RAMDEOBABA UNIVERSITY
[RBU]
NAGPUR – 440013

RBU

RAMDEOBABA UNIVERSITY, NAGPUR

Formerly Shri Ramdobaba College of Engineering & Management (RCOEM) Est. 1984

PROGRAMME SCHEME & SYLLABI

B. Tech Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

2024-25

School of Computer Science & Engineering

Department Vision

To achieve excellence in Artificial Intelligence and Machine Learning education for global competency while upholding human values.

Department Mission

To pursue excellence in Academics, Research and Innovation by:

M1: Creating innovative and dynamic learning environments to deliver quality technical education by continuously improving curriculum and teaching methodologies.

M2: Collaborating with academia, industry, and society to strengthen the design thinking, research, innovation, and entrepreneurship ecosystem.

M3: To foster a lifelong learning ecosystem by providing cutting-edge laboratories that keep up with the latest advances in artificial intelligence.

M4: Encouraging student centric activities to develop leadership skills, instil human values and ethics, and foster a feeling of dedication and accountability.

Programme Outcomes

Engineering graduates will be able to:

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

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

3. **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.

4. **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.
5. **Modern Tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **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.

7. **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.

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

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

10. **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.

11. **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.

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

B. Tech. Computer Science and Engineering
(Artificial Intelligence & Machine Learning)
[2024-25]
Teaching & Evaluation Scheme [B. Tech CSE-AIML]
Semester - I

Sr. No.	Course Type	Course Code	Course Name	Hours/ Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/ Internal Evaluation	Total	
1	ESC	24CS01TH0101	Fundamentals of Programming	3	0	3	50	50	100	3
2	ESC	24CS01PR0101	Fundamentals of Programming Lab	0	2	1	25	25	50	-
3	PCC	24EE01TH0107	Computer Architecture and Organization	3	0	3	50	50	100	3
4	VSEC	24CS01PR0103	Computer Workshop–I Lab	0	2	1	25	25	50	-
5	ESC	24CS01PR0104	Fundamentals of Linux OS Lab	0	2	1	25	25	50	-
6	VEC	24CS01TH0105	Cyber Laws & Ethics in IT	2	0	2	50	50	100	2
7	BSC	24HS03TH0103	Probability and Statistics	3	0	3	50	50	100	3
8	BSC	24HS03PR0101	Computational Mathematics Lab for CSE	0	2	1	25	25	50	-
9	VEC	24HS02TH0104	Foundational Course in Universal Human Values	1	0	1	50	-	50	-
10	BSC	24HS05TH0102	Introduction to Quantum Computing	3	0	3	50	50	100	3
11	BSC	24HS05PR0102	Introduction to Quantum Computing Lab	0	2	1	25	25	50	-
			TOTAL	**15**	**10**	**20**	**-**	**-**	**800**	**-**

Semester – II

Sr. No	Course Type	Course code	Course Name	Hours/ Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/Internal Evaluation	Total	
1	ESC	24CS01TH0201	Object Oriented Programming	3	0	3	50	50	100	3
2	ESC	24CS01PR0201	Object Oriented Programming Lab	0	2	1	25	25	50	-
3	PCC	24CS01TH0202	Data Structures	3	0	3	50	50	100	3
4	PCC	24CS01PR0202	Data Structures Lab	0	2	1	25	25	50	-
5	VSEC	24CS01PR0203	Computer Workshop–II Lab	0	2	1	25	25	50	-
6	PCC	24CS01TH0204	Operating Systems	3	0	3	50	50	100	3
7	PCC	24CS01PR0204	Operating Systems Lab	0	2	1	25	25	50	-
8	BSC	24HS03TH0214	Calculus and Linear Algebra	3	0	3	50	50	100	3
9	IKS	24HS02TH0203	Foundational Literature of	1	0	1	50	-	50	-

			Indian Civilization							
10	BSC	24HS02PR0202	Professional Communication Lab	0	2	1	25	25	50	-
11	CCA	24HS04PR0201	Sports-Yoga-Recreation	0	2	1	25	25	50	-
12	VEC	24HS01TH0202	Environmental Science	1	0	1	50	-	50	-
13	VEC	24HS01PR0202	Environmental Science Lab	0	2	1	25	25	50	-
13	CCA	24HS02PR0206-1 to 16/ 24HS04PR0202-1 to 4/	Liberal/Performing Art	0	2	1	25	25	50	-
			TOTAL	**14**	**16**	**22**	**-**	**-**	**900**	**-**

Liberal/ Performing Art Bucket

Sr. No.	Course Code	Course Title	L	P	Credits	Continuous Evaluation	End Sem Exam/ Internal Evaluation	Total	ESE Duration
1	24HS02PR0206-01	Fundamentals of Indian Classical Dance: Bharatnatayam	0	2	1	25	25	50	_
2	24HS02PR0206-02	Fundamentals of Indian Classical Dance: Kathak	0	2	1	25	25	50	_
3	24HS02PR0206-03	Introduction to Digital Photography	0	2	1	25	25	50	_
4	24HS02PR0206-04	Introduction to Japanese Language	0	2	1	25	25	50	_
5	24HS02PR0206-05	Art of Theatre	0	2	1	25	25	50	_
6	24HS02PR0206-06	Introduction to French Language	0	2	1	25	25	50	_
7	24HS02PR0206-07	Introduction to Spanish Language	0	2	1	25	25	50	_
8	24HS02PR0206-08	Art of Painting	0	2	1	25	25	50	_
9	24HS02PR0206-09	Art of Drawing	0	2	1	25	25	50	_
10	24HS02PR0206-10	Nature Camp	0	2	1	25	25	50	_
11	24HS02PR0206-11	Developing Self-awareness	0	2	1	25	25	50	_
12	24HS02PR0206-12	Art of Poetry	0	2	1	25	25	50	_
13	24HS02PR0206-13	Creative and content writing	0	2	1	25	25	50	_
14	24HS02PR0206-14	Science of life through Bhagwad Gita	0	2	1	25	25	50	_
15	24HS02PR0206-15	Sanskrit Sambhashan Spoken Sanskrit	0	2	1	25	25	50	_
16	24HS02PR0206-16	Kirtan Kala	0	2	1	25	25	50	_
17	24HS04PR0202-01	Adventure Sports	0	2	1	25	25	50	_
18	24HS04PR0202-02	Introduction to Defense Forces & Obstacle Training	0	2	1	25	25	50	_
19	24HS04PR0202-03	Self Defense and Indian Martial Arts	0	2	1	25	25	50	_
20	24HS04PR0202-04	Basic Nutritional Course	0	2	1	25	25	50	_

Semester - III

Sr. No.	Course Type	Course Code	Course Name	Hours/ Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/ Internal Evaluation	Total	
1	PCC	24CS03TH0301	Theory of Computation	3	0	3	50	50	100	3
2	PCC	24CS03TH0302	Database Management Systems	3	0	3	50	50	100	3
3	PCC	24CS03PR0302	Database Management Systems Lab	0	2	1	25	25	50	-
4	VSEC	24CS03PR0303	Programming Laboratory – I	0	4	2	25	25	50	-
5	PCC	24CS03TH0304	Microcontroller and Sensors	3	0	3	50	50	100	3
6	PCC	24CS03PR0304	Microcontroller and Sensors Lab	0	2	1	25	25	50	-
7	BSC	24HS03TH0301	Discrete Mathematics	3	0	3	50	50	100	3
8	OE	24CSOEC01TH0305	Open Elective-I	2	0	2	50	50	100	2
9	MDM	24CS03TH0306	MDM-I	3	0	3	50	50	100	3
			TOTAL	**17**	**8**	**21**	**-**	**-**	**750**	**-**

Semester - IV

Sr. No.	Course Type	Course code	Course Name	Hours / Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/Internal Evaluation	Total	
1	PCC	24CS03TH0401	Internet of Things (IoT)	3	0	3	50	50	100	3
2	PCC	24CS03TH0402	Design and Analysis of Algorithms	3	0	3	50	50	100	3
3	PCC	24CS03PR0402	Design and Analysis of Algorithms Lab	0	2	1	25	25	50	-
4	PCC	24CS03TH0403	Artificial Intelligence	3	0	3	50	50	100	3
5	PCC	24CS03PR0403	Artificial Intelligence Lab	0	2	1	25	25	50	-
6	VSEC	24CS03PR0404	Programming Laboratory – II	0	4	2	25	25	50	-
7	OE	24CSOEC01TH0405	Open Elective-II	2	0	2	50	50	100	2
8	CEP	24CS03PR0405	Community Engagement Project	0	4	2	25	25	50	-
9	VEC	24CS03TH0406	Creativity, Innovation & Design Thinking	2	0	2	50	-	50	-
10	AEC	24CS03PR0407	Basic Competitive Coding	0	2	1	50	-	50	-
11	MDM	24CS03TH0408	MDM-II	3	0	3	50	50	100	3
			TOTAL	**16**	**14**	**23**	**-**	**-**	**800**	**-**

Semester - V

Sr. No.	Course Type	Course Code	Course Name	Hours / Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/ Internal Evaluation	Total	
1	PCC	24CS03TH0501	Machine Learning	3	0	3	50	50	100	3
2	PCC	24CS03PR0501	Machine Learning Lab	0	2	1	25	25	50	-
3	PCC	24CS03TH0502	Cloud & Edge Computing for AI	3	0	3	50	50	100	3
4	PCC	24CS03PR0502	Cloud & Edge Computing for AI Lab	0	2	1	25	25	50	-
5	PCC	24CS03TH0503	Computer Networks	3	0	3	50	50	100	3
6	PCC	24CS03PR0503	Computer Networks Lab	0	2	1	25	25	50	-
7	PCC	24CS03PR0504	Data Analytics & Visualization Lab	0	4	2	25	25	50	-
8	EEM	24CS03PR0505	Idea Lab	0	2	1	25	25	50	-
9	PEC	24CS03TH0506	Program Elective-I	3	0	3	50	50	100	3
10	OE	24CSOEC01TH0505	Open elective-III	2	0	2	50	50	100	2
11	MDM	24CS03TH0507	MDM-III	3	0	3	50	50	100	3
			TOTAL	**17**	**12**	**23**	**-**	**-**	**850**	**-**

Semester - VI

Sr. No.	Course Type	Course code	Course Name	Hours/ Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/Internal Evaluation	Total	
1	PCC	24CS03TH0601	Deep Learning	3	0	3	50	50	100	3
2	PCC	24CS03PR0601	Deep Learning Lab	0	2	1	25	25	50	-
3	PCC	24CS03TH0602	Generative AI Techniques	3	0	3	50	50	100	3
4	PCC	24CS03PR0602	Generative AI Techniques Lab	0	2	1	25	25	50	-
5	PEC	24CS03TH0603	Program Elective –II	3	0	3	50	50	100	3
6	PEC	24CS03TH0604	Program Elective –III	3	0	3	50	50	100	3
7	PCC	24CS03PR0605	Comprehensive Viva	0	2	1	50	-	50	-
8	AEC	24HS02TH0601	Business Communication	1	0	1	50	-	50	-
9	AEC	24HS02PR0601	Business Communication Lab	0	2	1	25	25	50	-
10	VSEC	24CS03PR0606	Mini Project	0	4	2	25	25	50	-

11	AEC	24CS03PR0607	Advanced Competitive Coding	0	2	1	50	-	50	-
12	MDM	24CS03TH0608	MDM-IV	3	0	3	50	50	100	3
			TOTAL	**16**	**14**	**23**	**-**	**-**	**850**	**-**

Semester – VII

Sr. No.	Course Type	Course Code	Course Name	Hours/ Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/ Internal Evaluation	Total	
1	PCC	24CS03TH0701	Reinforcement Learning	3	0	3	50	50	100	3
2	PCC	24CS03PR0701	Reinforcement Learning Lab	0	2	1	25	25	50	-
3	PCC	24CS03TH0702	Graph ML-Foundation & Application	3	0	3	50	50	100	3
4	PCC	24CS03PR0702	Graph ML-Foundation & Application Lab	0	2	1	25	25	50	-
5	PCC	24CS03TH0703	Data Privacy in AI	2	0	2	50	50	100	2
6	PEC	24CS03TH0704	Program Elective-IV	3	0	3	50	50	100	3
7	PRJ	24CS03PR0705	Major Project-1	0	8	4	50	50	100	-
8	AEC	24CS03PR0706	Participative Learning	0	2	1	50	-	50	-
9	Internship	24CS03PR0707	Internship Evaluation [Min 6 Weeks]	-	-	-	-	-	-	-
			TOTAL	**11**	**14**	**18**	**-**	**-**	**650**	**-**

Semester – VIII

Sr. No.	Course Type	Course code	Course Name	Hours / Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/Internal Evaluation	Total	
1.	PEC	24CS03TH0801	Program Elective-V NPTEL/SWAYAM	3	0	3	50	50	100	3
2.	PEC	24CS03TH0802	Program Elective-VI NPTEL/SWAYAM	3	0	3	50	50	100	3
3.	PRJ	24CS03PR0803	Major Project-2	0	12	6	50	50	100	-
			TOTAL	**6**	**12**	**12**	**-**	**-**	**300**	**-**
			OR							
1.	Internship	24CS01PR0804	Industry Internship/Research Internship/TBI	**0**	**24**	**12**	**200**	**100**	**300**	

