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 MACHINE LEARNING- In collaboration with Intel and NEC)

(B.Tech. CSE - AI & ML - INTEL-Intel)

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

PEO1: Graduates will possess an Industry-Academic Synergy of AI and ML principles enhanced by practical experience gained through collaboration with Intel and NEC.

PEO2: Graduates will stay at the forefront of technological advancements by continually engaging with the latest industry trends, tools and practices.

PEO3: Graduates will excel in applying their knowledge to solve real-world problems, leveraging the industry-driven curriculum and hands-on training provided by Intel and NEC.

GRADUATE ATTRIBUTES

The Graduate Attributes of B.Tech CSE (AI & ML - INTEL-Intel) are:

GA 1 Demonstrates strong foundations in AI, ML algorithms, and Intel-optimized frameworks.

GA 2 Applies creative problem-solving to develop AI-driven solutions for real-world challenges.

GA 3 Capable of analyzing and interpreting complex data sets to inform intelligent decisions.

GA 4 Effectively works in multidisciplinary and industry-partnered teams, including Intel's AI ecosystem.

GA 5 Understands and applies responsible AI principles ensuring fairness, transparency, and accountability.

GA 6 Proficient with Intel AI tools, hardware accelerators, and best practices for enterprise deployment.

GA 7 Committed to lifelong learning and staying updated with emerging AI/ML technologies and Intel innovations.

PROGRAMME OUTCOMES

On completion of the **B.Tech CSE (Artificial Intelligence & Machine Learning - In collaboration with Intel and NEC)) Programme,** students should be able to:

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

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

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

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

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

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

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

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of 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: Graduates will demonstrate proficiency in applying AI and ML theories and tools to real-world problems, leveraging collaborations

PSO 2: Graduates will acquire essential entrepreneurial skills including business planning, market analysis, and product development with guidance from Intel and NEC experts.

PSO 3: Students will be proficient in designing, developing and testing AI and ML prototypes, translating theoretical knowledge into practical applications.

Summary of Credits

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

SEMESTER WISE CREDIT STRUCTURE

Sl. No.	Category of Courses	1st Year		2nd Year		3rd Year		4th Year		Total
		Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Sem VII	Sem VIII	
1.	Departmental Core	08	07	20	11	12	11	07	–	76
2.	Discipline Specific Electives (DSE)	–	–	–	06	06	06	06	06	30
3.	Open Electives	–	–	–	–	03	03	03	–	09
4.	Applied Sciences	08	11	–	–	–	_	–	–	19
5.	Internships/ Field Visits	–	–	–	–	–	_	02	–	02
6.	Project	–	–	–	–	–	_	–	15	15
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 & Machine Learning- In Collaboration with Intel and NEC)

Semester – I

(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
2.	25BTIN111	**Core Course** Fundamentals of Computing	3	0	0	3	3
3.	25BTIN112	**Core Course** Introduction to Programming	3	0	0	3	3
4.	25BTIN113	**Applied Science** Mathematics – I	3	1	0	4	4
5.	25BTIN114	**Applied Science** Physics I	3	1	0	4	4
6.	25AEEN911	**Ability Enhancement Compulsory Course (AECC)** Effective Communication	3	0	0	3	3
7.	25BTIN911	**Value-Added Course** Performing Arts/Sports (Non-Graded)	3	0	0	3	1
8.	25BTIN211	**Core Course** Fundamentals of Computing Lab	0	0	2	2	1
9.	25BTIN212	**Core Course** Introduction to Programming Lab	0	0	2	2	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.	25BTIN121	**Core Course** Python Programming and RASPBERRY PI	3	0	0	3	3
2.	25BTIN122	**Applied Science** Probability, Statistics and Stochastic Processes	3	0	0	3	3
3.	25BTIN123	**Applied Science** Mathematics II	3	1	0	4	4
4.	25BTIN124	**Applied Science** Physics II	3	0	0	3	3
5	25BTIN125	**Core Course** Discrete Structures for Computer Science	3	0	0	3	3
6	25EVST921	**Value Added Course** Environmental Science	2	0	0	2	2
7	25BTIN221	**Core Course** Python Programming and RASPBERRY PI Lab	0	0	2	2	1
8	25BTIN222	**Applied Science** Physics II Lab	0	0	2	2	1
9	25BTIN223	**Skill Enhancement Course** Extended Reality and its Applications Lab	0	0	2	2	1
		TOTAL	**17**	**1**	**6**	**24**	**21**

Semester – III

(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTIN131	**Core Course** Artificial Intelligence	3	0	0	3	3
2.	25BTIN132	**Core Course** Signals and Systems	3	0	0	3	3
3.	25BTIN133	**Core Course** Digital Design	3	0	0	3	3
4.	25BTIN134	**Core Course** Data Structures and Algorithms	3	0	0	3	3
5.	25BTIN135	**Core Course** Object-Oriented Programming with JAVA	3	0	0	3	3
6.	25BTIN136	Professional Ethics	2	0	0	2	2
7.	25BTIN931	**Value Added Course** Indian Constitution	1	0	0	1	1
8.	25BTIN231	**Core Course** Digital Design Lab	0	0	2	2	1
9.	25BTIN232	**Core Course** Data Structures and Algorithms Lab	0	0	2	2	1
10	25BTIN233	**Core Course** Object-Oriented Programming Lab	0	0	2	2	1
		Total	**18**	**0**	**06**	**24**	**21**

Semester – IV

(Total Credits: 21)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTIN141	**Core Course** Machine Learning	3	0	0	3	3
2.	25BTIN142	**Core Course** Database Management Systems	3	0	0	3	3
3.	25BTIN143	Computer Organization and Architecture	3	0	0	3	3
4.	25BTIN841	**Skill Enhancement Course** Engineering Economics and Foreign Trade	3	0	0	3	3
5.	25BTIN341 25BTIN342 25BTIN343	**Programme Specific Elective (PSE) I:** Operating Systems Social Network Analysis Data Mining and Data Warehousing	3	0	0	3	3
6.	25BTIN344 25BTIN345 25BTIN346	**Programme Specific Elective (PSE) II:** Full Stack Development-DevOps Edge AI Design and Analysis of Algorithms	3	0	0	3	3
7.	25BTIN241	**Core Course** Machine Learning Lab	0	0	2	2	1
8.	25BTIN242	**Core Course** Database Management Systems Lab	0	0	2	2	1
		Total	**18**	**0**	**04**	**22**	**20**

Semester – V

(Total Credits: 24)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTIN151	**Core Course** Deep Learning	3	0	0	3	3
2.	25BTIN152	**Core Course** Computer Networks	3	0	0	3	3
3.	25BTIN153	**Core Course** Theory of Computation	3	1	0	4	4
4.	25BTIN851	**Skill Enhancement Course** Principles of Management	3	0	0	3	3
5.	25BTIN351 25BTIN352 25BTIN353	**Programme Specific Elective (DSE) III** Software Engineering Nature Inspired Computing Fuzzy sets, Logics and Systems	3	0	0	3	3
6.	25BTIN354 25BTIN355 25BTIN356	**Programme Specific Elective (DSE) IV** Quantum ML Cognitive Computing Nature Language Processing	3	0	0	3	3
7.	25BTIN051 25BTIN052 25BTIN053	**Generic Elective I (Open Elective):** Artificial Intelligence Python Programming Computer Networks	3	0	0	3	3
8.	25BTIN251	**Core Course** Deep Learning Lab	0	0	2	2	1
9.	25BTIN252	**Core Course** Computer Networks Lab	0	0	2	2	1
		Total	**21**	**01**	**04**	**26**	**24**

Semester – VI

(Total Credits: 20)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTIN161	**Core Course** Predictive Analysis	3	0	0	3	3
2.	25BTIN162	**Core Course** Complier Design	3	0	0	3	3
3.	25BTIN163	**Core Course** Cryptography and Network Security	3	0	0	3	3
4.	25BTIN361 25BTIN362 25BTIN363	**Programme Specific Elective (PSE) V** Applied Artificial Intelligence Neuromorphic Computing Computer Vision	3	0	0	3	3
5.	25BTIN364 25BTIN365 25BTIN366	**Programme Specific Elective (PSE) VI** Applied Machine Learning Internet of Things Data Visualization	3	0	0	3	3
6.	25BTIN061 25BTIN062 25BTIN063	**Open Elective II (Generic)** AI Tools Internet of Things Cybersecurity	3	0	0	3	3
7.	25BTIN261	Integrated advanced AI and IoT Lab	0	0	2	2	1
8.	25BTIN262	Compiler Design Lab	0	0	2	2	1
		Total	**18**	**0**	**04**	**22**	**20**

Semester – VII

(Total Credits: 21)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTIN171	**Core Course** High Performance Computing	3	0	0	3	3
2.	25BTIN172	**Core Course** Ethics, Policy, Laws and Standards in AI	3	0	0	3	3
3.	25BTIN371 25BTIN372 25BTIN373	**Programme Specific Elective (PSE) VII** Systems Engineering Evolutionary Computation Digital Marketing	3	0	0	3	3
4.	25BTIN374 25BTIN375 25BTIN376	**Programme Specific Elective (PSE) VIII** Pattern Recognition Augmented Intelligence Computational and Systems Biology	3	0	0	3	3
5.	25BTIN071 25BTIN072 25BTIN073	**Open Elective III** Advanced Python Programming Optimisation Algorithms Computing (Latest)	3	0	0	3	3
6.	25BTIN571	Mini Project	0	0	0	0	2
7.	25BTIN271	**Core Course** High Performance Computing Lab	0	0	2	2	1
8.	25BTIN471	Industrial Internship	0	0	0	0	2
		Total	**15**	**0**	**02**	**17**	**20**

