedforward neural networks; processor specific code transformation; extreme multicore classification; optimization of ML on modern multicore systems	9
V	**Tiny Machine Learning** ML to the edge devices; real time processing; instant decision making; local inference; reduction in data transfer; offline operation; cost reduction; privacy and security; applications – telematics devices, fraud detection, property risk analysis, retail operation and inventory management; Tiny ML vs IoT	9

COURSE OUTCOMES:

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

CO1	Describe the history behind artificial intelligence
CO2	Illustrate AI concepts in resource constrained environment
CO3	Demonstrate resource constrained model for edge devices
CO4	Infers difficulties in incorporating resource constrained ML
CO5	Develop tiny ML model for existing problems

Text Books:

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009
2. Katharina Morik and Peter Marwedel. Machine Learning under Resource constraints. De Gruyter. 2022

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&DS)	Programme Code	BTDS		
Course Code	25BTDS385	Number of Hours/Week	3		
Semester	VIII (PSE X)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	WEB 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 to:

- **Understand Data Mining Concepts and Functionalities:** Learn the foundational principles of data mining, including pre-processing techniques like cleaning, integration, reduction, and discretization, along with the architecture and classification of data mining systems.
- **Explore Association Rule Mining:** Study efficient algorithms for frequent item set mining, discover various types of association rules, and perform correlation and constraint-based analysis for meaningful data insights.
- **Master Classification and Prediction Techniques:**Analyze methods like decision trees, Bayesian classifiers, backpropagation, support vector machines, and ensemble techniques to develop accurate classification and prediction models.
- **Analyze Clustering Techniques and Outlier Detection:** Examine clustering methods, such as partitioning, hierarchical, density-based, and model-based techniques, and apply these methods to high-dimensional data and outlier analysis.
- **Mine Complex Data Types:** Explore multidimensional analysis and mining techniques for complex data objects, including spatial, multimedia, text, and web data, for advanced data mining applications.

UNIT	TOPICS	HOURS
I	**Introduction:** Basic Data Mining Tasks – Data Mining Versus Knowledge Discovery in Data Bases – Data Mining Issues – Data Mining Matrices – Social Implications of Data Mining – Data Mining from Data Base Perspective.	9
II	**Neural Networks:** Data Mining Techniques – a Statistical Perspective on data mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms.	9
III	**Fuzzy Systems** Classification: Introduction – Statistical – Based Algorithms – Distance Based Algorithms – Decision.	9
IV	**Genetic Algorithm:** Clustering Tree – Based Algorithms – Neural Network Based Algorithms – Rule Based .Algorithms – Combining Techniques: Introduction – Similarity and Distance Measures –Outliers – Hierarchical Algorithms. Partitioned Algorithms.	9

V	**Hybrid Systems:** Association Rules: Introduction - Large Item Sets – Basic Algorithms – Parallel &Distributed .Algorithms – Comparing Approaches – Incremental Rules – Advanced Association Rules .Techniques – Measuring the Quality of Rules.	**9**

Course Outcomes

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

CO1	Understanding Data Mining Techniques and Their Applications
CO2	Mastery of Machine Learning Algorithms for Data Mining
CO3	Critical Analysis of Data Mining Issues and Social Implications
CO4	Expertise in Hybrid and Combined Data Mining Approaches
CO5	Application of Data Mining Techniques for Real-World Problems

Text Books:

1. Jiawei Han & Micheline Kamber, Data Mining Concepts & Techniques, 2011, 3rd Edition.

Reference Books:

1. Margaret H.Dunbam, Data Mining Introductory and Advanced Topics, Pearson,Education 2003.

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	3	2	2	3	2	2	1	3	2	2	1	3	2	2
CO2	3	3	3	2	3	3	2	2	3	3	3	2	3	3	3
CO3	2	2	3	3	2	3	3	2	3	2	3	2	2	3	2
CO4	3	3	2	3	3	3	3	3	3	3	2	2	3	3	3
CO5	3	3	3	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&DS)	Programme Code	BTDS		
Course Code	25BTDS386	Number of Hours/Week	3		
Semester	VIII (PSE X)	Max. Marks	100		
Year	IV	Credits	3		
Programme Specific Elective					
Course Title	GENERATIVE 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:

- To explore classical and advanced concepts in generative AI
- To equip different generative models in modern AI
- To construct an existing problem into standard machine learning paradigm
- To dealt with generative models for scalable machine learning.

UNIT	TOPICS	HOURS
I	**Introduction** Introduction – artificial intelligence, machine learning, deep learning; intelligent agent and its environment; state space searches; informed and informed searches; adversarial searches; supervised and unsupervised learning; discriminative AI – classification, regression, clustering, dimensionality reduction, reinforcement learning;	9
II	**Generative AI** Data generation; data transformation; data enrichment; boltzmann machines; gibbs sampling; restricted boltzmann machines; deep belief networks; deep boltzmann machines; autoencoders; varioational autoencoders; generative adversarial networks (GANs)	9
III	**Modern Generative AI** Nash equilibrium; GANs applications – generating realistic images, image to image translation, super resolution, data augmentation, style transfer; contrastive language-image pretraining (CLIP); diffusion models; stable diffusion Tech; midjourney; autoregression;	9
IV	**Large Language Models** Markov chains; rule based text generation; recurrent neural networks; long short-term memory networks; N-gram models; seq2seq; GAN for text generation; Transformers; tokenization; pretraining and fine tuning LLMs; prompt engineering; GPTs	9
V	**Ethical concerns and social implications** Bias and fairness in AI generated data; data privacy, safety, security; mis information and misuse of generative AI; generative AI's impact on jobs and industry; dependency on AI; environmental concerns; AI oversight and self regulations; multi tasking and multi sensory generative AI	9

COURSE OUTCOMES:

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

CO1	Infers classical generative algorithms in AI
CO2	Execute classical ML approaches into generative machine learning
CO3	Implement generative models for ML applications
CO4	Validate the ML models to improve the performance
CO5	Develop an innovative generative 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
2. Martin musiol. Generative AI. Wiley publications. 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	3	1	3	0	1	0	0	0	1	0	3	0	1	2
CO2	3	2	1	3	1	0	2	0	0	1	0	2	1	2	3
CO3	3	2	2	3	3	2	3	0	0	2	0	2	2	2	3
CO4	2	3	1	2	3	1	2	1	1	1	1	2	2	1	3
CO5	3	2	3	3	3	2	3	3	3	2	2	2	3	3	3

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