Electives Basket

Micro Specialization	Elective-I [V Sem]	Elective-II [VI Sem]	Elective-III [VI Sem]	Elective-IV [VII Sem]	Elective-V [VIII Sem]	Elective-VI [VIII Sem]
Security	AI Security Essentials	Data Privacy and Ethical AI	Block chain and Security in AI	Ethical Hacking for AI and ML	Advanced Topics in AI Security	Network & Cloud Security
Image processing and NLP	Image Processing & Generative Models	Computer Vision	Natural Language Processing	Soft Computing	Automatic Speech/ Video recognition	Advanced Natural Language Processing with Transformers
Advanced AIML	Programming for Data Science and AI	Applied Artificial Intelligence and Expert Systems	Artificial Intelligence for Robotics	Graphical & Generative Model for ML	Trustworthy AI and Explainable AI	Industry Applications of ML
Generic AI	Intelligent Multiagent System	Business Intelligence	Cognitive Systems	Intelligent Robots & Drone Technology	Knowledge Representation	Intelligent Embedded System

Common Points of All Programs under CSE School

Multidisciplinary Minor [MDM] Track
[For Students other than School of Computer Science & Engineering]

Semester	MDM	Track
Semester-III	MDM-I	Introduction to Web Development
Semester-IV	MDM-II	Front End Development
Semester-V	MDM-III	Backend Technologies
Semester-VI	MDM-IV	Cloud Technologies

Open Elective

Semester	Course Name
Semester-III [Open Elective-I]	Cyber Laws & Ethics/ Statistical Computing with R/Introduction to Data Science
Semester-IV [Open Elective-II]	Tools for Data Science/Web Development/Mobile App Development
Semester-V [Open Elective-III]	Data Analytics & Visualization/Open-Source Technologies/Basics of Ethical Hacking

Minor

Semester	Track
Semester-III	Programming for Problem Solving
Semester-IV	Tools & Techniques of Artificial Intelligence
Semester-V	Exploratory Data Analysis
Semester-VI	Fundamentals of Machine Learning
Semester-VII	Project

Honors Courses [NO ESE exam, Continuous Assessment]

Honors in Emerging Technologies

Sr. No.	Sem	Course Code	Name of Course	Hours per week		Credits	Maximum Marks			ESE Duration Hrs
				L	P		Continuous Evaluation	End Sem Exam	Total	
1	III		Blockchain and Web 3 Programming	3	0	3	100	-	100	-
2	IV		Development of Progressive Web Application	3	0	3	100	-	100	-
3	V		Cloud Native App Development	4	0	4	100	-	100	-
4	VI		Introduction to Devops	4	0	4	100	-	100	-
5	VII		Project	0	8	4	50	50	100	-

Honors in Full Stack Development

Sr. No.	Sem	Course Code	Name of Course	Hours per week		Credits	Maximum Marks			ESE Duration Hrs
				L	P		Contin uous Evaluation	End Sem Exam	Total	
1	III		Web Development	3	0	3	100	-	100	-
2	IV		Full Stack-I	3	0	3	100	-	100	-
3	V		Full Stack-II	4	0	4	100	-	100	-
4	VI		Software Development Automation	4	0	4	100	-	100	-
5	VII		Project	0	8	4	50	50	100	-

Honors in Cyber Security

Sr. No.	Sem	Course Code	Name of Course	Hours per week		Credits	Maximum Marks			ESE Duration Hrs
				L	P		Continuous Evaluation	End Sem Exam	Total	
1	III		Information and Cyber Security	3	0	3	100	-	100	-
2	IV		Cyber Security Auditing	3	0	3	100	-	100	-
3	V		Cyber Forensics: Threats, Vulnerability, Malware	4	0	4	100	-	100	-
4	VI		Security Strategies in Windows and Linux	4	0	4	100	-	100	-
5	VII		Project	0	8	4	50	50	100	-

Honors in Data Science

Sr. No.	Sem	Course Code	Name of Course	Hours per week		Credits	Maximum Marks			ESE Duration Hrs
				L	P		Contin uous Evaluation	End Sem Exam	Total	
1	III		Data Science Essentials	3	0	3	100	-	100	-
2	IV		Software Architecture Analysis	3	0	3	100	-	100	-
3	V		Data Engineering	4	0	4	100	-	100	-
4	VI		Business and Web Analytics	4	0	4	100	-	100	-
5	VII		Project	0	8	4	50	50	100	-

Honors in AIML

Sr. No.	Sem	Course Code	Name of Course	Hours per week		Credits	Maximum Marks			ESE Duration Hrs
				L	P		Continuous Evaluation	End Sem Exam	Total	
1	III		Computational Statistics for Data Science	3	0	3	100	-	100	-
2	IV		Distributed Computing Frameworks	3	0	3	100	-	100	-
3	V		AIML Techniques for Vision and Navigation	4	0	4	100	-	100	-

4	VI		Generative Adversarial Networks	4	0	4	100	-	100	-
5	VII		Project	0	8	4	50	50	100	-

Honor With Research

Sr. No.	Sem	Course Code	Name of Course	Hours per week		Credits	Maximum Marks			ESE Duration Hrs
				L	P		Continuous Evaluation	End Sem Exam	Total	
1	VII		Research Methodology / NPTEL	4	0	4	50	50	100	-
2	VII		Project -I	0	8	4	100	100	200	-
3	VIII		Project -II	0	20	10	200	200	400	-

Value Added Courses [Duration 30 Hours]

- Industrial IoT Applications
- Amazon Web Services [Cloud]
- Power BI
- Zero Trust Cloud Security

Exit Programs Options

First Year [Certificate Course in Basic Programming Skills]

i. Computer Hardware and Networking
ii. Advanced JAVA programming
iii. Python Programming
iv. Web Designing

Second Year [Diploma in respective discipline]

i. Web Development
ii. Mobile Development
iii. Data Analyst
iv. Ethical Hacking
v. IT certified data engineer
vi. Blockchain and its application

Third Year [Bachelor of Vocation in respective discipline]

i. Project

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01TH0101 **Course: Fundamentals of Programming**
L: 3Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

Course Objectives:
The objective of this course is to develop logical thinking and problem-solving techniques.

Unit I: Algorithm and Flowchart for problem-solving, Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Decision Control Statement- if and Conditional operators.

Unit II: Switch case statement, Loops, Pre-processor Directives

Unit III: Concept of functions, User defined and Library Functions, parameter passing, Recursion, Storage class, Pointers.

Unit IV: Arrays: 1-D, 2-D, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Pointers to the array, Command line arguments, User Defined Data Types: Structures, enum, union

Unit V: File handling Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using fflush().

Course Outcomes
On successful completion of the course, student shall be able to
1. Design logic for simple problem statements using flowchart and algorithm.
2. Develop solution for problem statements involving decision-making and loops.
3. Apply the concept of functions for modular programming
4. Implement solution for problem statements using arrays and structures
5. Perform file operations

Text Books:
1. The C Programming Language: B. W. Kernighan and D. M. Ritchie, Second Edition, Pearson, June 2015
2. Programming in ANSI C: E. Balguruswami McGraw Hill

Reference Books
1. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01PR0101 **Course: Fundamentals of Programming Lab**
L: 0Hrs, T: 0 Hr, P: 2Hr, Per Week **Total Credits: 1**

Syllabus

- Practical's will be conducted based on Syllabus of Fundamentals of Programming [**24CS01TH0101]**

Course Outcomes

On successful completion of the course, student shall be able to

1. Design logic for simple problem statements using flowchart and algorithm.
2. Develop solution for problem statements involving decision-making and loops.
3. Apply the concept of functions for modular programming.
4. Implement solution for problem statements using arrays and structures.
5. Perform file operations.

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24EE01TH0107 **Course: Computer Architecture and Organization**

L: 3 Hrs, P: 0Hr, Per Week **Total Credits: 3**

SYLLABUS

UNIT I: Fundamentals of Computer Architecture:

Number Systems and their operations, Floating Point number representation, Basics of Computer Architecture and Organization, Evolution of Computing System, Performance Metrics (MIPS, FLOPS, CPI, IPC, Execution time).

UNIT II: Instruction Set Architecture and Arithmetic Operations:

Instruction Execution cycle, Instruction Set Architecture, addressing modes, Instruction set classification, Pipelining Architecture, Multiplication: Booth's Algorithm, Bit-pair recoding, Integer Division: Restoring and non-restoring division.

UNIT III: Memory Hierarchy and Management:

Memory hierarchy, Types of memory in Computer System and their Characteristics, Cache memory: Mapping functions, Replacement policies, Virtual Memory: Paging and Segmentations, Memory interleaving

UNIT IV: Input/output Organization:

Introduction to I/O systems: I/O interface and bus systems, Modes of data Transfer: Program I/O, Interrupt driven I/O and Direct Memory access (DMA), I/O addressing Techniques, Interrupts: Interrupts and interrupt handling mechanisms.

UNIT V: Advanced Computer Architectures and Parallel Processing:

Pipelining and Super Scalar Execution, Parallel processing and Multicore Architecture, Flynn's Taxonomy for parallel architectures, GPUs and their role in modern computing.

Course Outcomes:

On successful completion of course, students will be able to:

1. Explain the basic structure and operation of a computer system.
2. Analyze Instruction Set Architecture and Arithmetic Operations
3. Evaluate Memory Hierarchy and Management
4. Demonstrate I/O organization, data transfer methods, and interrupt handling.
5. Apply the knowledge of computer architecture principle to comprehend advance computing architectures

Text Books

1. V.C. Hamacher, Z.G. Vranesic and S.G. Zaky; Computer Organization; 5th edition; McGrawHill,2002.
2. W. Stallings; Computer Organization & Architecture; PHI publication; 2001.

Reference Books

1. M Mano; Computer System and Architecture; PHI publication; 1993. A.S. Tanenbaum; Structured Computer Organization; Prentice
2. J. P. Hayes; Computer Architecture & Organization; 3rdedition; McGraw-Hill; 1998.

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code : 24CS01PR0103 **Course : Computer Workshop-I Lab**

L: 0 Hrs, P: 2 Hrs, Per Week **Total Credits: 1**

Syllabus:

MS Excel

Complex formulas: INDEX-MATCH and array formulas, Pivot tables for comprehensive data analysis, Advanced charting for dynamic data visualization, Conditional formatting for data insights, Automating tasks with macros, Data validation for error-free data entry

HTML

Creation of headers, paragraphs, links, importing of images, tables, designing of forms, and document structure of HTML.

HTML-5

Navigation in Webpage, Multimedia based tags- audio, video, iframe, Creating Animations.

CSS & Bootstrap

Introduction to Cascading Style Sheets, Features, Core syntax, Style Sheets and HTML StyleRule, Text Properties

Course Outcomes

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

1. Perform Data Analysis using MS Excel.
2. Design static web pages using HTML.
3. Demonstrate proficiency in web page styling using CSS and Bootstrap.
4. Develop websites using MS Excel, HTML and CSS

Text Books

1. Microsoft Excel 2019: Data analysis and Business Modelling, Wayne Winston, Microsoft Press, 6th edition 2019.
2. HTML & CSS: The Complete Reference, Thomas Powell, MGH, 5th edition, 2017.
3. Bootstrap 5 Foundations, Daniel Charles Foreman, Independently published, 2021.

Reference Books

1. Mastering Advanced Excel, Ritu Arora, BPB Publications, 2023.
2. HTML and CSS: Design and Build Webs, Jon Duckett, Wiley, 1st edition, 2011.
3. Web Design: A Beginner’s Guide, Wendy Willard, MGH, 2nd edition, 2010.

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01PR0104 **Course: Fundamentals of Linux OS Lab**

L: 0 Hrs, P: 2 Hr, Per Week **Total Credits: 1**

Course Objectives:

The course on Open-Source Software Tools aims to provide a comprehensive understanding and practical skills in open-source software. Students will explore the history, principles, and significance of open source. The course covers hands-on experience with popular open-source operating system and software tools. Through this course, students will gain the knowledge and skills to effectively utilize and contribute to the open-source ecosystem.

Linux Operating System:
1. Introduction and history of Linux OS
2. Basic commands
3. File system and file handling commands
4. User, Group management commands
5. Process handling commands
6. Package management
7. Shell and shell script
8. Introduction to popular IDEs, Git

Course Outcomes

Upon completion of the course, students will be able to

1. Understand the architecture and use of Linux operating system.
2. Effectively use different services provided by Linux operating system.
3. Automate tasks and write simple programs using shell scripts.
4. Use popular IDEs for program development.

Text Book
1. Linux Pocket guide- Daniel J. Barrett, O'Reilly Media
2. Linux: The Complete Reference, Sixth Edition- Richard Petersen, McGraw Hill Education

Reference Books
1. Linux Administration: A Beginner’s Guide – Wale Soyinka, McGraw Hill Publication
2. Linux Command Line and Shell Scripting Bible- Richard Blum, Wiley

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01TH0105 **Course: Cyber Laws & Ethics in IT**

L: 2 Hrs, P: 0 Hr, Per Week **Total Credits: 2**

Syllabus:

UNIT I
Ethics in business world & IT professional malpractices, Introduction to firewalls, IDS System, Distortion and fabrication of information

UNIT II
Ethics of IT Organization: Contingent Workers H- IB Workers, Whistle- blowing, Protection for Whistle- Blowers, Handling Whistle- blowing situation, Digital divide.

UNIT III
Intellectual Property: Copyrights, Patents, Trade Secret Laws, Key Intellectual property issues, Plagiarism, Privacy: The right of Privacy, Protection, Key Privacy and K- Anonymity issues, Identity Theft, Consumer Profiling,

UNIT IV
Cyber laws and rights in today's digital age, Emergence of Cyberspace, Cyber Jurisprudence, Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber terrorism, cyber tort, Cyber Defamation & hate speech, Competitive Intelligence, Cybersquatting, The Indian Information Technology Act 2000 IT Act.