Semester – VIII

(Total Credits: 18)

SI.No	Course Code	Course Title	L	T	P	Contact Hrs / Wk	Credits
1.	25BTIN581	Capstone Project	0	0	0	0	15
2.	25BTIN381 25BTIN382 25BTIN383	**Programme Specific Elective (PSE)) IX** Game Theory for Machine Learning Semantic Web Technology GPU Computing	3	0	0	3	3
	25BTIN384 25BTIN385 25BTIN386	**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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN 111	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.	12
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).	12
III	**Computer Software** Machine language, Mnemonics, High level Language, Assembler, Compiler, Interpreter, System Development Programs, System Management Programs , Standard Application Programs , Unique Application Programs, Problem Solving, Structuring the Logic	12

IV	**Memory management** Introduction, History, Functions, Process, Memory File, Management Device, Security Management, Types of Operating Systems, Providing User Interface, Popular Operating Systems.	**12**
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.	**12**

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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN211	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&ML-INTEL)	Programme Code	BTIN
Course Code	25BTIN112	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 introduction, Syntax and Semantics	9
II	**Introduction to C language** History of C, Prerequisites of C, Features and its applications, Structure of C, Preprocessor directives, Data types and constants, variables and its types, Tokens, Identifiers and format specifiers, Operators and Enums, Data I/O, Decision making and Branching, Loop Introdcution, programs with looping structure, Control Flow programs with control flow	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&ML-INTEL)	Programme Code	BTIN
Course Code	25BTIN212	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&ML-INTEL	Programme Code	BTIN
Course Code	25BTIN 113	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 & ML - INTEL	Programme Code	BTIN		
Course Code	25BTIN 114	Number of Hours/Week	4		
Semester	I	Max. Marks	100		
Year	I	Credits	4		
Applied Science Course					
Course Title	PHYSICS I		L	T	P
			3	1	0

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

COURSE OBJECTIVES:

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

UNIT	TOPICS	HOURS
I	Algebra of vectors-Describing motion: displacement, velocity, speed, acceleration; Cartesian, polar,spherical, and cylindrical polar coordinates; Mathematical tools- differentiation and integration methods, Taylor's series	12
II	Concept of inertia; concept of inertial and non-inertial frames; Newton's laws of motion; Application of Newton's laws: particles in gravitational field, simple harmonic motion, tension in a string, frictional force, viscous force, damped harmonic oscillator, forced harmonic oscillator and resonance. Concept of momentum- center of mass, conservation of momentum, momentum and flow of mass, work-energy theorem, conservative and non-conservative forces, conservation of energy, concept of power, conservation laws and particle collisions	12
III	Concept of moment of inertia; fixed axis rotation; angular displacement, angular velocity, and angular acceleration; vector nature of angular velocity; angular momentum; torque; conservation of angular momentum; gyroscope motion	12
IV	Central forces; central force motion as one-body problem; conservation laws in central forcemotion; Kepler's laws	12
V	Galilean transformations; uniformly accelerating systems; principle of equivalence; Physics in rotating 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 & ML - INTEL)	Programme Code	AEEN		
Course Code	24AEEN 811	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN121	Number of Hours/Week	3		
Semester	II	Max. Marks	100		
Year	I	Credits	3		
Core Course					
Course Title	PYTHON PROGRAMMING AND RASPBERRY PI FUNDAMENTALS		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	**Advanced Object-Oriented Programming Concepts** Python core syntax and object-oriented operations - Understanding and implementing -Inheritance (single, multiple, multilevel) -Polymorphism (method overloading/overriding) -Composition and delegation - Attribute encapsulation: public, protected, private - Subclassing built-in classes - Static methods vs. Class methods - Abstract classes and methods using abc module - Function argument syntax - Decorators and function wrapping.	8
II	**Exception Handling & Object Operations** Creating and serving custom exceptions - Exception chaining and logging - Shallow vs. Deep copy operations using copy module - Serialization and Deserialization using: pickle, json- Best practices for safe object handling and data persistence.	8
III	**Python Coding Conventions and Best Practices** Introduction to Python Enhancement Proposals (PEPs) - PEP 8 - Style Guide for Python Code - PEP 257 - Docstring Conventions - Using PEP 8 compliant linters - Coding layout conventions - Indentation, line length, whitespace, imports - Naming conventions (variables, classes, constants) - Documentation strings and comments - Pythonic practices and idioms - Introduction to metaprogramming-Using meta classes - Class variables and dynamic class creation.	8
IV	**GUI Programming with Python** GUI programming fundamentals - Introduction to popular GUI toolkits (e.g., Tkinter, PyQt) - Widget layout and geometry managers - Widgets: buttons, labels, entries, frames - Event-driven programming - Event binding and callbacks - Observables and state tracking - Styling widgets: colors (RGB, HEX), fonts - Designing responsive and interactive	8

	interfaces.	
V	**Network and Database Programming** Fundamentals of network programming- Working with sockets - Client-server architecture - Sending/receiving data over TCP/UDP - Developing a simple REST API client - File processing - Reading/writing text and binary files - Working with file paths and directories - Environment – communication - Using OS, sys, subprocess - Introduction to database programming with sqlite - Creating tables, inserting, querying, updating data.	**8**

COURSE OUTCOMES:

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

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

CO2 : Understand the programming concepts in abstract and paradigm level

CO3 : Structure python programs for solving problems

CO4 : Develop python programs using OOP concept

CO5 : Execute ML project using python tools

Text Books:

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

Reference Books:

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

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

	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 & ML)	Programme Code			BTIN
Course Code	25BTIN221	Number of Hours/WK			2
Semester	II	Max. Marks			100
Year	I	Credit			1
Core Course					
Course Title	PYTHON PROGRAMMING AND RASPBERRY PI FUNDAMENTALS		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&ML-INTEL)	Programme Code	BTIN
Course Code	25BTIN122	Number of Hours/Week	3
Semester	II	Max. Marks	100
Year	I	Credits	3
Applied Science			

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.	6
III	**Joint distributions**-marginal and conditional distributions-moments-independence of random variables-covariance, and correlation joint moment generating functions-additive properties of random variables-functions of random variables-ordered Statistics.	8

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

COURSE OUTCOMES:

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

- CO1: Understand Basic Probability Concepts
- CO2: 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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN123	Number of Hours/Week	4		
Semester	II	Max. Marks	100		
Year	I	Credits	4		
Applied Science					
Course Title	MATHEMATICS II		L	T	P
			3	1	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.	10
II	**Vector spaces**: Vector space-subspaces-spanning space-bases and dimensions. Linear transformation-matrix representations of linear transformations-range space and rank-null space and nullity-the rank and nullity theorem-invertibility.	6
III	**Eigenvalues and eigenvectors**: Eigen values-eigenvectors and some applications of eigenvalue problems-Hermitian, skew-Hermitian, unitary matrices and their eigenvalues-eigen bases.	8
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.	8
V	**Ordinary Differential Equations**: Review of First Order ODE-Lipschitz condition-Picard`s theorem; Linear differential equations: Linear dependence and Wronskian-linear ODE with constant coefficients of higher order characteristic equations- Cauchy-Euler equations-method of undetermined coefficients-method of variation of parameters- solutions methods using Laplace Transform	10

COURSE OUTCOMES:

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

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

Text Books:

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

Reference Books:

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

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

	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN 124	Number of Hours/Week	3		
Semester	II	Max. Marks	100		
Year	I	Credits	3		
Applied Science					
Course Title	PHYSICS II		L	T	P
			3	0	0

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

COURSE OBJECTIVES:

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

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

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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN222	Number of Hours/Week	2		
Semester	II	Max. Marks	100		
Year	I	Credits	1		
Applied Science					
Course Title	PHYSICS II LAB		L	T	P
			0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours					

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

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

List of experiments

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

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

	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN125	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	8
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.	8
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
- Understand the fundamental aspects of discrete and continuous mathematical structures.
- Demonstrate the principles of mathematical induction to prove statements.
- Differentiate between various algebraic structures and analyze their properties.
- Apply logical reasoning and mathematical techniques to solve problems in set theory, algebra and graph theory.
- Construct new mathematical models thereby generating solutions to complex recurrence relations and graph problems.

Text Books

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

Reference Books

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

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

	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN921	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.	12

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	**10**

Andragogy

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

COURSE OUTCOMES:

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

CO1:	Define environmental studies and its interdisciplinary nature
CO2:	Analyze the structure and functions of various ecosystems, including aquatic ecosystems.
CO3:	Evaluate the growing energy needs and the role of alternative energy sources
CO4:.	Understand levels of biodiversity (genetic, species, and ecosystem) and identify 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&ML-INTEL)	Programme Code	BTIN
Course Code	25BTIN131	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	**Unit-1** Introduction, Definition ,Future of Artificial Intelligence ,Characteristics , Typical Intelligent agents , Problem solving approach , Problem Solving methods , Search strategies ,Uniformed and informed , Heuristics ,Local search ,Algorithm and optimization problems, Searching with partial observations , Constraint satisfactory problems ,Constraint propagation ,Back tracking search ,Game playing ,Optimal decision.	8
II	**Unit- 2** Alpha beta pruning, Stochastic games, First order predicate logic, Porlog programming, Unification, Forward Chaining, Backward chiming ,Resolution ,Knowledge Representation ,Ontological Engineering ,Categories ,Objects, Events ,Mental Events ,Mental Objects ,Reasoning Systems ,Reasoning with default information ,Typical AI Problems.	8
III	**Unit-3** Architecture for intelligent agents, Agent communication, Negotiation, Bargaining, Argumentation, Agents, Trust, Reputation, Multi agent systems, AI applications, Language Models, Information Retrieval, Information extraction, Natural language processing, Machine translation , Speech recognition ,Robot Hardware ,Perception .	8
IV	**Unit-4** Planning, Moving, Frames, Semantic Net Scripts, Goals, Plans ,Inheritance in Taxonomies ,Description logics ,Formal concept analysis ,Conceptual graphs ,Hierarchies in domain, Knowledge based reasoning ,Agents ,Facts of knowledge ,Logic and inference, Formal logic ,Propositional logic.	8
V	**Unit-5** Resolution method, First order logic Second order logic, Genetic algorithms, Travelling sales man problem, Neural networks, Emergent systems, Ant colony optimization, Generate and search, Depth first	8

	search, Breadth first search, Comparison of BFS and DFS, Quality of Solution, Depth bounded DFS, DF Iterative deepening, Hill climbing ,Beam search ,Peak to peak methods.	