Course Outcomes
On successful completion, of course student will able to learn:

1. To analyze the role of ethics in IT organization.
2. To identify various cyber laws with respect to legal dilemmas in the Information Technology field.
3. To interpret various intellectual property rights, Privacy, Protection issues in Information Technology field.
4. To describe the ways of precaution and prevention of Cyber Crime as well as Human Rights.

Text Books:

1. George Reynolds, “Ethics in information Technology”,5th edition, Cengage Learning
2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001.

Reference Books:

1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.
2. Debora Johnson,” Computer Ethic s”,3/e Pearson Education.

3. Sara Baase, “A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet,” PHI Public at ions.
4. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
5. Dr Pramod Kr.Singh, “Laws on Cyber Crimes [Along with IT Act and Relevant Rules]” Book Enclave Jaipur India.

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS03TH0103 **Course: Probability and statistics**

L: 3 Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 3**

Course Pre-requisite: Basics of Probability and Statistics.

Course Objective:
The objective of this course is to expose student to understand the basic importance fundamental principles of probability, including probability distributions, random variables, basic statistical methods used for data analysis, inferential statistics, hypothesis testing, confidence intervals, and regression analysis in computer science and Information technology.

Syllabus

Unit I (8 hours)
Measure of central tendency, quartile, inter quartile range and outliers**,** Probability spaces, conditional probability, independence, Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution and their applications.

Unit II: (8 Lectures)
Joint probability function, Introduction to stochastic process, random walk, stationary and auto regressive process, transition probability Matrix, Discrete time Markov chain and its applications in queueing problems.

Unit III: (**8 hours)**
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, correlation and regression – Rank correlation, Multiple regression and correlation and its application in analysis of data.

Unit IV: (8 Lectures)
Sampling Distributions, Point and Interval Estimations, Testing of Hypothesis for single mean and proportion.

Unit V: (7 Lectures):
Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes, maximum likelihood estimation

Course Outcomes

On successful completion of the course, student shall be able to

1. Grasp the meaning of discrete and continuous random variables, probability distribution. Interpret the meaning of probabilities derived from distributions. This involves understanding what the calculated probabilities represent in practical terms and drawing conclusions from the results.
2. To analyze and interpret stochastic models, including calculating probabilities, transition probabilities, and steady-state probabilities within stochastic systems.
3. Grasp the fundamental concepts of curve fitting like regression techniques, model selection, and the use of different types of curves or functions to approximate data.
4. Understand the fundamental concept of hypothesis testing, including the null hypothesis (H0) and alternative hypothesis (H1), significance levels, p-values, and the basic logic behind hypothesis testing.

5. To apply MLE to various statistical models, such as linear regression, exponential distribution, etc. They should understand how to formulate likelihood functions and derive estimators for unknown parameters.

Text Books:

1. M R. Spiegal , Theory and Problems of probability and statistics :,2nded :,Schaum series
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books:

1. Maurtis Kaptein, Statistics for data science, An introduction to probability, statistics and Data Analysis, Springer 2022.
2. Jay L Devore, Probability and Statistics for Engineering and sciences, 8th edition, Cenage learning.

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS03PR0101 **Course: Computational Mathematics Lab for CSE**
L: 0 Hrs, T: 0 Hr, P: 2Hr, Per Week **Total Credits: 1**

Course Objectives: The computational Mathematics Lab course will consist of experiments demonstrating the principles of Mathematics relevant to the study of Science and Engineering. Students will show that they have learnt Laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid conclusions. On successful completion of the course students shall be able to:

Course Outcomes:
By using open source software Students will be able to

1. Utilize mathematical software as an advanced calculator to create and manipulate 2D and 3D plots in SageMath, enabling effective visualization and interpretation of data
2. Recognizing, solving, and applying recurrence relations to a wide range of computational problems
3. Use partial derivatives and gradients for optimizing multivariable functions
4. Apply linear algebra concepts, including matrix representations and Singular Value Decomposition (SVD), for image processing and dimensionality reduction.
5. Understand different curve fitting techniques, such as linear, polynomial, and exponential fitting and learn how to choose the appropriate curve fitting method based on the data characteristics.
6. Understand and articulate the fundamental concepts and purposes of hypothesis testing in data analysis.

Mapping of Course outcomes (COs) with Experiments

Exp. No.	Name of Experiments	Mapped COs
1	To use mathematical software as an advance calculator and for visualization of data	CO1
2	2D - 3D Plotting and data visualization	CO1
3	Exploring Recurrence Relations in Computational Algorithms	CO2
4	Applied optimization (Maxima, minima and Gradient descent method)	CO3
5	Application of Matrices in image processing	CO4
6	Linear Algebra with Various applications (computer Graphix, cryptography ,stochastic process)	CO4
7	Curve Fitting to identify trends and patterns within dataset .	CO5
8	Validating Hypotheses in Data Analysis	CO6

Reference:

1. Paul Zimmermann, Computational Mathematics with Sagemath , siam publisher.

Syllabus for Semester I, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code :24HS02TH0104 **Course: Foundation course in Universal Human Values**

L: 1 Hr, P: 0 Hrs, Per Week **Total Credits: 1**

Course Objectives:
1. To help the student see the need for developing a holistic perspective of life
2. To sensitize the student about the scope of life – individual, family (inter-personal relationship), society and nature/existence
3. To strengthen self-reflection
4. To develop more confidence and commitment to understand, learn and act accordingly

Syllabus
Unit 1:- Aspirations and concerns
Need for Value Education: Guidelines and content of value education.
Exploring our aspirations and concerns: Knowing yourself, Basic human aspirations Need for a holistic perspective, Role of UHV; Self-Management: harmony in human being

Unit 2:- Health
Harmony of the Self and Body, Mental and physical health; Health for family, friends and society.

Unit 3:- Relationships and Society
Harmony in relationships, Foundational values: Trust, Respect, Reverence for excellence, Gratitude and love; harmony in society; harmony with nature.

Course outcome:
On completion of course, students will be able to achieve the following:
1. Develop a holistic perspective of life
2. Better understanding of inter-personal relationships and relationship with society and nature.
3. An ability to strengthen self-reflection

Text book
1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

Reference books:
1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.

8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code:24HS05TH0102 **Course: Introduction to Quantum Computing**

L: 3 Hrs, P: 0Hr, Per Week **Total Credits: 3**

Course Objectives

1. To introduce the fundamentals of quantum computing to students
2. The problem-solving approach using finite dimensional mathematics

Unit I: Basic Quantum Theory

Brief introduction about Quantum Computers and Quantum mechanics, Wave nature of Particles, Bohr's quantization condition, Heisenberg's Uncertainty principle, Wave function, probability, Schrodinger's wave equation, Operators, Electron in an infinite potential well, Eigen value and Eigen functions.

Unit II: Complex Vector Spaces

Algebra and Geometry of Complex numbers, Real and Complex Vector Spaces, definitions, properties, Abelian group, Euler's formula, Dr Moivre's formula, Matrix properties.

Unit III: Linear Algebra in Quantum Computing

Basis and Dimensions, Inner products, Hilbert Spaces, Eigenvalues and Eigenvectors, Hermitian and Unitary Matrices, Tensor Product, Applications of linear algebra in computer graphics.

Unit IV: Classical and Quantum Systems

Deterministic and Probabilistic Systems, Quantum Systems, Stochastic billiard ball, Probabilistic double slit experiment with bullet and photon, Superposition of states, assembling systems, Entangled states.

Unit V: Quantum representation of systems

Dirac notations, Stern-Gerlach experiment, transition amplitude, norm of the ket, Bloch Sphere, Observables, Spin matrices, commutator operator, expectation values, variance, standard deviation, Heisenberg's uncertainty principle in matrix mechanics, measuring, dynamics, observations.

Unit VI: Architecture and Algorithms

Bits and Qubits, Classical Gates and their equivalent quantum representation, Reversible Gates: CNOT, Toffoli, Fredkin, gates, outline of Pauli X, Y, Z gates, Hadamard gates, Deutsch Gate. Quantum Algorithms: Deutsch's algorithm, Grover's search algorithm.

Applications of quantum computing in Cryptography, Quantum teleportation, Cybersecurity, banking, finance, advance manufacturing and artificial intelligence.

Course Outcomes

After successful completion of the course, the students will be able to -

1. Use the basic quantum theory relating to the probabilistic behaviour of an electron in an atom.
2. Utilize the knowledge of complex vector space in the domain of quantum theory.
3. Analyse classical and quantum approach towards the quantum computation.
4. Classify deterministic and probabilistic systems and analyse quantum observations and quantum measurements.
5. Use quantum gates in building architecture and quantum algorithms.

Text Book

1. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008
2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995

Reference Books

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008
2. Quantum computation and quantum information, Michael A. Nielsen and Isaac Chuang, Cambridge University Press 2010

Syllabus for Semester I, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code:24HS05PR0102 Course: Introduction to Quantum Computing Lab

L: 0 Hrs, P: 2Hr, Per Week Total Credits: 1

The laboratory will consist of general computational physics practical.

1. Linear and Nonlinear data fitting and Error analysis by LLSF method .
2. Analysing the complex behavior of Wave packets
3. Understanding the Eigen values, Eigen functions of 1-D Quantum Well.
4. Working with Vectors.
5. Working with Matrices: Real and Complex numbers.
6. Properties of Unitary and Hermitian Matrices, Inner Product, Tensor Product etc.
7. Simulation of Classical gates by Quantum representation of the gates and inputs.
8. Introduction to IBM quantum computer.
9. Simulation of Quantum gates: CNOT gate, Toffoli gate, Fredkin gate, Hadamard gate on IBM quantum computer.
10. Arithmetic operations using IBM Quantum computer.
11. Quantum Half adder and Full adders.

Course Outcomes:

The physics laboratory will consist of experiments and programming exercises illustrating the principles of physics relevant to the study of computer science and engineering.

On completion of the course, the students will be able to

1. Utilize Mathematica software for graph plotting and for least squares fitting of the experimental data.
2. Compare the properties of real and complex matrices with reference to their use in quantum system.
3. Apply the computational methods to solve eigenvalues and eigenfunctions, tensor products.
4. Simulate classical and Quantum gates.
5. Design programmes on IBM Quantum Computers.

Reference Books

1. Quantum Computing explained, David Mcmohan, Wiley-Interscience, John Wiley & Sons, Inc publication 2008
2. Quantum Computation and Quantum Information, Michael A. Nielson and Isaac L. Chuang, Cambridge University, Press 2010

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01TH0201 **Course: Object Oriented Programming**

L: 3 Hrs, P: 0Hr, Per Week **Total Credits: 3**

Course Objectives

1. To make students understand the Fundamental features of an object-oriented language like Java: object classes and interfaces, exceptions, and libraries of object collections
2. Introduce students to fundamental concepts like exception handling, generics, collection classes, and streams.

Syllabus

Unit I:

Features of Object-Oriented Programming languages, Abstraction, Encapsulation, Inheritance, polymorphism, and late binding. Programming paradigms, Bytecode, JDK, JRE, JVM.
Concept of a class and object, ways of representing objects, access specifiers, constructors and methods, constructor overloading

Unit II:

Method Overloading, Arrays and Array of objects, Wrapper classes (Integer, Double etc.), String Class, creating packages, importing packages, access specifiers, static and non static members.

Unit III:

Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, overriding, run time polymorphism, abstract classes and methods, Interface, implementation of interface
Lambda Expressions Introduction, Block, passing Lambda Expressions as arguments

Unit IV:

Exceptions: Types of exception, use of try-catch block, handling multiple exceptions, using finally, throw and throws clause, user-defined exceptions.
Introduction to streams, byte streams, character streams, file handling in Java, Serialization.

Unit V:

Generics: type-safety, generic class with two type parameters, bounded generics, wildcard, and generic method.
Collection classes: Arraylist, TreeSet, HashMap, Iterator, ListIterator, Collections class, Comparator, Comparable
Introduction to Design Patterns, Need of Design Pattern, Classification of Design Patterns, Role of Design Pattern in Software design, Creational Patterns, Structural Design Patterns and Behavioral Patterns.

Course Outcomes:

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

1. Apply object-oriented principles such as abstraction, encapsulation, inheritance and polymorphism to develop efficient Java Programs.
2. Illustrates various Java constructs, including constructors, methods, arrays, wrapper classes, packages, and lambda expressions for effective program development.
3. Implement exception handling mechanisms and Java streams for robust and error-free programming.
4. Utilize generics and collections to develop scalable and maintainable software solutions.

5. Analyze the characteristics, significance and applications of design patterns in the software development process.

Text Books

1. Herbert Schildt; JAVA The Complete Reference; Ninth Edition, Tata McGraw- Hill Publishing Company Limited.
2. Design Patterns by Erich Gamma, Pearson Education

Reference Books

1. Herbert Schildt and Dale Skrien; Java Fundamentals A Comprehensive Introduction; Tata McGraw- Hill Education Private Ltd 2013.
2. Core Java Volume I – Fundamentals" by Cay S. Horstmann and Gary Cornell

Course Code: 24CS01PR0201 **Course: Object Oriented Programming Lab**

L: 0 Hrs, P: 2Hr, Per Week **Total Credits: 1**

- Practical's will be conducted based on Syllabus of Object-Oriented Programming [24CS01TH0201]

Course Objectives

1. To make students understand the Fundamental features of an object-oriented language like Java: object classes and interfaces, exceptions, and libraries of object collections
2. Introduce students to fundamental concepts like exception handling, generics, collection classes, and streams.

Course Outcomes:

On successful completion of the course, students will be able to

1. Execute Java programs using the concept of classes, objects, methods, wrapper classes and packages to enhance code reusability and modularity.
2. Develop reusable and modular code by implementing inheritance and interfaces.
3. Implement robust programming practices using exception handling mechanism and Java streams for effective error handling and file operations.
4. Utilize generics and collection classes to data management and software scalability.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01TH0202 **Course: Data Structures**

L: 3 Hrs, P: 0Hr, Per Week **Total Credits: 3**

Course Objectives

1. To introduce the basic concepts of data structures and algorithms.
2. To prepare students to use linear and non-linear data structures.
3. To familiarize students with different searching and sorting techniques.
4. To enable students to use appropriate data structure for solving real-world problems.

SYLLABUS

UNIT-I: Data Structures and Algorithm Basics

Introduction: Elementary data organizations and operations on it. Abstract data types (ADT) and their characteristics.

Algorithms: Characteristics, Asymptotic notations, time and space trade-offs, Analysis of algorithm.

Array ADT: Representations – row-major and column-major form, Dynamic Arrays, Implementation of Real-life problems using arrays.

UNIT-II: Stacks and Queues

Stack ADT: Stack implementation using arrays, Applications of stacks – expression conversion and evaluation, implementation of multiple stacks, Real life problem implementation using stacks

Queue ADT: Queue implementation using arrays, Circular queue, Real life problem implementation using Queue, introduction to double-ended queues and priority queue

UNIT-III: Linked Lists

Singly Linked Lists (SLL): Creation of SLL, Operations on SLL: Insertion, Deletion, Traversal, reversal, ordering, etc., Linked representation of stacks and queues, Header node linked lists.

Doubly and Circular Linked Lists (DLL and CLL): Creation of Linked list and operations on it.

UNIT-IV: Trees

Trees: Terminologies, Binary tree and operations, Binary search tree [BST] and operations, Threaded binary trees.

Self-balancing Search Trees: Tree rotations, AVL tree and operations, B tree, B+- tree and operations.

UNIT-V: Sorting, Searching

Sorting: Internal and External sorting, Concept of Stable sort. Implementation of Shell, quick, merge, heap, counting sort, performance analysis and comparison.

Searching: Revision of linear search, binary search and complexity analysis of search methods. Hash functions and hash tables, closed and open hashing, randomization methods (division method, mid-square method, folding), collision resolution techniques.

Introduction to Graphs: Basic terminologies, representation of graphs, graph traversals: depth first search (DFS) and Breadth first search (BFS).

Course Outcomes:

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

1. Analyse the efficiency of algorithms through time and space complexities.
2. Implement real life problems using different linear data structures.
3. Implement real life problems using different Nonlinear data structures.
4. Apply different searching, sorting and hashing methods for efficient search.

Text Books

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed; Fundamentals of Data Structures in C; Second Edition; Universities Press; 2008.
2. Robert Kruse, C. L. Tondo, Bruce Leung, Sashu Mogalla, Data Structures and Program Design in C; Second Edition; Pearson Education; 2006.
3. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; Pearson Education; 2002.

Reference Books

1. Seymour Lipschutz; Data Structures; First Edition; McGraw Hill; 2006.
2. Yedidyah Moshe, J. Augenstein, Aaron M. Tenenbaum; Data Structures Using C; Second Edition; PHI publication.
3. Thomas Cormen, Charles Leiserson, Ronald Rivest and Clifford Stein, Introduction to Algorithms, Third Edition; Prentice Hall of India; 2009.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01PR0202 **Course: Data Structures Lab**

L: 0 Hrs, P: 2Hr, Per Week **Total Credits: 1**

- Practical's will be conducted based on Syllabus of Data Structure [24CS01TH0202]

Course Objectives

1. To impart to students the basic concepts of data structures and algorithms.
2. To familiarize students on different searching and sorting techniques.
3. To prepare students to use linear (stacks, queues, linked lists) and non-linear (trees, graphs) data structures.
4. To enable students to devise algorithms for solving real-world problems.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24CS01PR0203	**Course: Computer Workshop-II Lab**
L: 0 Hrs, P: 2Hr, Per Week	**Total Credits: 1**

Syllabus:

JavaScript: Introduction to JavaScript, Syntax, Variables and Data Types, Statements, Operators, Literals, Functions, Objects-Arrays-Built-in Objects, Handling Events in JavaScript, Form creation & validation, PHP database connectivity.

Introduction to ES6: Let and Const Declarations, Arrow Functions and Template Literals, Destructuring and Spread/Rest Operators, Classes and Modules, Exploring array methods.

UX Programming: Figma Basics, Wireframe and Prototype, Digital Storytelling

Course Outcomes

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

1. Design and develop dynamic web pages using JavaScript.
2. Demonstrate PHP database connectivity and perform basic CRUD operations.
3. Apply ES6 features to create interactive and dynamic web designs.
4. Develop high-fidelity designs and prototypes in Figma

Text Books

1. JavaScript: The Definitive Guide: Master the World's Most-Used Programming Language, David Flanagan, Shroff/O'Reilly, 7th edition, 2020.
2. PHP & MySQL, Jon Duckett, John Wiley & Sons Inc, 1st edition, 2022.
3. Simply ES6: Mastering JavaScript and ES6 to its fullest, Anna Voice, Ray Voice, Independently published, 2nd edition, 2020.
4. Ultimate Figma for UI/UX Design, Aditi Sharma, Orange Education Pvt. Ltd, 2025.

Reference Books

1. JavaScript: The Complete Reference, Thomas Powell, Fritz Schneider, MGH, 3rd edition, 2012.
2. Exploring ES6, Axel Rauschmayer, Leanpub, 2018.
3. User story mapping, Jeff Patton, O'Reilly Media, 1st edition, 2014.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code : 24CS01TH0204	**Course : Operating Systems**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week	**Total Credits: 3**

Course Objectives

1. To learn the need and evolution of operating systems.
2. To learn various concepts and issues related to Process management, Memory management and File management.

Syllabus

Unit I:

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls

Process Management: Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching, Types of Schedulers and their role, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SRTF, Priority, RR, Multilevel queue and multilevel feedback queue.

Unit II:

Threads: difference between a process and a thread, Benefits of threads, Types of threads, Concept of multithreads.

Inter-process Synchronization: Critical Section, Race Conditions, Mutual Exclusion, Peterson's solution for synchronization, Hardware Solutions, Semaphores, Monitors, Classical synchronization Problems: Producer-Consumer Problem, Reader-Writer Problem, Dinning Philosopher Problem.

Unit III:

Deadlocks: Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock Detection and Recovery.

Unit IV:

Memory Management: Basic concept, Address binding, Dynamic loading, Dynamic Linking, Swapping, Logical and Physical address mapping, Contiguous Memory allocation – Fixed and variable partition, internal and external fragmentation, Compaction, Non-contiguous Memory allocation: Segmentation: principle of operation, Segment Map table, protection and sharing, Paging: Principle of operation – Page Map table, Hardware support for paging, Protection and sharing, Structure of Page Map table.

Virtual Memory: Concept of Virtual Memory, Instruction Interruptibility, Locality of reference, Demand paging: Page fault, Dirty bit, valid-invalid bit, Page Replacement algorithms: First in First Out, Optimal, Least Recently used, LRU approximation algorithms, counting based page replacement, Page Buffering algorithms, Local Vs Global algorithms, Thrashing, Page allocation strategies to overcome trashing: Working set model and Page Fault Frequency

Unit V:

File Management: Concept of File, Access methods, File types, File operations, Directory structure, File System structure, Allocation methods, Free-space management.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, Boot block, Bad blocks.

Course Outcomes:

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

1. Differentiate between different types of operating systems and different CPU scheduling algorithms
2. Apply the concept of process synchronization in real life problems
3. Identify the occurrence of deadlock and handle it.
4. Apply various memory management techniques
5. Apply various file management techniques

Text Books

1. Operating System Concepts, 8th Edition by A. Silberschatz, P.Galvin, G. Gagne, Wiley India.
2. Modern Operating Systems, 2nd Edition by Andrew Tanenbaum, PHI.

Reference Books:

1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
2. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code : 24CS01PR0204	**Course : Operating Systems Lab**
L: 0Hrs, P: 2Hrs, Per Week	**Total Credits: 1**

- Practical's will be based on Syllabus of Operating Systems [24CS01TH0204]

Course Objectives

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that include architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management.

Course Outcomes:

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

1. Implement system commands by making use of LINUX system calls.
2. Implement processes and process schedulers.
3. Design solutions to process synchronization and deadlock handling.
4. Implement Memory management and File management solutions.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS03TH0213 | **Course: Calculus & Linear Algebra**

L: 3 Hrs, P: 0Hr, Per Week | **Total Credits: 3**

Course Objective
The objective of this course is to familiarize the prospective engineers with techniques in Calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Syllabus

Unit I: (8 Lectures)
Differential Calculus: Functions of univariate, Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem, Taylor's theorem, Taylor's and Maclaurin series.

Unit II: (10 Lectures)
Partial Differentiation: Partial derivatives, Euler's Theorem, chain rule, application of partial differentiation: total derivative, Jacobians, Maxima, Minima for the functions of two variables., Extrema of function of multivariable,

Unit III: (8 Lectures)
Vector Calculus: Scalar and vector fields, gradient of scalar point function, directional derivatives, divergence and curl of vector point function, application of vector calculus:Line integral, Gradient Descent method.

Unit IV: (8 Lectures)
Rank-nullity theorem; Consistency of system of linear equations and its solution, Orthogonal matrices, Eigen values and eigenvectors, Diagonalization of matrices, Orthogonal transformation and quadratic to canonical forms, Introduction to n-dimensional vector spaces, Singular value decomposition and its applications.

Unit V: (6 Lectures)
Infinite series: Sequences, Infinite series of real and complex numbers, Cauchy criterion, tests of convergence, absolute and conditional convergence, uniform convergence, power series, radius of convergence.

Course Outcomes
On successful completion of the course, student shall be able to

1. Apply the concepts of continuity and differentiability to find Taylor's and Maclaurin series.
2. Understand the methods of partial derivatives and apply these concepts to determine extreme values of the functions of two variables.
3. Demonstrate the basic knowledge of vector differentiation and line integral.
4. Interpret the solutions of system of linear equations and use the concepts of Eigen values, Eigen vectors to find diagonalization of matrices, reduction of quadratic form to canonical form.
5. Internalize convergence of sequences and apply it to determine whether infinite series convergent or divergent with appropriate tests.

Text / References Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Volume I & II, Pune, Vidhyarthi Griha Prakashan, Pune-411030 (India).

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code : 24HS02TH0203 Course : Foundational Literature of Indian Civilization

L: 1 Hrs, P: 0 Hrs, Per Week Total Credits: 1

Syllabus

Unit I: Overview of Indian Knowledge System:

Importance of ancient knowledge, defining IKS, Historicity of IKS, Some unique aspects of IKS.

Unit II: The Vedic corpus:

Introduction of Vedas, four Vedas, divisions of four Vedas, six Vedangas, Distinct features of Vedic life.

Unit III: Indian Philosophical systems:

Development and unique features, Vedic schools of philosophy, *Samkhya* and *Yoga* School of philosophy, *Nayay* and *Vaisesika* school of philosophy, *Purva-mimamsa* and *Vedanta* schools of Philosophy, Non-vedic philosophies: Jainism, Buddhism, and other approaches

Unit IV: Vedic Maths -1

Introduction of Vedic Mathematics, Bodhyan geometry, circular functions, inverse circular functions.

Unit -V: Vedic Maths – 2

Multiplication of polynomials by *nikhilaṃ* and *ūrdhvatiryagbhyām* sutra. Verification by *Gunitasamuccayaḥ*. Division of two polynomials using *parāvartya yojayet*. HCF and LCM of two polynomials using *ādyamādyenāntyamantyena* and *ānurūpyeṇa.* Factorization of polynomials up-to degree 3 using *ānurūpyeṇa*, *Lopanasthāpanābhyām*, *ādyamādyenāntyamantyena*.

Course outcome:

At the end of the course the students will be able to achieve the following:

1. Understand the Indian knowledge system and its scientific approach.
2. Get introduced to the Vedic corpus and recognize the multi-faceted nature of the knowledge contained in the Vedic corpus.
3. Understand the salient features of the philosophical systems of the Vedic and non-Vedic schools.
4. Develop an understanding about the foundation of Vedic Mathematics.

Reference Books

1. B. Mahadevan, Vinayak Rajat Bhar, Nagendra Pavana R. N., “Introduction to Indian Knowledge System: Concepts and Applications” PHI, 2022
2. S.C. Chatterjee and D.M. Datta, An introduction to Indian Philosophy, University of Calcutta, 1984

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code : 24HS02PR0202 **Course : Professional Communication Lab**

L: 0 Hrs, P: 2 Hrs, Per Week **Total Credits: 1**

Course Objective

To enhance competency of communication among learners and prepare them for effective workplace communication

Syllabus

Professional Communication-1

Practical 1: Speaking Skills

This practical will cover the following topics: Effective communication techniques, Role of paralinguistic features viz. pronunciation, stress, intonation and rhythm, meeting people, asking questions, types of barriers and techniques to overcome them.