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&ML-INTEL)	Programme Code	BTIN
Course Code	25BTIN132	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:

1. Understanding the fundamental characteristics of signals and systems.
2. Understanding the concepts of vector space, inner product space and orthogonal series.
3. 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.
4. 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, time shifting, time scaling, etc.), Parseval's theorem, and time-bandwidth product. Discrete-Time Fourier Transform (DTFT): Fourier transform of discrete-time signals, properties of DTFT (linearity, time shifting, time scaling, etc.). Relationships among Fourier Representations: Relationship between Fourier series, CTFT, and DTFT.	9
IV	**Laplace Transform and Sampling:** Laplace Transform: Definition of	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&ML-INTEL)	Programme Code	BTIN
Course Code	25BTIN133	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN231	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN 134	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,	8
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.	8
III	**Dynamic programming**Memoization, Tabulation, Rod Cutting, Matrix Chain Multiplication, Longest common subsequence, Greedy Algorithms-Introducing greedy approach, activity selection problem, Huffman codes, Graphs, Trees and Algorithms	8
IV	**Introducing spanning trees**, Minimum spanning tree, algorithms,Kruskal, Prims, Bellman-Ford algorithm, Single source shortest path in directed acyclic graphs, Dijkstra's algorithms, Floyd-Warshall algorithm	8
V	**NP-Completeness** Polynomial time, Verification algorithms, NP-Complete, NP-Hard	8

COURSE OUTCOMES:

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

CO1: Understand the Fundamental Data Structures.

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

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

CO4: Utilize graph representations and perform operations.

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

Text Books:

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

ReferenceBooks:

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN232	Number of Hours/Week	2		
Semester	III	Max. Marks	100		
Year	II	Credits	1		
Core Course					
Course Title	DATA STRUCTURE AND ALGORITHMS LAB		L	T	P
			0	0	2

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

COURSE OBJECTIVES:

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

Programs:

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

Course Outcomes:

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

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

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN135	Number of Hours/Week	3		
Semester	III	Max. Marks	100		
Year	II	Credits	3		
Core Course					
Course Title	OBJECT ORIENTED PROGRAMMING		L	T	P
			3	0	0

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

COURSE OBJECTIVES:

- To demonstrate a clear understanding of the necessity and principles of Object-oriented programming.
- To create applications focusing on Object oriented programming concepts.
- To manage memory using pointers leveraging C++ streams and STL container.
- To develop reusable and modular code using the concepts learned.
- To write diversified solutions using C++ language.

UNIT	TOPICS	HOURS
I	**Introduction Object Oriented Programming** Necessity – Differences between procedural and Object-oriented programming- characteristics of object-oriented languages - C and C++, Functions Need of functions, Returning values from functions, Member functions -Types, Object oriented concepts- Introduction – Class, Objects, data abstraction, encapsulation, inheritance, polymorphism, Class and object creation, Simple class and object	8
II	**Operations with objects** Initialization of class objects- Constructor and Destructor- constructor- Default- parameterized -Copy, Objects as function arguments-Returning objects from functions-Memory allocation for objects, Member function definition- Member functions defined- Inside and outside the class	8
III	**Overloading and Functions** Operator overloading- Fundamentals of operator overloading- restriction- operator functions as class members-overloading unary and binary operators- Function Overloading- Friend and Virtual Functions- Data Abstraction, Encapsulation -its application	9
IV	**Inheritance and Polymorphism** Base Class-Derived Class- Base-Class Access Control- protected base class- inheritance-Inheriting Multiple Base Classes-Virtual Base Classes-Types of Inheritance- Public and Private inheritance, aggregation: Classes within classes, inheritance and program development, Virtual Functions and polymorphism, Calling Virtual Function through Base Class Reference- Hierarchical- Pure virtual functions	9
V	**Pointers and Files** Early binding and Late binding, Pointers- Addresses and pointers- the address of operator and pointer and arrays- Memory management: New and Delete, pointers to objects, debugging pointers, References and Dynamic Allocation Operators, Exception Handling-Try-catch class types - C++ Streams Stream classes-formatted I/O, File I/O, The Standard Template Library Overview of STL- Containers- associated programs.	9

COURSE OUTCOMES:

CO 1: Recall the concepts of structured programming.
CO 2: Understand the differences between structure programming and object-oriented programming
CO 3: Able to execute C++ programs utilizing member functions
CO 4: Implement operator and function overloading to extend the capabilities of the programs
CO 5: Create classes and objects employing data abstraction, encapsulation, inheritance and polymorphism in real-world scenarios.

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

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

Programme	B.Tech CSE (AI&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN233	Number of Hours/Week	2		
Semester	III	Max. Marks	100		
Year	II	Credits	1		
Core Course					
Course Title	OBJECT ORIENTED PROGRAMMING LAB		L	T	P
			0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours					

Exercise	TOPICS
Exercise 1	Structure of a basic C++ object-oriented program and the difference between astructured program
Exercise 2	Classes and Objects
Exercise 3	Access specifiers
Exercise 4	Member functions and types
Exercise 5	Constructors and Destructors
Exercise 6	Pointers (Referencing and Dereferencing)
Exercise 7	Dynamic memory allocation
Exercise 8	Data Abstraction along with encapsulation
Exercise 9	Inheritance and its types
Exercise 10	Polymorphism
Exercise 11	Function overloading and operator overloading
Exercise 12	Exception handling
Exercise 13	Template class
Exercise 14	Abstract Base Class with Concrete Methods
Exercise 15	Virtual Functions

COURSE OUTCOMES

CO1: Demonstrate an understanding of the foundational principles of structured programming.
CO2: Differentiate between structured programming and object-oriented programming paradigms.
CO3: Develop C++ programs using member functions effectively.
CO4: Apply operator and function overloading techniques to enhance program functionality.
CO5: Implement classes and objects using principles of data abstraction, encapsulation, inheritance, and polymorphism in real-world 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	1	1	1	1	2	0	0	0	1	0	2	2	1	1	2
CO2	2	2	2	1	2	0	0	0	1	0	2	2	1	1	1
CO3	1	2	3	1	2	0	0	0	1	0	2	3	1	2	2
CO4	1	2	3	2	2	0	0	0	1	0	2	3	2	2	2
CO5	1	2	3	1	2	0	0	0	1	0	3	3	2	2	2

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

Programme	B.Tech CSE (AI&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN931	Number of Hours/Week	2		
Semester	III	Max. Marks	100		
Year	II	Credits	2		
Value Added Course					
Course Title	PROFESSIONAL ETHICS		L	T	P
			2	0	0

0L-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 analyze how 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.	8
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.	8
III	**Engineering as Social Experimentation** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	8
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.	8
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	8

COURSE OUTCOMES:

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

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

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

Semester IV

Programme	B.Tech CSE (AI&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN 141	Number of Hours/Week	3		
Semester	IV	Max. Marks	100		
Year	II	Credits	3		
Core Course					
Course Title	MACHINE LEARNING		L	T	P
			3	0	0

COURSE OBJECTIVES:

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

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

UNIT	TOPICS	HOURS
I	**Introduction** Machine learning what and why supervised and unsupervised learning, polynomial curve fitting, probability theory- discrete random variables, fundamental rules, Bayes rule, Independence and conditional independence, continuous random variables, Quantiles, Mean and variance, probability densities, Expectation and covariance.	8
II	**Linear models for regression** Maximum likelihood estimation – least squares, robust linear expression, ridge regression, Bayesian linear regression. Linear models for classification: Discriminant function – Probabilistic generative models, Probabilistic discriminative models, Laplacian approximation, Bayesian logistic regression, Kernels functions, using kernels in GLMs, Kernel trick, SVMs.	8
III	**Mixture models and EM** K-means clustering, mixtures of Gaussians, An alternative view of EM, Factor analysis, PCA, choosing the number of latent dimensions. Clustering – measuring dissimilarity, evaluating the output of clustering methods, Hierarchical clustering.	8
IV	**Sequential data** Markov models, HMM – maximum likelihood for the HMM, The forward and Backward algorithm, the sum-product algorithm, scaling factors, Viterbi algorithm, linear dynamical systems.	8

V	**Combining models** Bayesian model averaging, Boosting, Adaptive basis function models, CART, generalized additive models, Ensemble learning.	**8**

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.