Practical 2: Listening Skills

This practical will cover the following topics: Listening Comprehension, active listening, reasons for poor listening, traits of a good listener, and barriers to effective listening

Practical 3: Reading

This practical will cover the following topics: Reading Comprehension: types and strategies

Professional Communication-2

Practical 4: Presentation Skills: Orientation & Mock Session

This practical will cover the following topics: Introduction to professional presentation skills, planning the content, effective delivery, aspects of non-verbal communication, visual designing, tips for effective presentations

Practical 5: **Presentation Skills: Practice**

Practical 6: Group Discussions and Personal Interview: Orientation & Mock Session

This practical will cover the following topics: types of group discussion, strategies for effective group discussion, types of questions in an interview, resume making, use of power words, tips for a successful interview

Practical 7: Group Discussions and Personal Interview: Practice

Professional Communication-3

Practical 8: Writing Practices- 1

This practical will cover the following topics: Vocabulary building, Grammar and mechanics

Practical 9: Writing Practices-2

This practical will cover the following topics: Sentence and paragraph structures, Note-making

Practical 10: Writing Practices- 3

This practical will cover the following topics: Academic Correspondence

Course Outcomes

On completion of Professional Communication Lab course, students will be able to achieve the following**:**

1. Implement essential language skills- listening, speaking, reading, and writing
2. Demonstrate the techniques of effective Presentation Skills
3. Evaluate and apply the effective strategies for Group Discussions and Personal Interviews
4. Effectively implement the comprehensive principles of written communication

Reference Books

1. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

Syllabus for Semester II, B. Tech. Computer Science & Engineering

Course Code :24HS04PR0201 **Course: Sports Yoga Recreation**

L: 0 Hrs, P: 2 Hrs, Per Week **Total Credits: 1**

Aim of the Course: The course aims to foster Health and wellness through Healthy and Active Lifestyle and creating awareness about the fundamentals of Physical Education, Sports, Yoga, Recreation and its effectiveness through practical experiences and hands on activities.

Objectives of the Course:

1. To impart the students with basic concepts of Sports, Yoga and Recreational activities for health and wellness.
2. To familiarize the students with health-related Exercise and evaluate their Health-related Fitness.
3. To make Overall growth & development with team spirit, social values and leadership qualities among students through various sports, games and Yogic activities.
4. To create Environment for better interaction and recreation among students as neutralizer for stress through various minor and recreational games.

Course Content:

Unit 1:

- Warm up and Cool Down and Stretching Exercises.
- General and Specific Exercises.
- Calculation of BMI & Resting Pulse Rate.
- General and Specific exercises for strength, Speed, Agility, Cardiovascular Endurance, Flexibility, Coordinative abilities.
- Practice of Fundamental Skills of Volleyball, Table Tennis and Chess, etc.
- Knowledge and practice of the Equipment used in a Gymnasium and its application.

Unit 2:

- Yoga: Standing, Sitting, Prone & Supine positions.
- Suryanamaskar.
- Pranayama, Meditation and Relaxation Techniques.
- Recreational Games.
- Practice of Fundamental Skills of Basketball, Football, Carrom, etc.
- Health related Physical Fitness Test.

Course Outcomes: On completion of the course, students will be able to:

1. Understand fundamental skills, basic principle and practices of sports and Yoga.
2. Practically learn the principles of implementing general and specific conditioning of physical exercises and yoga.
3. Develop Health-related fitness and Body-mind co-ordination through various fitness activities, sports, recreational games and yoga.
4. Practice Healthy & active living with reducing Sedentary Life style.

Assessment Pattern:

Assessment Type	Weightage in Marks	Total Marks
Practical	Physical Efficiency Test – 30 Marks Sports/Games skill Activity/Project – 10 Marks Yoga Activities – 10 Marks	50
		Total – 50 Marks

References Books

1. Russell, R.P. (1994). Health and Fitness Through Physical Education. USA: Human Kinetics.
2. Uppal, A.K. (1992). Physical Fitness. New Delhi: Friends Publication.
3. AAPHERD "Health related Physical Fitness Test Manual."1980 Published by Association drive Reston Virginia
4. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashtrothanna Prakashana.
5. Dr. Devinder K. Kansal, A Textbook of Test Evaluation, Accreditation, Measurements and Standards (TEAMS 'Science)

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS01TH0202 **Course: Environmental Science**

L: 1 Hrs, P: 0 Hrs, Per Week **Total Credits: 1**

Syllabus:

Unit I: Sustainability Engineering

Multidisciplinary nature of Environmental Science, air and water pollution; solid waste management; local and global environmental challenges; climate change; sustainable cities; sustainable sources of energy, Introduction to the idea of sustainability and its relevance; environment-related legislation; Green Chemistry

Unit II: E-Waste and Green Computing

E-waste Management: Sources, Legislation, Prevention, Control, Recent developments.
Waste due to Nano-materials and Micro-Plastics.
Green Computing: Green Computing, Computing in Environment and Research, Green devices and green data Servers.

Text Books:

1.Shikha Agrawal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press.
2. Dr. Rajshree Khare, A Textbook of Engineering Chemistry (AICTE), S.K. Kataria & amp; Sons.
3. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand Publications.
4. M Afshar Alam, Sapna Jain, Hena Parveen, Green Computing Approach Towards Sustainable Development, Wiley Interscience Publications.

Reference Books:

1. E-waste recycling and management: present scenarios and environmental issues, Khan, Anish, and Abdullah M. Asiri. 2019, Springer, Vol. 33. ISBN: 978-3-030-14186-8.
2. Hans-Eckhardt Schaefer, Nanoscience: The Science of the Small in Physics, Engineering, Chemistry, Biology and Medicine, Springer-Verlag Berlin Heidelberg.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS01PR0101 **Course: Environmental Science Lab**

L: 0 Hrs, P: 2 Hrs, Per Week **Total Credits: 1**

List of Experiments:

Any Eight Experiments from the following:
[1] Demonstration of Handling of hazardous chemicals, MSDS (material safety data sheet), waste minimization strategies and chemical waste disposal.
[2] Preparation of different Solutions: Molar solution, Normal solution and percent solution and Determination of concentration in their various forms.
[3] Basic statistical analysis of results of neutralization of acid against the base and preparing acceptable graphs using software.
[4] Estimation of Copper ions from acid digested PCB solution.
[5] Estimation of Chromium ions from e-waste sample.
[6] Prediction of NMR spectra and analytical data of molecules using Computational Software and its analysis.
[7] Spectroscopic determine of wavelength of maximum absorption of chemical/biological compound in solution and plotting of calibration curves.
[8] Estimation of Fe (II) ions from e-waste rust spectrophotometrically / calorimetrically using 1,10-Phenanthroline method.
[9] Determination of Free CO2 in the given water sample.
[10] Determination of dissolved oxygen (DO) in the given water sample.
[11] Estimation of Chlorine in water.
[12] Determination of rate of the reaction at room temperature and analysis of experimental data using Computational Software
[13] Determination of AQI of a region.
[14] Use of various open online search tools for Environmental Case Studies.

Coures Outcome:
The students will learn to:
1. Apply the fundamental principles of measurement and skills in preparation and handling of Environmentally hazardous materials and interpret the statistical data related to measurements.
2. Use of the computational tools for searching, interpretation of results, etc. and preparation of case study regarding Environmental Issues.

Suggested Books/Reference Books:
(1) S. S. Dara, A Textbook on Experiments and Calculations in Engineering Chemistry, S. Chand Publications.
(2) J. B. Yadav, Advanced Practical Physical Chemistry, Krishna's Prakashan Media (P) Limited.
(3) A. J. Elias, Collection of Interesting General Chemistry Experiments, Universities Press Publications.
(4) V. K. Ahluwalia, S. Dhingra and A. Gulati, College Practical Chemistry, Universities Press Publications.

Suggested Reference Books:
(1) David Young, Computational Chemistry: A Practical Guide for Applying Techniques to Real World Problems, Wiley Interscience Publications

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206 **Course : Liberal/Performing arts**

L: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 1**

Liberal/Performing arts basket

Sr. No.	Course Code	Course Name	Sem	Hours/week	Credits	Maximum marks	
						Learning Assessment 1	Learning Assessment 2
1	24HS02PR0206-01	Fundamentals of Indian Classical Dance: Bharatnatyam	II	2	1	25	25
2	24HS02PR0206-02	Fundamentals of Indian Classical Dance: Kathak	II	2	1	25	25
3	24HS02PR0206-03	Introduction to Digital Photography	II	2	1	25	25
4	24HS02PR0206-04	Introduction to Japanese Language and Culture	II	2	1	25	25
5	24HS02PR0206-05	Art of Theatre	II	2	1	25	25
6	24HS02PR0206-06	Introduction to French Language	II	2	1	25	25
7	24HS02PR0206-07	Introduction to Spanish Language	II	2	1	25	25
8	24HS02PR0206-08	Art of Painting	II	2	1	25	25
9	24HS02PR0206-09	Art of Drawing	II	2	1	25	25
10	24HS02PR0206-10	Nature camp	II	2	1	25	25
11	24HS02PR0206-11	Developing Self-awareness	II	2	1	25	25
12	24HS02PR0206-12	Art of Poetry	II	2	1	25	25
13	24HS02PR0206-13	Creative and content writing	II	2	1	25	25
14	24HS02PR0206-14	Science of life through Bhagwad Gita	II	2	1	25	25
15	24HS02PR0105-15	Sanskrit Sambhashan	II	2	1	25	25

		Spoken Sanskrit					
16	24HS02PR0105-16	Kirtan Kala	II	2	1	25	25
17	24HS04PR0202-1	AdventurSports	II	2	1	25	25
18	24HS04PR0202-2	Introduction to Defense Forces & Obstacle Training	II	2	1	25	25
19	24HS04PR0202-3	Self Defense and Indian Martial Arts	II	2	1	25	25
20	24HS04PR0202-4	Basic Nutritional Course	II	2	1	25	25

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-01 **Course: Fundamentals of Indian Classical Dance: Bharatnatyam**

L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective

The course aims to introduce the students to Bharatnatyam, an important element of Indian traditional knowledge system. The course will not only provide the learning and skill to perform this art but would also enhance many mental and physical aspects of the students such as strength, flexibility, discipline, self-confidence, creativity, focus, coordination, etc.

Syllabus

Practical -1: Orientation in Bharatnatyam
Practical-2: Tattu Adavu till 8, Naatta Adavu 4 Steps, Pakka Adavu 1 step, Metta Adavu 1 Step, Kuditta Metta Adavu 4 Steps,
Practical -3: Practice sessions
Practical-4: Tatta Kuditta Adavu (Metta), Tatta Kuditta Adavu (Metta) 2 Steps, Tirmanam Adavu 3 Steps, Kattu Adav - 3 Steps, Kattu Adav - 3 Steps
Practical-5: Practice sessions
Practical-6: Tiramanam (front) 3 Steps, Repeat of Tiramanam (Overhead) 3 Steps,
Practical-7: practice sessions
Practical – 8: final practice sessions and performances.

Course Outcomes

On completion of the course, students will be able to achieve the following:

CO1: Understand the importance of dance and Bharatnatyam as an Indian dance form
CO2: Develop skills to perform the dance form at its basic level.
CO3: Evaluate their strengths and interest to take bridge course to give *Pratham* (1^{st} level formal exam of Bharatnatyam).

Recommended Reading

1. Introduction to Bharata's Natyasastra, Adya Rangacharya, 2011
2. The Natyasastra and the Body in Performance: Essays on the Ancient Text, edited by Sreenath Nair, 2015
3. Bharatanatyam How to ... : A Step-by-step Approach to Learn the Classical Form, Eshwar Jayalakshmi, 2011

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-02 **Course: Fundamentals of Indian Classical Dance: Kathak**

L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective

The course aims to introduce the students to Kathak, an important element of Indian traditional knowledge system. The course will not only provide the learning and skill to perform this art but would also enhance many mental and physical aspects of the students such as strength, flexibility, discipline, self-confidence, creativity, focus, coordination, etc.

Syllabus

Practical -1: Orientation in Kathak. Correct posture of kathak, Basic Movements and exercise Stepping, Chakkar of 5 counts (Bhramari),
Practical -2: practice sessions of practical 1
Practical -3: Hastaks, Hastaks and Steppings, Reciting asamyukta Mudra shloka, Hastak and steppings
Practical -4: practice sessions of practical 3
Practical -5: Todas and Asamyukta hasta mudra shlok, Vandana of Shlok, 2 Todas and Vandana, Ghante Ki Tihai,
Practical -6: practice sessions of practical 5
Practical -7: 2 1 Chakkardar Toda and Ginnti Ki Tihai, 2 Todas and 1 Chakkardar Toda, practice sessions
Practical -8: Final performances.

Course Outcomes

On completion of the course, students will be able to achieve the following:

1. Understand the importance of dance and Kathak as an Indian dance form
2. Develop skills to perform the dance form at its basic level.
3. Evaluate their strengths and interest to take bridge course to give *Prarambhik* (1^{st} level formal exam of Kathak).

Recommended reading

1. Kathak Volume1 A "Theoretical & Practical Guide" (Kathak Dance Book), Marami Medhi & Debasish Talukdar, 2022, Anshika Publication (13 September 2022)

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-03 **Course: Introduction to Digital Photography**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective
The course aims to develop basic skills of students in digital photography to lay a foundation for them as a hobby and/or a profession.

Syllabus
Practical 1: **Orientation in digital photography:** Genres, camera handling and settings
Practical 2: **Rules of Composition**
Practical 3: **Rules of Composition**: practice sessions
Practical 4: **Understanding Exposure and Art of Pre-Visualization**
Practical 5: **Rules of Composition and Art of Pre-Visualization:** practice sessions
Practical 6: **Post Processing Photographs and Portfolio creation**
Practical 7: **Post Processing Photographs:** practice sessions
Practical 8: **Portfolio finalization and presentation in selected genre.**

Course outcome:
At the end of the course the students will be able to achieve the following:
1. Develop an understanding of the technical aspects and aesthetics of Photography.
2. Apply the rules of digital photography for creating photographs.
3. Develop skills to enhance photographs through post processing.
4. Create a portfolio of their photographs in selected genre.

Reference material

1. Scott Kelby (2020) The Digital Photography Book: The Step-by-Step Secrets for how to Make Your Photos Look Like the Pros, Rocky Nook, USA
2. Larry Hall (2014) Digital Photography Guide: From Beginner to Intermediate: A Compilation of Important Information in Digital Photography, Speedy Publishing LLC, Newark
3. J Miotke (2010) Better Photo Basics: The Absolute Beginner's Guide to Taking Photos Like a Pro, AMPHOTO Books, Crown Publishing Group, USA

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-04 **Course: Introduction to Japanese Language**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective

The course aims to develop basic communication skills in Japanese Language and help develop a basic understanding of Japanese culture for effective cross-cultural communication.

Syllabus

Practical-1: Orientation about Japan, its language, and its culture
Practical-2: Communication Skills 1: Vocabulary for basic Japanese language
Practical -3: Practice sessions
Practical-4: Basic day to day greetings in Japanese language and their usage through role-play
Practical-5: Practice sessions
Practical- 6: Communication Skills 2: framing sentences
Practical- 7: Practice sessions
Practical- 8: Introduction of Japanese Culture, Arts, Traditions, Etiquettes and Manners etc.

Course outcome

After the completion of the course the students will be able to achieve the following:

1. Basic understanding about Japan as a country and Japanese culture.
2. Ability to use vocabulary required for basic level communication in Japanese language.
3. Able to frame simple sentences in Japanese for everyday conversations

Recommended reading

1. Marugoto Starter (A1) Rikai - Course Book for Communicative Language Competences, by The Japan Foundation, Goyal Publishers & Distributors Pvt. Ltd (ISBN: 9788183078047)
2. Japanese Kana Script Practice Book – Vol. 1 Hiragana, by Ameya Patki, Daiichi Japanese Language Solutions (ISBN: 9788194562900)

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-05 **Course: Art of Theatre**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objectives:
The course aims to develop in the students, an actor's craft through physical and mental training.

Syllabus:

Practical 1: **Orientation in theatre**
Practical 2: **Voice and Speech training**
Practical 3: **Voice and Speech training**: practice sessions
Practical 4: **Art of acting**
Practical 5: **Art of acting:** practice sessions
Practical 6: **Art of script writing**
Practical 7: **Art of script writing:** practice sessions
Practical 8: **Final performances**

Course Outcomes:
On completion of the course, students will be able to achieve the following:
1. Understand and synthesize the working of the prominent genres of theatre across the world.
2. Apply the skill of voice and speech in theatre and public speaking
3. Apply the art of acting and also develop generic skills such as confidence, communication skills, self-responsibility, motivation, commitment, interpersonal skills, problem solving, and self-discipline.
4. Apply skills acquired related to technical/production aspects of theatre and also develop problem solving and interpersonal skills.

Reference books:
1. Boleslavsky, R. (2022). Acting: The First Six Lessons (1st ed., pp. 1-92). Delhi Open Books.
2. Shakthi, C. (2017). No Drama Just Theatre (1st ed., pp. 1-171). Partridge.
3. Bruder, M., Cohn, L. M., Olnek, M., Pollack, N., Previto, R., & Zigler, S. (1986). A Practical Handbook for the Actor (1st ed.). Vinatge Books New York.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-06 **Course: Introduction to French Language**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective:

To help build a foundation and interest in French language so that the students can pursue the proficiency levels of the language in higher semesters.

Syllabus
List of Practical's

Practical-1: Orientation about France, the language, and culture
Practical-2: Communication Skills 1: Vocabulary building for everyday conversations
Practical -3: Practice sessions
Practical-4: Reading and writing Skills : Reading and writing simple text in French
Practical-5: Practice sessions
Practical-6: Communication Skills 2: listening comprehension
Practical-7: Practice sessions
Practical-8: Writing Skills: Write basic French and practice

Course outcomes:

On successful completion of the course the students will be able to achieve the following:

1. Demonstrate basic knowledge about France, the culture and similarities/differences between India and France
2. Learn to use simple language structures in everyday communication.
3. Develop ability to write in basic French about themselves and others.
4. Develop ability to understand beginner level texts in French

Recommended reading

1. 15-minute French by Caroline Lemoine
2. Cours de Langue et de Civilisation Françaises by G. Mauger Vol. 1.1
3. Cosmopolite I by Natalie Hirschsprung, Tony Tricot

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-07 **Course: Introduction to Spanish Language**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective:

To help build a foundation and interest in Spanish language so that the students can pursue the proficiency levels of the language in higher semesters.

Syllabus
List of Practicals

Practical-1: Orientation about Spain, the language, and culture
Practical-2: Communication Skills 1: Vocabulary building for everyday conversations
Practical-3: Practice sessions
Practical-4: Reading and writing Skills : Reading and writing simple text in Spanish
Practical-5: Practice sessions
Practical-6: Communication Skills 2: listening comprehension
Practical-7: Practice sessions
Practical-8: Writing Skills: Write basic Spanish and practice

Course outcomes:
On successful completion of the course the students will be able to achieve the following:

1. Demonstrate basic knowledge about Spain, the culture and similarities/differences between India and France
2. Learn to use simple language structures in everyday communication.
3. Develop ability to write in basic Spanish about themselves and others.
4. Develop ability to read and understand beginner level texts in Spanish

Recommended reading

1. 15-Minute Spanish by Ana Bremon
2. Aula Internacional 1 by Jaime Corpas ,Eva Garcia, Agustin Garmendia.
3. Chicos Chicas Libro del Alumno by María Ángeles Palomino

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-08 **Course: Art of Painting**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective

Painting is fundamentally about learning to see, and to transport that vision onto paper through a variety of mark making techniques. This course aims to develop basic skills of students in painting to lay a foundation for them as a hobby and/or a profession.

Syllabus

Practical 1: **Orientation in Painting tools & basics of lines, shapes, light, shadows and textures**
Practical 2: **The art of observation -** how to see shapes in drawing
Practical 3: **Introduction Water color -** how to handle water paints
Practical 4: **Introduction to acrylic colors -** how to handle acrylic paints
Practical 5: **Explore layering paint and capturing the quality of light with paint.**
Practical 6: **Create landscape painting**
Practical 7: **Create Abstract painting**
Practical 8: **Paint on Canvas** (try to recreate any famous painting)

Course outcome:
At the end of the course the students will be able to achieve the following:

1. Become familiar with the basic methods, techniques & tools of painting.
2. Train the eye and hand to develop sense of balance, proportion and rhythm.
3. Develop the ability to observe and render simple natural forms.
4. Enjoy the challenging and nuanced process of painting.

Reference material

1. Drawing made easy by Navneet Gala; 2015th edition
2. Alla Prima II Everything I Know about Painting--And More by Richard Schmid with Katie Swatland
3. Daily Painting: Paint Small and Often To Become a More Creative, Productive, and Successful Artist by Carol Marine

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-09 **Course: Art of Drawing**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective
Drawing is fundamentally about learning to see, and to transport that vision onto paper through a variety of mark making techniques. This course aims to develop basic skills of students in drawing to lay a foundation for them as a hobby and/or a profession.

Syllabus
Practical 1: **Orientation in Drawing tools & basics of lines, shapes, light, shadows and textures**
Practical 2: **The art of observation** how to see shapes in drawing
Practical 3: **One/two-point basic linear perspective**
Practical 4: **Nature drawing and landscapes**
Practical 5: **Gestalt principles of visual composition**
Practical 6: **Figure drawing**: structure and proportions of human body
Practical 7: **Gesture drawing:** expression and compositions of human figures
Practical 8: **Memory drawing:** an exercise to combine the techniques learnt

Course outcome:
At the end of the course the students will be able to achieve the following:
1. Become familiar with the basic methods, techniques & tools of drawing.
2. Train the eye and hand to develop sense of balance, proportion and rhythm.
3. Develop the ability to observe and render simple natural forms.
4. Enjoy the challenging and nuanced process of drawing.

Reference material

1. Drawing made easy by Navneet Gala; 2015th edition
2. Perspective Made Easy (Dover Art Instruction) by Ernest R. Norling

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-10 **Course: Nature Camp**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course Objective: To create an opportunity for the students to develop affinity with nature and thus subsequently impact their ability to contribute towards sustainability of nature.

Syllabus
In collaboration with the Forest Department and/or a local NGO working in the field of environment conservation, this course would be conducted in 24 hours. Students will be taken to a tiger reserve in Central Indian region or Forest fringe villages or work with an NGO from Central Indian region working on natural resource management. The camps (for 2 days) will cover any one of the following topics as decided by the course coordinator:

1. Awareness about each element of biodiversity (camps on moths, butterflies, birds, other wildlife etc)
2. Environment management (water, forest, wildlife) – practices of Forest Department in managing a tiger reserve, and other aspects of water and forest conservation.
3. Sustainable natural resource management - initiatives by rural communities and local NGOs
4. Man-animal conflict and solutions (socio-economic and technical) – role of local communities and Forest Department
5. Traditional practices in environment conservation – role of local communities and local NGO

Course outcome:
After the completion of the course the students will be able to do the following:
1. Develop an affinity with nature by observing and understanding it marvels with guidance from experts
2. Develop an understanding of the challenges and solutions associated with nature and its conservation.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-11 **Course: Developing Self-awareness**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objectives:
The course aims to develop students in their personal as well as professional life by means of graphotherapy, NLP, and Neurobics

Syllabus:

Practical 1: **The Power of Handwriting (Handwriting is Brainwriting)**
Practical 2: **Know yourself through handwriting**
Practical 3: **The Role of Signature in your life**
Practical 4: **Graphotherapy to enhance yourself in all ways**
Practical 5: **Neurolinguistic Programming , S.M.A.R.T Goal**
Practical 6: **Effective Communication Model, Rapport Building and Anchor**
Practical 7: **Brain Directives & Linguistic Presuppositions**
Practical 8: **Neurobics**

Course Outcomes:
On completion of the course, students will be able to achieve the following:

1. Gain foundational understanding of graphology and through self-analysis will achieve greater awareness about their strengths and weaknesses & areas for personal growth
2. students will be equipped with tools and techniques for continuous self-improvement, using signature analysis and graphotherapy as part of their personal development journey
3. understand how to use Neuro Linguistic Programming (NLP) strategies to set and achieve goals effectively, overcoming mental blocks and limiting beliefs.
4. Enhance ability to absorb, retain, and recall information, which can benefit academic and professional performance.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-12 **Course: Art of Poetry**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Syllabus

Practical 1: **Art of poetry – orientation**
Practical 2: **Forms of poetry – orientation**
Practical 3: **Forms of poetry – recitation**
Practical 4: **Application of poetry – orientation**
Practical 5: **Application of poetry – practical session**
Practical 6: **Poetry and aesthetics**
Practical 7: **Writing poetry – orientation**
Practical 8: **Writing poetry – writing sessions**

Course Outcomes:

At the end of the course the student will be able to achieve the following:

1. Understand the origin and development of poetry
2. Appreciate the art of poetry in life
3. Develop aesthetic sense
4. Develop holistic perspective to their personality

Reading material

I. The Art of Poetry
1. Fry, S. (2005). The ode less travelled: Unlocking the poetic mind. HarperCollins.
2. Addonizio, K., & Laux, D. (1997). The poet's companion: A guide to the pleasures of writing poetry. W.W. Norton & Company.
3. Lucy, J. (Ed.). (2001). The art of poetry. Penguin Books.

II. Understanding and Interpretation of Poetry
1. Hirsch, E. (1999). How to read a poem: And fall in love with poetry. Harcourt Brace & Company.
2. Pinsky, R. (1998). The sounds of poetry: A brief history. Farrar, Straus and Giroux.
3. Meyer, M. (2005). Poetry: An introduction. Bedford/St. Martin's.

III. Writing Poetry
1. Hugo, R. (1979). The triggering town: Lectures and essays on poetry and writing. W.W. Norton & Company.
2. Bradbury, R. (1990). Zen in the art of writing: Releasing the creative genius within you. Bantam Books.
3. Behn, R., & Twichell, C. (Eds.). (1992). The practice of poetry: Writing exercises from poets who teach. HarperCollins.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-13 **Course: Creative and content writing**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objective:
The objective of the course is to equip students with comprehensive skills in creative and content writing through experiential learning and real-world applications.