Reference Books:

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

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

	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN241	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:

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

List of experiments:

S.NO	TITLE
1	Devise a program to import, load and view dataset
2	Create a program to display the summary and statistics of the dataset
3	Implement linear regression to perform prediction
4	Implement Bayesian logistic regression and SVM for classification
5	Implement HMM to predict the sequential data
6	Implement CART learning algorithms to perform categorization
7	Implement Ensemble learning models to perform classification

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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN142	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.	8
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.	8
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	8

IV	**Unit IV** Transaction State, Implementation of Atomicity and Durability, Concurrent, Executions, Serializability, Recoverability , Implementation of Isolation , Testing for serializability, Lock ,Based Protocols , Timestamp Based Protocols, Validation, Based Protocols , Multiple Granularity. Recovery and Atomicity, Log Based Recovery , Recovery with Concurrent Transactions , Buffer Management , Failure with loss of nonvolatile storage,Advance Recovery systems, Remote Backup systems.	**8**
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.	**8**

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&ML-INTEL)	Programme Code	BTIN (P)		
Course Code	25BTIN242	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

Programs

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN143	Number of Hours/Week	3		
Semester	IV	Max. Marks	100		
Year	II	Credits	3		
Core Course					
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;	8
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;	8
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;	8
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;	8
V	**P and NP Problems** NP-Completeness – polynomial time, verification, NP-Completeness and reducibility, NP-Complete problems; Naïve string matching algorithm, Rabin-Karp algorithm;	8

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:

2. Thomas H. Cormen. Algorithms Unlocked. The MIT Press, 2013
3. 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN243	Number of Hours/Week	2		
Semester	IV	Max. Marks	100		
Year	II	Credits	1		
Core Course					
Course Title	DESIGN AND ANALYSIS OF ALGORITHMS LAB		L	T	P
			0	0	2

Course Objectives:

1. To implement advanced algorithms and data structures for efficient problem-solving.
2. To develop skills in analyzing the time and space complexity of algorithms.
3. To apply recursive techniques and tree structures in practical applications.
4. To understand and implement hashing and collision resolution strategies.
5. To explore greedy algorithms and their applications in optimization problems.

Programs:

1. Solving Recurrences using Recursion Tree.
2. Insertion and deletion operations in a Binary Search Tree.
3. Implementation of an AVL tree with insertion, deletion, and tree rotations.
4. Runway reservation system using a Binary Search Tree.
5. Implementation of Strassen's algorithm for matrix multiplication.
6. Randomized algorithm to find the median of an unsorted array.
7. Implementation of a hash table with chaining.
8. Open addressing with double hashing for collision resolution.
9. Huffman Coding.
10. Greedy algorithm.
11. Kruskal's algorithm to find the minimum spanning tree of a graph.
12. Dijkstra's algorithm to find the shortest path.

Course Outcomes:

By learning Design and Analysis of Algorithms students will be able to

CO 1 : Implement and demonstrate various algorithmic techniques in real-world scenarios.
CO 2 : Analyze and compare the efficiency of different algorithms and data structures.
CO 3: Utilize recursion and tree structures effectively for solving computational problems.
CO 4: Design and implement hashing methods for efficient data retrieval.
CO 5: Apply greedy algorithms to optimize solutions for practical 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	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&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN144	Number of Hours/Week	3		
Semester	IV	Max. Marks	100		
Year	II	Credits	3		
Core Course					
Course Title	COMPUTER ORGANIZATION		L	T	P
			3	0	0

COURSE OBJECTIVES:

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

- To understand the basic hardware and software issues of computer organization
- To understand the representation of data at machine level
- To understand how computations are performed at machine level
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

UNIT	TOPICS	HOURS
I	Introduction, Technologies for building Processors and Memory, Performance, The Power Wall, Operations of the Computer Hardware, Operands Signed and Unsigned numbers, Representing Instructions, Logical Operations, Instructions for Making Decisions	10
II	MIPS Addressing for 32, Bit Immediates and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Subword Parallelism, Streaming SIMD Extensions and Advanced Vector Extensions in x86.	8
III	Logic Design Conventions - Building a Datapath, A Simple Implementation Scheme, overview of Pipelining, Pipelined Datapath, Data Hazards: Forwarding versus Stalling, Control Hazards, Exception, Parallelism via Instructions, The ARM Cortex–A8 and Intel Core i7 Pipelines, Instruction, Level Parallelism and Matrix Multiply Hardware Design language.	10
IV	Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance, dependable memory hierarchy, Virtual Machines, Virtual Memory, Using FSM to Control a Simple Cache, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks, Advanced Material: Implementing Cache Controllers.	10
V	Disk Storage and Dependability, Parallelism and Memory Hierarchy: RAID levels, performance of storage systems, Introduction to multi-threading clusters, message passing multiprocessors.	8

COURSE OUTCOMES:

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

CO1 : Understand the architecture and functionality of central processing unit

CO2 : Analyze the abstraction of various components of a computer

CO3 : Analyze the hardware and software issues and the interfacing

CO4 : Work out the trade-offs involved in designing a modern computer system

CO5 : Understand the various memory systems and I/O communication

Text Books:

1. David A. Patterson, John L. Hennessey, "Computer Organization and Design, The Hardware/Software Interface", Fifth Edition, Morgan Kauffman/Elsevier, 2014.

2. Smruti Ranjan Sarangi, "Computer Organization and Architecture", McGraw Hill Education, 2015.

Reference Books:

1. V. Carl Hamacher, Zvonko G. Varanesic, Safat G. Zaky, "Computer Organization", Sixth Edition, McGrawHill Inc., 2012.

2. William Stallings, "Computer Organization and Architecture", Eighth Edition, Pearson Education, 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	1	1	2	1	2	2	3	1	2	1	3	3	2	1
CO2	3	3	1	2	3	1	1	1	1	1	1	3	2	1	1
CO3	3	3	3	2	2	1	2	2	1	1	3	3	3	3	2
CO4	2	3	1	3	2	2	2	2	2	1	1	3	3	2	2
CO5	3	3	2	3	3	2	1	1	1	1	1	3	3	2	2

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

Programme	B.Tech CSE (AI&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN041	Number of Hours/Week	3		
Semester	IV (DSE I)	Max. Marks	100		
Year	II	Credits	3		
Discipline Specific Elective					
Course Title	OPERATING SYSTEM		L	T	P
			3	0	0

COURSE OBJECTIVES:

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

- To explore fundamental concepts in 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.	8
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.	8
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	8
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	8
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 hardware operations, streams, performance.	8

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:

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

Reference Books:

3. 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

	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

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

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN042	Number of Hours/Week	3		
Semester	IV (DSE I)	Max. Marks	100		
Year	II	Credits	3		
Discipline Specific Elective					
Course Title	CONTINUAL 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 fundamental concepts and significance of Continual Learning (CL).
- To understand Regularization-based approaches like EWC (Elastic Weight Consolidation) and Synaptic Intelligence (SI).
- To investigate Natural Language Processing (NLP) models with CL, including Transformer-based methods.
- To explore Federated Continual Learning (FCL) and its role in Edge AI & Distributed Learning.
- To identify open challenges and limitations of existing CL models.

UNIT	TOPICS	HOURS
I	**Introduction to Continual Learning (CL):** Definition and Scope of Continual Learning - Key Challenges: Catastrophic Forgetting, Plasticity - Stability Tradeoff, Transfer & Retention of Knowledge Comparison with Related Fields: Online Learning, Meta - Learning, Incremental Learning, Types of CL Paradigms: Task-incremental, Class - incremental, Domain-incremental, Online Learning Applications: Robotics, Healthcare, Finance, Autonomous Systems, NLP.	10
II	**Approaches & Strategies for Continual Learning:** Replay - based Methods: Experience Replay, Generative Replay - Memory - Augmented Neural Networks (MANN), Regularization - based Methods: Elastic Weight Consolidation (EWC) - Synaptic Intelligence (SI)- Learning without Forgetting (LwF), Architectural Strategies: Progressive Neural Networks - PackNet & PathNet - Dynamic Expansion Models.	9
III	**Continual Learning in Deep Learning & NLP:** Computer Vision Applications- Incremental Image Classification- Domain Adaptation for CL, Natural Language Processing (NLP)- Transfer Learning in NLP- Transformer-based CL (Adapter Layers, Prompt Learning) - Self-Supervised Learning in Continual Learning.	9
IV	**Reinforcement Learning & Federated Continual Learning:** Continual Learning in Reinforcement Learning (RL) : Policy Gradient Methods & Zero-shot Transfer - Curriculum Learning & Lifelong RL, Federated Continual Learning (FCL): CL in Edge AI & Distributed Systems- Privacy-Preserving Continual Learning.	9

V	**Challenges, Ethical Considerations & Future Directions:** Challenges in Continual Learning: Model Adaptation & Forgetting Mitigation - Bias & Fairness in Continual Learning Models - Industry Applications & Emerging Trends Future of Continual Learning in AI & Robotics	**8**

COURSE OUTCOMES:

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

CO1	Understand Fundamentals of Continual Learning
CO2	Apply and Compare Different Continual Learning Strategies
CO3	Implement Continual Learning in Deep Learning and NLP
CO4	Explore Reinforcement Learning & Federated Continual Learning
CO5	Analyze Ethical Considerations & Future Research in Continual Learning

Text Books:

1. Lifelong Machine Learning, Author: Zhiyuan Chen & Bing Liu, Publisher: Morgan & Claypool Publishers, Year: 2018, ISBN: 978-1681733173.
2. Ethics of Artificial Intelligence and Robotics – Markus D. Dubber, Oxford University Press, Publication Date: June 30, 2020, ISBN-13: 978-0190067397.
3. NeurIPS, ICML Research Papers on Ethical AI & Continual Learning.