Syllabus

Creative Writing
Practical 1: **Introduction to Creative and Content Writing**
Practical 2: **Character and Story Development**
Practical 3: **Crafting Compelling Narratives**

Content Writing
Practical 4: **SEO and Digital Content Strategies**
Practical 5**: Writing for Media**
Practical 6: **Tools**

Content Creation
Practical 7: **Digital Storytelling**
Practical 8: **Creative Portfolio Launch**

Course outcomes:
On completion of the course, student will be able to achieve the following:
1. Understand and apply fundamental concepts and techniques of creative writing.
2. Apply storytelling techniques to create engaging narratives.
3. Develop and implement effective SEO and digital content strategies
4. Create and refine content using various tools and applying diverse writing styles and formats.
5. Utilize digital tools to craft multimedia narratives and create a professional portfolio.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-14 **Course: Science of life through Bhagwad Gita**
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course Objective
The objective of the course is to seek directions from the Bhagwad Gita to garner life skills for a successful and happy life

Syllabus

Practical 1: **Introduction to Bhagwad Gita - methodology**
Practical 2: **Real life application of chapter 1-3**
Practical 3: **Real life application of chapter 4-6**
Practical 4: **Real life application of chapter 7-9**
Practical 5: **Real life application of chapter 10-12**
Practical 6: **Real life application of chapter 13-15**
Practical 7: **Real life application of chapter 16-18**
Practical 8: **Meditation and breathing techniques**

Course Outcome
1. To understand the methodology to correctly interpret and analysis the scripture
2. To understand the application of various teaching of the Bhagwad Gita
3. Use meditation and breathing techniques for healthy mind and body.

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-15 **Course:** ***Sanskrit Sambhashan- Spoken Sanskrit***
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objectives:
The objective of the course is to enhance the communication skills of the students in Sanskrit

Syllabus:

संस्कृतसम्भाषणशिबिरस्य पाठ्यक्रमः

प्रथमं दिनम्

- गीतम् - पठत संस्कृतम्.......... ।
- मम नाम -भवतः नाम किम्? भवत्याः नाम किम्? द्वयोः मध्ये परिचयः । परस्परं 5 जनान् ।
- सः कः? सा का? तत् किम्?
- एषः, एषा, एतत् ।
- अहम्, भवान्, भवती....... ...अभिनयः ।
- आम्,न, वा/किम्.................अभिनयः ।
- अस्ति × नास्ति.................अभिनयः ।
- अत्र, तत्र, कुत्र, सर्वत्र, अन्यत्र, एकत्र - अभिनयः ।
- षष्ठी - तस्य, एतस्य, कस्य, तस्याः, एतस्याः, कस्याः, मम, भवतः, भवत्याः................अभिनयः ।
  मम नासिका, भवतः नासिका, भवत्याः नासिका ।
  एतत् कस्य? अङ्गानि प्रदर्श्य प्रश्नः ।
- दशरथस्य..., सीतायाः..., लेखन्याः..., पुस्तकस्य..., ।
  स्फोरकपत्रस्य (Flash Card) उपयोगः करणीयः ।
  'पुत्रः' 'पतिः' इत्यादीनां वाक्यपत्राणाम् (Charts) उपयोगः करणीयः ।
- गीतम् - मनसा सततं स्मरणीयम् ।
- आवश्यकम्, मास्तु, पर्याप्तम्, धन्यवादः, स्वागतम् ।
- पूर्वनिश्चितसम्भाषणप्रदर्शनम् ।
- क्रियापदानां पाठनम् -
  गच्छति । आगच्छति । पठति । लिखति । खादति ।पिबति ।
  क्रीडति । वदति । उत्तिष्ठति । उपविशति ।
- गच्छामि । आगच्छामि......... ।
- गच्छतु । आगच्छतु............ ।
- सङ्ख्याः - (अ) 1, 2, 3, 4,...............10 ।
  (आ) 10, 20, 30,.............100 ।
- समयः - 5.00, 5.15, 5.30, 4.45 ।
- कथा - गतानुगतिको लोकः । (काचित् कथा सरलया भाषया वक्तव्या) ।
- रटनाभ्यासः (पूर्वमेव लिखितानि पठितानि च कानिचित् वाक्यानि वाचनीयानि) ।
- एकं वाक्यम् (प्रत्येकं छात्रः एकं वाक्यं वदेत् ।)
- सूचना ।
- ऐक्यमन्त्रः ।

द्वितीयं दिनम्

- गीतम् ।
- पुनस्स्मारणम् ।
- शब्देषु लिङ्गभेदज्ञापनम् - यथा -सः सुधाखण्डः, सा कुञ्चिका, तत् पुष्पम् ।
- बहुवचनपाठनम् –
  बालकाः..., बालिकाः..., लेखन्यः..., पुस्तकानि... ।
- ते, के, ताः, काः, तानि, कानि, एते, एताः, एतानि, भवन्तः, भवत्यः, वयम् । (चित्राणि उपयोक्तव्यानि ।)
- वचनपरिवर्तनाभ्यासः । यथा - सः बालकः - ते बालकाः ।
- अस्ति - सन्ति ।
- कति?
- सप्तमी - हस्ते । उत्पीठिकायाम् । लेखन्याम् । पुस्तके ।
  (स्फोरकपत्रस्य प्रयोगः करणीयः ।)
  वाक्यपत्रस्य उपयोगेन वाक्यानि वाचनीयानि ।
- कदा?
- उत्तराणां प्रश्नाः । (शिक्षकः आरम्भे उत्तरं वदेत्, अनन्तरं छात्राः तस्य प्रश्नं पृच्छेयुः ।)
  यथा - रामः प्रातःकाले शालां गच्छति ।
  रामः कदा शालां गच्छति?
- अद्य, श्वः, परश्वः, प्रपरश्वः, ह्यः, परह्यः, प्रपरह्यः, इदानीम् ।
- गीतम् ।
- गच्छन्ति । गच्छामः । गच्छन्तु ।
- शिष्टाचारः - सुप्रभातम्/नमस्कारः/शुभरात्रिः/हरिः ओम्/क्षम्यताम्/चिन्ता मास्तु ।
- प्रातर्विधिः - दन्तधावनम् इत्यादयः शब्दाः पाठनीयाः ।
- सङ्ख्या - 1-50 ।
- समयः - 6.05, 6.10, 5.55, 5.50
- स्वागतसम्भाषणम् । (शिक्षकः सहशिक्षकेण सह कृत्वा प्रदर्शयेत्)
- कथा ।
- रटनाभ्यासः ।
- वाक्यद्वयम् (प्रत्येकम् अपि छात्रः वाक्यद्वयं वदेत् ।)
- सूचनाः ।
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- गीतम्।
- आरोग्यसम्बन्धिशब्दाः – वैद्यरोगिसम्भाषणम्।
- प्रश्नोत्तरस्पर्धा।
- ऋषीणां नामानि।
- कथा - शिक्षकः एकां कथां वदति। अनन्तरं छात्रेषु एकैकः तस्याः कथायाः एकैकं वाक्यम् उक्त्वा कथां सम्पूर्णां करोति।
- सङ्ख्या - दीर्घसङ्ख्यापाठनम्।
- प्रश्नोत्तरम्।
- क्रीडा - (गणद्वये नामस्मरणक्रीडा)
- कथा।
- पुस्तकानां परिचयः।
- सप्त वाक्यानि।
- सूचना।
- ऐक्यमन्त्रः।

अष्टमं दिनम्

- गीतम्।
- पुनःस्मारणम्।
- वारम्।
- अतः - यतः परिवर्तनाभ्यासः।
- यद्यपि – तथापि।
- यत्र – तत्र।
- कति - कियत् - एतयोः भेदज्ञापनम्।
- यावत् – तावत्।
- यत् – तत्।
- यः - सः।
- या – सा।
- गीतम्।
- अस्माकम्।
- चर्चा।
- सङ्ख्या - 'शतायुः - गतायुः' क्रीडा।
- विनोदकणिकाकथनम्।
- कथा।
- अष्ट वाक्यानि।
- समाजनिधिविषये सूचना।
- ऐक्यमन्त्रः।

नवमं दिनम्

- गीतम्।
- पुनःस्मारणम्।
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  द्वयम् - द्वयम् - द्वयम्
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  चत्वारः - चतस्रः - चत्वारि
- शिश्रकः - अहं वैद्यः - मम नाम सुरेशः
  (छात्राः तमुद्दिश्य प्रश्नान् पृच्छेयुः।)
- .... अर्थम् (समाजार्थम्, संस्कृतकार्यार्थम्...)।
- गीतम्।
- तव्यत् – अनीयर्।
- अनन्यकथारचना।
- सङ्ख्यान्वेषणम् (क्रीडा)।
- छात्रैः सह प्रश्नोत्तरम्।
- समाजनिधिविषये पुनःस्मारणम्।
- ऐक्यमन्त्रः।

दशमं दिनम्

- गीतम्।
- पुनःस्मारणम्।
- पत्रलेखनम्।
- दूरवाणीसम्भाषणम्।
- मार्गनिर्देशः – कुत्र गन्तव्यम् इत्यादि।
- तव्यत् अभ्यासार्थम् – अद्य किं किं करणीयम् ?
- सान्दर्भिकभाषणम् –
  1. प्रवासात् प्रतिनिवर्तनस्य।
  2. आपणिकस्य इत्यादि।
- क्रीडा – सङ्ख्यायोजनम् (गणद्वये)।
- शुभाशयाः।
- असत्यकथनम् / कल्पनाकथनम्।
- समारोपः (सर्वैः शिक्षार्थिभिः भारतमातुः पूजां कृत्वा निधिसमर्पणं करणीयम्।)
- पत्राचारप्रगतशिक्षणादिविषये सूचना।
- ऐक्यमन्त्रः।

<u>Course outcome</u>

At the end of the course, the students will be able to achieve the following:

1. Enhanced writing skills in Sanskrit
2. Enhanced speaking skills in Sanskrit
3. Enhanced listening skills in Sanskrit
4. Enhanced writing skills in Sanskrit

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS02PR0206-16 **Course:** ***Kirtan Kala***
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week **Total Credits: 01**

Course objectives:
The objective of the course is to provide the students with a spiritual experience as well as its benefits to them in the form of better abilities to concentrate and develop the ability to create a peaceful mind.

- कीर्तन परंपरेचा इतिहास आणि अखिल भारतातील कीर्तन परंपरांचा परिचय
- चार महिन्यात वीस संतचरित्रांचा परिचय अधिक त्याविषयी प्रवचन
- वीस संतांचा वाङ्मयीन परिचय
- प्रमुख पाच कीर्तन पद्धतींचे मांडणी तंत्र.
- पूर्वरंग - उत्तररंग सहित कीर्तनप्रक्रियेतील सर्व महत्वाचे टप्पे.
- कीर्तनासाठी आवश्यक असणारी कंठ संगीतात्मक माहिती
- टाळ, मृदंग, वीणा, तबला, पेटी या वाद्यांची ओळख.
- प्रवचनांसाठी अभ्यासग्रंथांचे मार्गदर्शन.
- वकृत्व कला, संभाषण कला, संवाद कौशल्य, कथाकथन यांची रहस्ये
- कीर्तनाचे अनुषंगाने संस्कृत मराठी श्लोक, सुभाषिते व प्रमाणाधार अशी ओव्या अभंगांची शिदोरी.

Course outcome
At the end of the course, the students will be able to achieve the following:
1. Learn from the inspiring spiritual journey of the saints and the history of Kirtan tradition
2. Learn about the musical instruments used in the art of Kirtan
3. Develop communication skills

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS04PR0202-01 **Course Name: Adventure Sports**
L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per Week **Total Credits: 01**

Course Objective:
This course introduces adventure sports, emphasizing experiential learning through participation in various activities. The course will cover the fundamentals, safety procedures, and physical and mental benefits of adventure sports. Students will engage in outdoor activities such as wall climbing, rappelling, and more, fostering a connection with nature and understanding the principles of risk management.

Syllabus:
- Tent pitching, knot practice session and Tent allotment
- Activities like Jumaring and Climbing
- Individual challenge like Burma bridge, ladder bridge, multi vine
- Group Task like improvise raft making and Kayaking
- activities like Archery rifle shooting, cycle ride

Pattern of Classes: 2 Days and 1 Night Camp

Course Outcome: By the end of this course, students will:
1. Understand the principles and benefits of adventure sports.
2. Develop basic skills in selected adventure sports.
3. Learn and apply safety measures and risk management techniques.
4. Foster teamwork, leadership, and problem-solving skills.
5. Cultivate a greater appreciation for nature and outdoor activities.

Syllabus for Semester II, B. Tech. Computer Science & Engineering [Artificial Intelligence & Machine Learning]

Course Code: 24HS04PR0202-02 **Course Name: Introduction to Defense Forces & Obstacle Training**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per Week **Total Credits: 01**

Course Objective:

- Understand the Structure and Function of Defense Forces
- Familiarize with Defense Force Training and Discipline
- Learn Basic Obstacle Course Techniques
- Apply Problem-Solving and Teamwork in Obstacle Training
- Explore the Role of Obstacle Training in Defense Preparedness

Syllabus:

- Knot and Hitch practice session
- Activities like Rappelling & Wall Climbing
- Burma bridge & ladder bridge
- First Aid
- Rifle Shooting
- Horse riding
- Group Task and Team building activities

Pattern of Classes: 2 Days and 1 Night Camp

Course Outcome:

Upon successful completion of the course, students should be able to:

1. Describe the Structure and Functions of Defense Forces
2. Demonstrate Knowledge of Defense Training Protocols
3. Navigate Basic Obstacle Courses
4. Collaborate and Problem-Solve in Team-Based Exercises
5. Connect Obstacle Training to Defense Preparedness
6. Evaluate and Reflect on Training Experiences

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS04PR0202-03   Course Name: Self Defense & Indian Martial Arts

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per Week   Total Credits: 01

Course Objective:
This course provides students with practical knowledge and skills in self-defense, focusing on personal safety and awareness. Students will learn basic techniques for self-defense, including striking, blocking, and evasion, while also discussing the legal and ethical considerations of self-defense. The course will emphasize both physical techniques and mental preparedness.