Reference Books:

1. The Oxford Handbook of Ethics of AI," Editors: Markus D. Dubber, Frank Pasquale, Sunit Das, Publisher: Oxford University Press .Year: 2020, ISBN: 978-0190067397.
2. Transformers for NLP: Build and Train Deep Learning Models for Natural Language Processing, Author: Denis Rothman, Publisher: Packt Publishing, Year: 2021, ISBN: 978-1800208973.

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

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN043	Number of Hours/Week	3		
Semester	IV (DSE I)	Max. Marks	100		
Year	II	Credits	3		
Discipline 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 –	9

	Collaboration networks – Co-Citation networks.	
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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN044	Number of Hours/Week	3		
Semester	IV (DSE I)	Max. Marks	100		
Year	II	Credits	3		
Discipline Specific Elective					
Course Title	FULL STACK DEVELOPMENT - DevOps		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

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN045	Number of Hours/Week	3		
Semester	IV (DSE I)	Max. Marks	100		
Year	II	Credits	3		
Discipline Specific Elective					
Course Title	BLOCK CHAIN AND ITS APPLICATION		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 Quantum Mechanical Foundations of Information Processing.
- Learn Core Concepts of Quantum Information Theory.
- Analyze Quantum Algorithms and Computational Models.
- Explore Quantum Communication Techniques.
- Understand Quantum Error Correction and Fault Tolerance

UNIT	TOPICS	HOURS
I	Block chain – The growth of blockchain technology – Distributed systems – The history of blockchain and bitcoin – Types of blockchain –Consensus	9
II	Decentralization – Decentralization using blockchain – methods of decentralization – Routes to decentralization – Blockchain and full ecosystem decentralization – Smarts contracts – Decentralizaed organizations – Platforms for decentralization	9
III	Symmetric Cryptography – Working with openSSL command – Introduction – Cryptography – Confidentiality – Integrity – Authentication – Non-repudiation – Accountability – Symmetric cryptography – Stream ciphers – Block ciphers – Data encryption standard – Advanced encryption standard	9
IV	Introducing bitcoin – Bitcoin – Digital keys and addresses – Transactions – Blockchain – Mining	9
V	Bitcoin network and payments – The bitcoin network – wallets – Bitcoin payments – innovation in bitcoin	9

COURSE OUTCOMES:

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

CO1	To understand the basics of blockchain
CO2	To interpret the decentralization in blockchain
CO3	To categorize the symmetric cryptography
CO4	To estimate block chain and its application
CO5	To evaluate bitcoin networks and payments

Text Book

1. **Mastering bitcoin**, Imran Bashir, Second Edition, packt, Birmingham, Mumbai, 2018

Reference Books

1. **Blockchain basics: A non-technical introduction in 25 steps,** Daniel Drescher, Apress, 2017
2. **Blockchain for Enterprise Application Developers,** Ambadas Tulajadas Chondari, Arshad Sarfaz Ariff, Sham M R, Wiley, 2020

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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	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

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN046	Number of Hours/Week	3		
Semester	IV (DSE I)	Max. Marks	100		
Year	II	Credits	3		
Discipline Specific Elective					
Course Title	DIGITAL IMAGE PROCESSING		L	T	P
			3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours					

COURSE OBJECTIVES:

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

- To learn the fundamentals of image processing and various transformations applied in an image
- To learn image enhancement techniques
- To understand image restoration
- To impart knowledge on different compression techniques.
- To discuss on image segmentation and feature representations

UNIT	TOPICS	HOURS
I	**Introduction** Introduction to Digital Image Processing - Characteristics of Digital Image - Basic relationship between pixels - Image sampling and quantization - Color models - Basic Geometric Transformations - Fourier Transform - Cosine-Sine and Hartley Transform - Hadamard-HaarSlant Transform - Discrete Fourier Transform	9
II	**Image Enhancement Techniques** Spatial Domain Methods - Basic Grey Level Transformation - Histogram Processing - Image subtraction - Image averaging - Spatial filtering - Smoothing - Sharpening filters - Laplacian filters - Frequency domain filters - Smoothing - Sharpening filters - Homomorphic filtering.	9
III	**Image Restoration** Model of Image Degradation/restoration process - Noise models - Spatial and Frequency Filters - Inverse filtering & Wiener Filtering - Least mean square filtering - Constrained least mean square filtering.	9
IV	**Image Compression** Fundamentals Image Compression Models - Lossless compression: Variable length coding - LZW coding - Bit plane coding - predictive coding - DPCM - Lossy Compression: Lossy Predictive Coding - Transform coding - Wavelet coding.	9

V	**Image Segmentation & Analysis** Image Segmentation techniques - Edge detection - Thresholding - Region - Boundary Extraction & Representation - Region - Moment representation - chain codes - Polygonal approximation - Texture - Pattern Recognition. Applications - Fingerprint/iris recognition - Remote sensing - Automatic character recognition - Medical image processing.	**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	Differentiate and interpret various image enhancement techniques
CO2	Reconstruct the image from the degraded image
CO3	Analyze and use appropriate image compression techniques
CO4	Suggest proper image features for classification problems
CO5	Develop the image segmentation techniques

Text Books:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2018.
2. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", Second Edition, Mc Graw Hill, 2020.

Reference Books:

1. A.K. Jain, "Fundamentals of Digital Image Processing", PHI, New Delhi, 2015.
2. William K Pratt, "Digital Image Processing", Fourth Edition, John Wiley, 2007.
3. S E Umbaugh, "Digital Image Processing and Analysis: Application with MATLAB and CVIP Tools", Third Edition , Taylor & Francis, CRC Press, 2018.
4. Frank Y. Shih, "Image Processing and Pattern Recognition", Wiley – IEEE Press, 2010.

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

high, 2 – Average, 1 - Low , 0-Null

Programme	B.Tech CSE (AI&ML-INTEL)	Programme Code	BTIN		
Course Code	25BTIN941	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:

-

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.	12
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	12
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.	12
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.	12

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.	**12**

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.

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN151	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 generalization.
- Apply deep learning methods to solve real-world problems in computer vision, NLP, and other domains.

UNIT	TOPICS	HOURS
I	**Unit 1 Introduction to neural networks** Biological neuron, Motivation from biological neuron, McCulloch Pitts Neuron, Perceptron, Perceptron learning Algorithm, Representation power of a network of perceptrons, Activation functions-Sigmoid, tanh, ReLU, leaky ReLU, Sigmoid neuron, Gradient descent learning Algorithm, Representation power of multilayer Network of Sigmoid Neurons, Representation power of function: Complex functions in real world examples.	9
II	**Unit2 Optimization** Limitations of gradient descent learning algorithm, Momentum based gradient descent, Nesterov accelerated gradient descent, AdaGrad, RMSProp, Adam learning algorithm, Stochastic gradient descent, Mini-batch gradient descent, Bias Variance tradeoff, Overfitting in deep neural networks, Hyperparameter tuning, Regularization: L2 regularization, Dataset Augmentation and Early Stopping, Dimensionality reduction, Principal Component Analysis, Autoencoders, Relation between PCA and Autoencoders, Regularization in Autoencoders.	9
III	**Unit 3 word2vec and Convolutional Neural networks** One hot representation of words, Distributed representation of words, SVD for learning word Representations, Continuous bag of words model, Skip-gram model, Introduction to Convolution Neural Networks, Kernel filters, The convolution operation with Filters, padding and stride, Max pooling and non-linearities,	9

	Classic CNNs architecture- The ImageNet challenge, Alex Net architecture, ZFNet, The intuition behind GoogleNet, Residual CNN-ResNet architecture, DenseNet Architecture.	
IV	**Unit 4 Recurrent Neural networks** Transfer Learning, Need for Transfer Learning, Applications of Transfer learning, Sequence Learning Problems, Recurrent Neural Networks, Backpropagation through time, Unfolded RNN, problem of exploding and vanishing Gradients, Seq to Seq Models, How gates help to solve the problem of vanishing gradients, Long-Short Term Memory architectures, Dealing with exploding gradients, Gated Recurrent Units, Encoder-Decoder Models and its applications.	**9**
V	**Unit 5 Attention models & Generative Adversarial Networks** Language Modeling, Image Captioning, Machine Translation, Attention Mechanism, Attention over images, Hierarchical Attention, Monte Carlo Methods, Local Independencies in a Markov Network, Joint Distributions, The concept of a latent variable, Restricted Boltzmann Machines, RBMs as Stochastic Neural Networks, Unsupervised Learning with RBMs, Setting up a Markov Chain for RBMs, Generative Adversarial Networks- Architecture, Generative Adversarial Networks- 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:	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN152	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN153	Number of Hours/Week	3		
Semester	V	Max. Marks	100		
Year	III	Credits	3		
Core Course					
Course Title	COMPUTER ARCHITECTURE		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 computer architecture and how hardware components such as the CPU, memory, and I/O devices interact to execute programs efficiently.
- To explore different types of computer architectures like Von Neumann, Harvard, RISC, and CISC, and to understand their respective advantages and limitations in real-world applications.
- To gain in-depth knowledge of computer arithmetic, digital logic, and memory systems, focusing on the design of ALUs, arithmetic operations, and memory hierarchy.
- To analyze and understand various input/output mechanisms, including the I/O bus, interrupt systems, and storage devices, and how they contribute to system performance.

UNIT	TOPICS	HOURS
I	**Introduction to Computer Architecture** Overview of Computer Systems: Basic components and operations. Computer Organization vs. Architecture: Differences and their relationship. Basic Building Blocks: Central Processing Unit (CPU), memory, input/output devices. Machine-Level Representation of Data: Binary, hexadecimal systems, representation of integers and floating-point numbers. Instruction Set Architecture (ISA): CISC vs. RISC architectures, instruction formats, addressing modes.	9
II	**Computer Arithmetic**: Adder, Ripple carry Adder, carry look Ahead Adder, Multiplication: Add and Shift, Array multiplier and Booth Multiplier, Division: restoring and Non-restoring Techniques. Floating Point Arithmetic: Floating point representation, Add, Subtract, Multiplication, Division	9
III	**Memory Organization**: RAM, ROM, Memory Hierarchy, Organization, Associative memory, Cache memory, and Virtual memory: Paging and Segmentation.	9
IV	**Input-Output Organization and arithmetic's**: Input-Output Interface, Modes of Transfer, Priority Interrupt, DMA, IOP processor. Error Detection and Correction (Parity Bit, Hamming Code, CRC)	9
V	**Fundamentals of Parallel Processing**: Types of Parallelism: Instruction-level, Data-level, Thread-level), Multi-Core and Multi-Processor Architectures (Types of Processors: Single-core, Multi-core, Clustered Systems, Shared vs. Distributed Memory Architectures, Synchronization Mechanisms), Pipelining (Instruction Pipelining, Hazards: Structural, Data, Control Hazards, Performance Improvement through Pipelining), GPU Architecture (Basics of Graphics Processing Units.	9

COURSE OUTCOMES:

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

CO1 :	Describe the fundamental components and architecture of a computer system, including CPU, memory, I/O devices, and storage systems
CO2 :	Explain the key concepts in computer architecture, such as instruction sets, memory hierarchy, and different types of computer architectures
CO3 :	Apply digital logic principles and computer arithmetic in designing and simulating basic components like ALUs and memory systems, and perform operations like binary arithmetic and error detection
CO4 :	Analyze the performance of computer systems by evaluating factors like memory access time, cache performance, pipelining efficiency, and the impact of parallelism and multi-core processing on system speed and scalability
CO5 :	Critically assess various input/output systems, including I/O buses, interrupts, and storage devices.

Text Book

1. M. Moris Mano , Computer System Architecture, 3rd edition, Pearson/PHI, India, 2014
2. **"Computer Organization and Design: The Hardware/Software Interface"** by David A. Patterson and John L. Hennessy

Reference Books

1. **"Parallel Computer Architecture: A Hardware/Software Approach"**by David Culler and Jaswinder Pal Singh (Publisher: Morgan Kaufmann),2014.
2. **"Computer Architecture: A Quantitative Approach"**by John L. Hennessy and David A. Patterson (Publisher: Elsevier), 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	2	0	0	2	0	0	0	0	2	0	0	3	0	3
CO2	3	2	0	0	2	2	0	0	0	0	0	0	3	0	3
CO3	0	0	3	3	3	3	0	0	0	3	0	3	2	3	3
CO4	3	2	0	3	0	3	0	0	0	0	0	0	3	0	3
CO5	0	2	0	0	0	3	3	3	0	2	0	0	3	0	3

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

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN154	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.	10
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.	10
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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN051	Number of Hours/Week	3		
Semester	V (DSE II)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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.	9

	Maintenance and Reengineering.	

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN052	Number of Hours/Week	3		
Semester	V (DSE II)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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.	8
II	**Genetic Algorithms:** Genetic algorithms: Mathematical foundation, Genetic problem solving, crossover and mutation. Genetic algorithms and Markov process, applications of genetic algorithms.	8
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.	8
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.	8
V	**Applications:** Selected nature inspired techniques - Bat algorithm- Cuckoo search algorithm. Deep Learning-Pattern recognition -Cybersecurity and its applications -Complex Network.	8

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN053	Number of Hours/Week	3		
Semester	V (DSE II)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN054	Number of Hours/Week	3		
Semester	V (DSE II)	Max. Marks	100		
Year	III	Credits	3		
Discipline Specific Elective					
Course Title	FULL STACK DEVELOPMENT-UI/UX		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 provide a knowledge in UI & UX.
- To Understand the need for UI & UX.
- To understand the various research methods used in design.
- To explore the various tools used in UI/UX.
- Creating a wireframe and prototype.

UNIT	TOPICS	HOURS
I	**INTRODUCTION** : UI vs. UX Design – Core Stages of Design Thinking – Divergent and Convergent Thinking -Brainstorming and Game storming – Observational Empathy.	8
II	**FOUNDATIONS OF UI DESIGN:** Visual and UI Principles – UI Elements and Patterns – Interaction Behaviours and Principles -Branding – Style Guides	8
III	**FOUNDATIONS OF UX DESIGN:** Introduction to User Experience-Why You Should Care about User Experience-Understanding User Experience-Defining the UX Design process and its methodology-Research in user Experience design-Tools and method for research.	8
IV	**WIREFRAMING, PROTOTYPING AND TESTING** Sketching Principles – Sketching Red Routes – Responsive Design – Wire framing – Creating Wire flows – Building a Prototype – Building High-Fidelity Mock ups – Designing Efficiently with Tools – Interaction Patterns – Conducting Usability Tests – Other Evaluative User Research Methods -Synthesizing Test Findings – Prototype Iteration	8
V	**RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE** Identifying and Writing Problem Statements – Identifying Appropriate Research Methods – Creating Personas – Solution Ideation – Creating User Stories – Creating Scenarios – Flow Diagrams – Flow Mapping – Information Architecture	8

COURSE OUTCOMES:

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

CO1	Build UI for User Applications.
CO2	Evaluate UX design of any product or applications.
CO3	Demonstrate UX skills in product development.
CO4	Implement Sketching principles.
CO5	Create wireframe and prototype.

Text Books:

1. Joel Marsh, "UX for Beginners", O'Reilly, 2022
2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021

Reference Books:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition, O'Reilly 2020
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018
3. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature.

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN055	Number of Hours/Week	3		
Semester	V (DSE II)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN056	Number of Hours/Week	3		
Semester	V (DSE II)	Max. Marks	100		
Year	III	Credits	3		
Discipline Specific Elective					
Course Title	SIX SIGMA		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 Six Sigma Principles**: Gain knowledge about Six Sigma principles, history, and its role in improving process quality and efficiency.
- **Implement DMAIC Methodology**: Learn how to effectively apply the DMAIC (Define, Measure, Analyze, Improve, Control) methodology in real-world processes to identify problems, analyze data, and improve quality.
- **Master the Define and Measure Phases**: Develop skills to define the project scope, identify key performance indicators, and measure process performance through data collection and analysis.
- **Analyze and Solve Problems Using Statistical Tools**: Apply various statistical tools and techniques to analyze data, identify root causes, and improve process performance.
- **Sustain Improvements**: Learn strategies for sustaining improvements, implementing control plans, and ensuring continuous process optimization in organizations.

UNIT	TOPICS	HOURS
I	**Introduction to Six Sigma** Introduction to Six Sigma: Definition, Evolution, and Importance, Principles of Six Sigma and its relationship with Total Quality Management (TQM), Overview of DMAIC methodology (Define, Measure, Analyze, Improve, Control), Six Sigma roles: Champion, Black Belt, Green Belt, Yellow Belt, Benefits of implementing Six Sigma in organizations.	8
II	**Define Phase:** Problem identification and defining the project scope, Creating project charter, stakeholders, and team structure, Defining customer requirements and Critical to Quality (CTQ), Voice of the Customer (VOC) and mapping customer needs, Process mapping and creating SIPOC diagrams.	8
III	**Measure Phase:** Defining and measuring process performance, Selecting process metrics and key performance indicators (KPIs), Data collection techniques: Types of data, sampling methods, and measurement systems analysis (MSA), Pareto analysis and other tools for measuring process performance, Statistical tools for measurement: Descriptive statistics, histograms, and control charts.	8
IV	**Analyze Phase:** Analyzing the data to identify root causes of problems, Tools for analysis: Fishbone diagram, 5 Whys, FMEA (Failure Modes and Effects Analysis), Hypothesis testing and statistical analysis: t-tests, ANOVA, regression analysis, Process capability analysis and identifying process variation, Use of statistical software (Minitab,	8

	Excel) in analyzing data.	
V	**Improve and Control Phases:** Improvement strategies and solutions: Brainstorming, creative problem solving, and innovation, Design of Experiments (DOE) and its role in process improvement, Statistical Process Control (SPC) and control charts, Implementation of control plans to sustain improvements, Developing and monitoring process control charts for continuous improvement.	**8**

Course Outcomes

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

CO1	Understand the principles, evolution, and significance of Six Sigma and DMAIC
CO2	Define projects using SIPOC diagrams, VOC, and CTQ to meet customer needs
CO3	Measure and evaluate process performance using KPIs, statistical tools, and charts
CO4	Analyze data using root cause tools (e.g., Fishbone, FMEA) and statistical software
CO5	Develop and monitor process improvements using SPC, DOE, and control charts

Text Books:

1. **George, Michael L.**, "The Lean Six Sigma Pocket Toolbook," McGraw-Hill Education, 2005.
2. **Harry, Mikel J., and Schroeder, Richard**. "Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations," Doubleday, 2000.
3. **Pande, Peter S., Neuman, Robert P., and Cavanagh, Roland R.**, "The Six Sigma Way: How GE, Motorola, and Other Top Companies Are Honing Their Performance," McGraw-Hill, 2000.

Reference Books:

1. **Hoffman, Michael**., "Six Sigma for Dummies," Wiley, 2005..
2. **Chase, Richard B., and Jacobs, F. Robert**, "Operations and Supply Chain Management," McGraw-Hill, 2014.
3. **Montgomery, Douglas C.**, "Introduction to Statistical Quality Control," Wiley, 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	3	3	2	2	3	2	3	3	2	2	2	3	2	2
CO2	3	3	3	3	3	3	3	3	3	3	2	2	3	3	2
CO3	3	3	2	3	3	3	2	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	2	3	3	2	2	3	3	3	3
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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN251	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

Lab1: Apply MP Neuron and perceptron to solve a binary classification problem
Lab2: Apply sigmoid neuron to solve a real-world classification / regression problem
Lab3: Build a FFN Network to solve a Multi- class classification problem
Lab4: Implement linear regression with stochastic gradient descent.
Lab5: Implement linear regression with stochastic mini-batch gradient descent and compare the results with previous exercise.
Lab 6: Optimizing neural networks using L2 regularization, Dropout, data augmentation and early stopping
Lab 7: Implement skip gram model to predict words within a certain range before and after the current word.
Lab 8: Implement LeNet for image classification
Lab 9: Implement ResNet for detecting objects.
Lab 10: Transfer learning implementation using VGG16 model to classify images.
Lab 11: Building a RNN to perform Character level language modeling
Lab 12: Build a LSTM network for Named Entity recognition.
Lab 13: Neural Machine Translation with attention.
Lab 14: Case study on Scene Understanding using RBMs
Lab 15: Case study on generating examples for Image dataset using Generative Adversial Networks

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN252	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

Semester VI

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN161	Number of Hours/Week	3		
Semester	VI	Max. Marks	100		
Year	III	Credits	3		
Core Course					
Course Title	INTEGRATED ADVANCED AI AND IOT		L	T	P
			3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours					

COURSE OBJECTIVES:

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

- To familiarize students with the Raspberry Pi board, its configurations, and basic Linux operating system commands. (Remember, Understand)
- To enable students to write Python programs for GPIO and interface sensors with the Raspberry Pi. (Apply)
- To develop understanding of communication protocols such as UART, SPI, and I2C using Raspberry Pi. (Understand, Apply)
- To introduce cloud communication through MQTT and basic GUI development for IoT applications. (Apply, Create)
- To explore the fundamentals of Edge Computing using Intel NCS2 and the Open, VINO toolkit. (Understand, Analyze)

UNIT	TOPICS	HOURS
I	**Introduction to Raspberry Pi** Overview of Raspberry Pi and its features - Different versions of Raspberry Pi - Initial configuration of the Raspberry Pi board - Introduction to Linux-based operating systems - Basic shell commands and usage of Linux terminal - Text editors: Vi and Nano - Configuring remote access using SSH- Introduction to shell scripting.	9
II	**Programming the Raspberry Pi** Introduction to GPIO programming using Python - LED blinking and push-button input handling - UART, SPI, and I2C communication protocols - Interfacing with DHT11 sensor - Configuring Raspberry Pi as an MQTT broker - Sending sensor data to the cloud - Developing a simple Python GUI for LED control.	9
III	**Sensor and Device Interfacing** Advanced sensor interfacing techniques - Real-time data acquisition and processing - Power management and hardware considerations - Integration with external peripherals - Use cases in IoT applications.	9
IV	**Raspberry Pi Communication Protocols** In-depth exploration of UART, SPI, and I2C, Protocol configuration and troubleshooting, Data transmission between multiple devices, Practical communication scenarios using Raspberry Pi, Network configuration and remote data exchange.	9

V	**Introduction to Edge Computing and AI Integration** Overview of Intel Neural Compute Stick 2 (NCS2), Interfacing NCS2 with Raspberry Pi, Introduction to the Intel OpenVINO toolkit, Basics of edge computing and its relevance, Real-time AI inference using Raspberry Pi and NCS2.	**9**

COURSE OUTCOMES:

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

CO1	Describe the architecture, features, and setup process of the Raspberry Pi board. (Remember, Understand)
CO2	Execute Python programs to control GPIO and interface digital sensors with Raspberry Pi. (Apply)
CO3	Demonstrate data communication using UART, SPI, and I2C protocols. (Apply, Analyze
CO4	Build simple IoT applications using MQTT for cloud connectivity and GUI for device control. (Apply, Create)
CO5	Analyze the role of Edge Computing and AI deployment using Intel NCS2 and OpenVINO on Raspberry Pi. (Analyze, Evaluate)

Text Books:

1. Programming the Raspberry Pi: Getting Started with Python by Simon Monk, Publisher: McGraw-Hill Education TAB (16February2013), ISBN-13:978-0071807838.

2. Raspberry Pi Cookbook: Software and Hardware Problems and Solutions 2nd Edition by Simon Monk, Publisher: O'Reilly Media; edition(June21,2016),ISBN-13:978-1491939109.

Reference Books:

1. Raspberry Pi 3 Cookbook for Python Programmers: Unleash the potential of Raspberry Pi 3 with over 100 recipes, 3rd Edition Paper back–April30,2018 by TimCox (Author), Dr. Steven Lawrence Fernandes (Author), Publisher: Packt Publishing; 3rd Revised edition (April 30, 2018),ISBN-13:978-1788629874.

2. Python for Everybody: Exploring Datain Python 3 by Charles Severance (Author), Aimee Andrion (Illustrator), Elliott Hauser (Editor), Sue Blumenberg (Editor), ASIN: B01IA5VIFM.

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN162	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	24TAM163	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.
3. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
4. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
5. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
6. 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN164	Number of Hours/Week	3		
Semester	VI	Max. Marks	100		
Year	III	Credits	3		
Core Course					
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

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN261	Number of Hours/Week	2		
Semester	VI	Max. Marks	100		
Year	III	Credits	1		
Core Course					
Course Title	Integrated advanced AI and IoT Lab		L	T	P
			0	0	2
L-Lecture Hours T-Tutorial Hours P-Practical Hours					

COURSE OBJECTIVES:

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

1. Familiarization with Raspberry Pi environment and installation of necessary software.
2. To interface LED/Buzzer with Raspberry Pi and to write a program to turn LED/Buzzer ON for 1 sec after every 2sec.
3. To interface Push button/Digital sensor (IR/LDR) with Raspberry Pi and write a program to turn ON the LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Raspberry Pi and send the temperate and humidity data on Things peak cloud.
5. To install MySQL database on Raspberry Pi and perform basic SQL queries.
6. Write a program on Raspberry Pi to publish/subscribe temperature data to/from MQTT broker.
7. Write a program to create TCP server on Raspberry Piand respond with humidity data to client when requested.
8. To interface Raspberry Pi with Arduino.
9. Implementation of data communication between smart phone and Raspberry Pi over Bluetooth
10. Interfacing of Raspberry Pi camera module with Raspberry Pi for capturing images. Interfacing Intel NCS2 with Raspberry Pi and running demo scripts.

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN061	Number of Hours/Week	3		
Semester	VI (DSE III)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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;	8
II	**Logic in AI** Different knowledge representation systems; syntax; semantics; forward chaining; Resolution; Reduction in satisfiability problems; SAT solvers; DPLL algorithms; Walk SAT algorithms	8
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;	8
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	8
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	8

COURSE OUTCOMES:

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

CO1	Describe the history behind artificial intelligence
CO2	Illustrate fundamental AI concepts
CO3	Demonstrate problem formulation in state space search
CO4	Infers adversarial search with alpha-beta pruning
CO5	Develop an AI model for existing problems

Text Books:

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

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN062	Number of Hours/Week	3		
Semester	VI (DSE III)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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	8
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	8
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;	8
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;	8
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;	8

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN063	Number of Hours/Week	3		
Semester	VI (DSE III)	Max. Marks	100		
Year	III	Credits	3		
Discipline Specific Elective					
Course Title	SCALABLE 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 scalable 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 scalable machine learning

UNIT	TOPICS	HOURS
I	**Introduction** Introduction; basics of linear algebra; scalars; vectors; tensors; norms; span; linear independence; matrix decompositions; probability – discrete and continuous random variable, expectation, variance, covariance; matrix calculus	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	**Deep Learning** Logistic regression; binary entropy cost function; multinomial classification; feedforward neural networks; backpropagation algorithm; convolution neural networks – types convolution; CNN architectures – LeNet, AlexNet, VGG Net, GoogleNet, ResNet, DenseNet; image classification; semantic segmentation; transfer learning	9
IV	**Training Large Networks** Activation functions; learning rate decay; weight initialization; data normalization; batch norm; recurrent neural networks; sequence classification; Training RNNs – Loss, BPTT; LSTM; Deep RNNs; clustering – kmeans, agglomerative	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	Execute classical ML approaches into scalable machine learning
CO3	Implement generative models for ML applications
CO4	Validate the ML models to improve the performance
CO5	Develop an innovative scalable ML model for existing problems

Text Books:

4. Gauri Joshi, Optimization Algorithms for Distributed Machine Learning SpringerLink, 2022.
5. Ian J. Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, Cambridge, MA, USA, 2016.
6. Stefano Ermon, Deep Generative models CS236 Fall 2023

Reference Books:

1. Andrew Ng., Machine Learning Yearning. deeplearning.ai, 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	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN064	Number of Hours/Week	3		
Semester	VI (DSE III)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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:

5. 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN065	Number of Hours/Week	3		
Semester	VI (DSE III)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN066	Number of Hours/Week	3		
Semester	VI (DSE III)	Max. Marks	100		
Year	III	Credits	3		
Discipline 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

Semester VII

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN171	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	**Fundamentals of HPC, Linux & Shell Scripting** Introduction to HPC, Intel HPC architecture (Xeon, GPUs, AI accelerators); Linux basics: File system, commands, environment setup; Shell scripting for automation; Secured Shell Intel oneAPI toolkit Introduction to Intel HPC Toolkit	9
II	**Traditional ML using Intel OneAPI** Parallel Computing Using Intel AI Analytics Toolkit (Optimized Scikitlearn, Pandas, NumPy); Intel Extension for Scikit-learn for optimized ML algorithms;	9
III	**Deep Learning on HPC with TensorFlow, Slurm & GPUs** Intel-optimized TensorFlow (tensorflow-mkl, oneDNN); Running DL models on Intel GPUs (Xeon, Habana Gaudi); Slurm job scheduling for Deep Learning (batch jobs, resource allocation); Training Tensorflow with Horovod	9
IV	**Distributed AI Training & Profiling Optimization** Distributed TensorFlow training with Slurm; Profiling & debugging with Intel Vtune	9
V	**Generative AI & LLMs on Intel HPC** Intel hardware for LLMs (Xeon, Habana Gaudi); Optimizing LLM inference with OpenVINO Toolkit; Fine-tuning LLMs on HPC	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN172	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.	8
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	8
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.	8
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.	8

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.	**8**

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN173	Number of Hours/Week	3		
Semester	VII	Max. Marks	100		
Year	IV	Credits	3		
Core Course					
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;	8
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)	8
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;	8
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	8
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	8

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

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN174	Number of Hours/Week	3		
Semester	VII	Max. Marks	100		
Year	IV	Credits	3		
Core Course					
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	6
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	7

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN071	Number of Hours/Week	3		
Semester	VII (DSE IV)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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	9

	Engineering and Cybersecurity.	

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN072	Number of Hours/Week	3		
Semester	VII (DSE IV)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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).	8
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.	8
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.	8
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.	8
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.	8

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 & ML - INTEL)	Programme Code	BTIN
Course Code	25BTIN073	Number of Hours/Week	3
Semester	VII (DSE IV)	Max. Marks	100
Year	IV	Credits	3

Discipline 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.	8
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.	8
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.	8
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.	8

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.	**8**

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN074	Number of Hours/Week	3		
Semester	VII (DSE IV)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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.	8
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.	8
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.	8

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.	**8**
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.	**8**

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN075	Number of Hours/Week	3		
Semester	VII (DSE IV)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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	8
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	8
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	8

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	**8**
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	**8**

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN076	Number of Hours/Week	3		
Semester	VII (DSE IV)	Max. Marks	100		
Year	IV	Credits	3		
Discipline Specific Elective					
Course Title	ADVANCED PYTHON - OBJECT ORIENTED PROGRAMMING		L	T	P
			3	0	0
L-Lecture Hours T-Tutorial Hours P-Practical Hours					

COURSE OBJECTIVES:

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

- To reinforce Python concepts using object-oriented techniques
- To build a strong foundation in core OOP principles
- To explore real-world design approaches using Python
- To understand structured and modular software development.

UNIT	TOPICS	HOURS
I	**Python Recap and OOP Basics:** Python data types, loops, conditionals, and functions - Introduction to Object-Oriented Programming - Defining Classes and Creating Objects - Attributes and Methods - __init__() constructor and self keyword System Design.	9
II	**Core OOP Principles:** Encapsulation and Abstraction - Inheritance: Single, Multilevel, Multiple - Method Overriding, super() keyword - Polymorphism and Dynamic Typing - Class and Static Methods.	9
III	**Advanced Class Features:** Special (Magic) Methods: __str__, __repr__, __len__, etc. - Private and Protected Members - Class vs Instance Variables - Object Lifecycle and Garbage Collection - Abstract Classes using abc module.	9
IV	**Exception Handling and File Operations:** Types of Errors and Exceptions - Try-Except-Else-Finally Blocks - Raising Exceptions and Custom Exceptions - Reading from and Writing to Files - Working with Text, CSV, and JSON files.	9
V	**OOP Design and Applications:** Composition vs Inheritance - Introduction to Common Design Patterns: Factory, Singleton - Modular Programming with Packages and Modules - Code Reusability and Maintainability - Real-world Use Cases and Case Study Discussion.	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	Explain OOP concepts and Python's class-based features.
CO2	Construct well-structured Python classes using inheritance and polymorphism.
CO3	Demonstrate exception handling and file operations effectively
CO4	Analyze design choices between inheritance, abstraction, and composition
CO5	Apply OOP concepts to design modular and reusable programs

Text book:

1. Dusty Phillips, *Python Object-Oriented Programming*, 4th Edition, Packt Publishing, 2022.
2. Kenneth A. Lambert, *Fundamentals of Python: First Programs*, 2nd Edition, Cengage Learning, 2018.

References:

1. Luciano Ramalho, *Fluent Python: Clear, Concise, and Effective Programming*, 2nd Edition, O'Reilly Media, 2022.
2. Allen B. Downey, *Think Python: How to Think Like a Computer Scientist*, 2nd Edition, O'Reilly Media, 2015.

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

	PO1	PO2	PO3	PO4	PO5	PO	PO7	PO	PO9	PO1	PO1	PO1	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	1	1	2	1	3	3	2	2
CO2	3	3	3	2	3	-	-	1	1	2	2	3	3	3	3
CO3	3	3	2	3	3	-	-	1	1	2	2	3	3	2	3
CO	3	3	3	3	3	1	1	-	1	1	2	3	3	3	3
CO5	3	3	3	3	3	1	-	1	2	3	3	3	3	3	3

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

Programme	B.Tech CSE (AI & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN271	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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN081	Number of Hours/Week	3		
Semester	VIII (DSE V)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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	8
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;	8
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	8
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`	8

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	**8**

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:

2. 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN082	Number of Hours/Week	3		
Semester	VIII (DSE V)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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.	8
II	**Web Services:** Uses, Basics of Web Services, SOAP, UDDI, Orchestrating Web Services, Securing Web Services, Grid Enabled and Semantic Web of Web Services	8
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	8
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.	8

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.	**8**

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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN083	Number of Hours/Week	3		
Semester	VIII (DSE V)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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;	8
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	8
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	8

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	**8**
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	**8**

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:

2. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall Press, USA, 3rd edition, 2009
3. 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN084	Number of Hours/Week	3		
Semester	VIII (DSE V)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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 & ML - INTEL)	Programme Code	BTIN		
Course Code	25BTIN085	Number of Hours/Week	3		
Semester	VIII (DSE V)	Max. Marks	100		
Year	IV	Credits	3		
Discipline 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.	8
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.	8
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.	8
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.	8

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.	**8**

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 & ML - INTEL)	Programme Code	BTIN
Course Code	25BTIN086	Number of Hours/Week	3
Semester	VIII (DSE V)	Max. Marks	100
Year	IV	Credits	3

Discipline Specific Elective

Course Title	APPROXIMATION 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:

- To understand the basics of approximation algorithm technique
- To understand the different types of algorithm and searching methods
- To infer about rounding of linear programs using deterministic and randomized
- To infer about primal-dual method
- Evaluate with cut and matrices method

UNIT	TOPICS	HOURS
I	**An Introduction to the Techniques – An introduction to approximation algorithms** – The whats and whys of approximation algorithms – An introduction to the techniques and to linear programming – A deterministic rounding algorithm – Rounding a dual solution - constructing a dual solution: the primal-dual method – A greedy algorithm – A randomized rounding algorithm	8
II	**Greedy algorithm and local search:** Scheduling jobs with deadlines on a single machine – the k-center problem – Scheduling jobs on identical parallel machines – the travelling salesman problem – maximizing float in bank accounts – finding minimum-degree spanning trees – edge colouring. **Rounding data and dynamic programming**: the knapsack problem – scheduling jobs on identical parallel machines – the bit-packing problem	8
III	**Deterministic rounding of linear programs:** Minimizing the sum of completion times on a single machine – minimizing the weighed sum of completion times on a single machine – Solving large linear programs in polynomial time – the prize-collecting Steiner tree problem – the uncapacitated facility location problem – the bin-packing problem. **Random sampling and randomized rounding of linear programs:** Simple algorithms for MAX SAT and MAX CUT – Derandomization - Flipping biased coins - Randomized rounding - Choosing the better of two solutions - Non-linear randomized rounding - the prize-collecting Steiner tree problem - The uncapacitated facility location problem- Scheduling a single machine with release dates - Chernoff bounds - Integer multicommodity flows - Random sampling and coloring dense 3-colorable graphs	8
IV	**Randomized rounding of semi definite programs:** A brief	8

	introduction to semidefinite programming - Finding large cuts - Approximating quadratic programs - Finding a correlation clustering - Coloring 3-colorable graphs. **The primal-dual method:** The set cover problem: a review - Choosing variables to increase - Cleaning up the primal solution - Increasing multiple variables at once - Strengthening inequalities - The uncapacitated facility location problem - Lagrangean relaxation and the k-median problem	
V	**Cuts and metrics:** The multiway cut problem and a minimum-cut-based algorithm - The multiway cut problem and an LP rounding algorithm - The multicut problem - Balanced cuts - Probabilistic approximation of metrics by tree metrics - An application of tree metrics: Buy-at-bulk network design - Spreading metrics, tree metrics, and linear arrangement	**8**

COURSE OUTCOMES:

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

CO1	To understand the basics of approximation algorithm technique
CO2	To understand the different types of algorithm and searching methods
CO3	To infer about rounding of linear programs using deterministic and randomized
CO4	To infer about primal-dual method
CO5	Evaluate with cut and matrices method

Text Book

1. The Design of Approximation Algorithm, David.P. Williamsons, David. B.Shmoys, Cambridge University Press, 2010

Reference Books

1. Approximation Algorithms, Vijay V. Varirani, Springer, 2003
2. NP-Hard Problems and Approximation Algorithm, Springer, 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	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