Syllabus:

1. **Mental Awareness**
    - Importance of Self Defense
    - Types of Self Defense
    - Rules of Self Defense
2. **Physical Session**
    - Various Self Defense Techniques
    - Different Situational Defense Techniques
3. **Improvise Weapon**
    - Knowledge and practice of different equipment's which can be used for self defense
4. **Martial Arts**
    - Introduction of Indian Martial Arts
    - Demonstration of Indian Martial Arts
    - Training of Indian Martial Arts (Lathi Kathi)

Pattern of Classes: Training/Classes at Campus

Course Outcome: By the end of this course, students will:

1. Understand the principles of personal safety and awareness.
2. Learn and practice basic self-defense techniques.
3. Develop strategies to avoid dangerous situations.
4. Understand the legal and ethical implications of using self-defense.
5. Build confidence and physical fitness through regular practice.

Syllabus for Semester II, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Machine Learning]

Course Code: 24HS04PR0202-4 **Course Name: Basic Nutritional Course**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per Week **Total Credits: 01**

Course Objective:
In the "Basics of Nutrition" course, students will develop a comprehensive understanding of essential nutrients and their roles in supporting overall health. They will learn to apply dietary guidelines effectively, tailoring recommendations to various age groups and health conditions. Additionally, students will cultivate the skills needed to assess and improve their own and others' eating habits for better health outcomes.

Syllabus:
Unit I
- Introduction to Nutrition – Define Balanced Diet, Nutrition, Optimum Nutrition, Nutrients, Concept of Health, Recommended Dietary Allowances (RDA)
- Carbohydrates (sources, functions and digestion)
- Proteins (sources, functions and digestion)
- Fats (sources, functions and digestion)
- Micronutrients (vitamins and minerals-sources, functions and digestion)

Practical I
- Display of all the foods with the help of students and while demonstrating teacher will again explain role and importance of nutrition in daily life. Deficiency will lead to chronic diseases and its prevention is very necessary for the quality of life.

Unit II
- What is Body Mass Index?
- What is Basal Metabolic Rate?
- What is Ideal Body Weight? (Male/Female)
- How to read labels on Food Packets?
- How to choose smart food and Concept of Rainbow diet, My Food Pyramid or My plate given by ICMR-NIN.

Practical II
- Calculation of Body Mass Index, Basal Metabolic Rate, Ideal Body Weight (Male/Female) with the use of self-body measurements.
- Demonstration of Rainbow diet, My Food Pyramid or My plate in a class.

Pattern of Classes:
Theory Classes – 10
Practical Classes – 2

Course Outcome:
By the end of the course, students will be able to accurately describe the functions of key nutrients and their impact on health, create balanced meal plans based on established dietary guidelines, and critically evaluate nutrition information to distinguish between credible and misleading sources.

Syllabus for Semester III, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0301 **Course : Theory of Computation**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. This course aims to understand the basic theory of computation concepts that lies at the backbone of all state-of-the-art applications and program design.
2. Students can understand the capabilities and limitations of computation, as well as the specific applications and characteristics of deterministic and non-deterministic finite automata, context-free grammars, and ultimately, Turing machines.

Syllabus

UNIT-I: Basics of Theory of Computation, Basics of Sets and Relation, Countability and Diagonalization, Pigeon- hole principle. Fundamentals of formal languages and grammars, Chomsky hierarchy of languages.

UNIT-II: Finite Automata, Deterministic finite automata (DFA), Nondeterministic finite automata (NFA) and equivalence with DFA, Minimization of finite automata, NFA with Epsilon Transitions, Finite Automata with output.

UNIT-III: Regular expressions and Regular languages, Regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, Context-free grammars (CFG) and language (CFL), parse trees, ambiguity in CFG, Reduction of CFGs, Chomsky and Greibach normal forms.

UNIT-IV: Push Down Automata, Deterministic pushdown automata and non-deterministic pushdown automata, Acceptance by two methods: Empty stack and Final State, Equivalence of PDA with CFG, closure properties of CFLs.

UNIT-V: Turing Machines, The basic model for Turing machines (TM), Turing recognizable recursively enumerable) and Turing-decidable (recursive) languages, variants of Turing machines, unrestricted grammars and equivalence with Turing machines, and TMs as enumerators.

Course Outcomes:

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

1. Describe the formal relationships among machines, languages, and grammars.
2. Generate the finite automata for given regular languages.
3. Construct a Regular expression and the grammar for a given language.
4. Design Pushdown Automata, Turing Machine for given languages.

Text Books

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Reference Books

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and the Theory of Computation, Tata McGraw Hill

Syllabus for Semester III, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0302 **Course : Database Management Systems**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To understand the role of a database management system in an organization.
2. To construct simple and advanced database queries using a data language.
3. To understand and apply logical database design principles and database normalization.
4. To recognize the need for transaction management and query processing.

SYLLABUS

UNIT-I Introduction to Database System Concepts and Architecture

Databases and Database Users, Characteristics of the Database Approach, Advantages of Using the DBMS Approach, When Not to Use a DBMS, Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.

UNIT-II The Relational Data Model and SQL

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations, SQL Data Definition, Data Types and Constraints, Data Management in SQL, Transforming ER Model into Relational Model.

UNIT-III Database Design and Normalization

Functional Dependencies, Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decomposition, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Other Dependencies and Normal Forms.

UNIT IV Indexing and Hashing

Ordered Indices, B+-Tree Index Files and its Extensions, Static Hashing and Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Some General Issues Concerning Indexing.

UNIT V Query Processing and Optimization

Measures of Query Cost, Query Operation: Selection, Sorting and Join Operation, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

UNIT VI Transaction Processing, Concurrency Control and Recovery

Introduction to Transaction Processing, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Deadlock Handling and Multiple Granularity, Database Recovery Techniques.

Course Outcomes:

On completion of the course the student will be able to

1. Identify the basic concepts and various data model used in database design.
2. Recognize the use of normalization and functional dependency.
3. Understand the purpose of query processing and optimization.
4. Apply and relate the concept of transaction, concurrency control and recovery in database.

Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan; "Database System Concepts" Sixth Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri and Shamkant Navathe; "Fundamentals of Database Systems", Sixth Edition, Addison Wesley 2011.

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke; "Database Management Systems"; Third Edition; Tata McGraw Hill Publication, 2003.
2. C. J. Date; "Database in Depth – Relational Theory for Practitioners"; O`Reilly Media, 2005.

Syllabus for Semester III, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0302 **Course : Database Management Systems Lab**

L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Course Objectives

1. To understand the role of a database management system in an organization.
2. To construct simple and advanced database queries using a data language.
3. To understand and apply logical database design principles and database normalization.

To recognize the need for transaction management and query processing

SYLLABUS

Practicals Based on Above Syllabus

Course Outcomes:

On completion of the course the student will be able to

1. Identify the basic concepts and various data model used in database design.
2. Recognize the use of normalization and functional dependency.
3. Understand the purpose of query processing and optimization.
4. Apply and relate the concept of transaction, concurrency control and recovery in database.

Text Books:

1.Abraham Silberschatz, Henry F. Korth and S. Sudarshan; “Database System Concepts” Sixth Edition, Tata McGraw Hill, 2011.

2.Ramez Elmasri and Shamkant Navathe; “Fundamentals of Database Systems”, Sixth Edition, Addison Wesley 2011.

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke; “Database Management Systems”; Third Edition; Tata McGraw Hill Publication, 2003.

2.C. J. Date; “Database in Depth – Relational Theory for Practitioners”; O`Reilly Media, 2005.

Syllabus for Semester III, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0303 **Course : Programming Laboratory I**

L: 0Hrs, T: 0 Hr, P: 4Hrs, Per Week **Total Credits: 02**

Course Objectives

1. Introduce students to basic Python programming concepts
2. Students will learn different data structures supported by python and its applications
3. to develop complex real-life python applications.

Syllabus

Variables, Data Types, and Input/Output

Declare variables of different types and print their values and Use input () to take user input and print() to display output.

Operators and Expressions

Perform arithmetic, comparison, logical, and assignment operations and Evaluate expressions using operator precedence.

Conditional Statements

Use if-else to check conditions (e.g., even/odd, largest number) and create a simple calculator using conditional logic.

Looping Constructs

Use for and while loops to print sequences and numbers and Implement Fibonacci series and loop control statements (break, continue).

Functions and Modules

Define functions with parameters and return values as well as Import and use built-in and user-defined modules.

Lists and Tuples

Create and manipulate lists (add, remove, sort, reverse), Access and slice tuples to extract values.

Dictionaries and Sets

Store key-value pairs in dictionaries and access values, and perform set operations like union, intersection, and difference.

File Handling (Basic)

Create, read, and write text files, append data to an existing file and display its content.

Course Outcomes:

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

1. Write and execute Python programs using basic syntax, data types, and input/output operations.
2. Use conditional statements (if-else) and loops (for, while) to solve simple computational problems.
3. Define and use functions and modules to improve code efficiency and organization.
4. Perform operations on lists, tuples, dictionaries, and sets to store and manage data effectively.
5. Read, write, and modify text files to manage data input/output operations.

Reference Books

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition , Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
3. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth Edition, 2009.
4. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition, 2013.

Syllabus for Semester III, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0304 **Course : Microcontroller and Sensors**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. Understand Microcontroller Architectures & Embedded Systems.
2. Develop Embedded C Programs.
3. Interface Sensors & Actuators.
4. Implement Communication Protocols for sensor data exchange.

Syllabus

Unit I Microcontrollers and Embedded Systems

Introduction to Microcontrollers & their Architectures, Difference Between ARM Cortex-M, ATmega, and other Microcontrollers. Overview of Embedded Systems, Components of Embedded Systems, Real world applications of Embedded Systems.

Unit II Embedded C Programming and ARM Cortex-M Architecture

Data Types, Pointers, Bitwise Operations, Working with Registers & Memory-Mapped I/O, Functions, and Structures. ARM Cortex-M Processor Architecture, Instruction Set, Advanced Embedded C Features for ARM: GPIO Interfacing, Timers, Interrupts, and Power Management.

Unit III Sensors

Classification of Sensors: Analog & Digital, Working Principles of Common Sensors: Temperature-Humidity (DHT11, LM35), Pressure & Humidity (BMP180, DHT22), Motion & Proximity (IR, Ultrasonic, PIR), Light & Sound (LDR, Microphone), Signal Conditioning, Feature Extraction & Noise Reduction, D/A and A/D converter, & Data Acquisition, Sensor Interfacing with Microcontrollers.

Unit IV Actuators

Sensors vs. Actuators, Pulse width modulation, Types of Actuators: Electrical Actuators (DC Motors, Servo Motors, Stepper Motors), Mechanical Actuators (Solenoids, Relays), Actuator Control**.**

Unit V Communication Protocols for Sensors

Serial Communication: UART, SPI, I2C, Wireless Communication: Bluetooth, Wi-Fi, Zigbee, Introduction to Sensor Networks & Data Collection Techniques, Real-time Sensor Data Processing using Microcontrollers, Overview of other Communication Modules (GPS, GSM).

Course Outcomes:

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

1. Understand microcontrollers & embedded systems.
2. Develop Embedded C programs for ARM.
3. Interface sensors & actuators to the microcontroller.
4. Implement communication protocols for data exchange in between microcontrollers and sensors.
5. Design microcontroller based systems.

Text Books

1. "Embedded Systems: Introduction to the ARM Cortex-M Microcontroller", *Jonathan Valvano.*
2. "Programming Embedded Systems in C and C++", *Michael Barr & Anthony Massa.*
3. "Mechatronics: Principles and Applications", *Godfrey C. Onwubolu.*

Reference Books

1. ARM Architecture Reference Manual, David Seal, Adison Wesley.
2. Real Time Systems – Design for distributed Embedded Applications: Herma K. Kluwer Academic.
3. "Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms", *Nikolaus Correll, Bradley Hayes, and David Wingate.*

Syllabus for Semester III, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0304 **Course : Microcontroller and Sensors Lab**

L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Course Objectives

1. Understand Microcontroller Architectures & Embedded Systems.
2. Develop Embedded C Programs.
3. Interface Sensors & Actuators.
4. Implement Communication Protocols for sensor data exchange.

Syllabus

Practicals are based on Theory Syllabus

Course Outcomes:

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

1. Understand microcontrollers & embedded systems.
2. Develop Embedded C programs for ARM.
3. Interface sensors & actuators to the microcontroller.
4. Implement communication protocols for data exchange in between microcontrollers and sensors.
5. Design microcontroller based systems.

Text Books

1. "Embedded Systems: Introduction to the ARM Cortex-M Microcontroller", *Jonathan Valvano.*
2. "Programming Embedded Systems in C and C++", *Michael Barr & Anthony Massa*
3. "Mechatronics: Principles and Applications", *Godfrey C. Onwubolu.*

Reference Books

1. ARM Architecture Reference Manual, David Seal, Adison Wesley.
2. Real Time Systems – Design for distributed Embedded Applications: Herma K. Kluwer Academic.
3. "Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms", *Nikolaus Correll, Bradley Hayes, and David Wingate.*

Syllabus for Semester IV, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0401 **Course : Internet of Things(IoT)**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. Understand the fundamentals of IoT, including sensing, actuation, networking, and communication protocols, along with machine-to-machine communication and interoperability.
2. To develop hands-on experience with Arduino and Raspberry Pi by designing IoT applications using sensors, actuators, and communication modules while programming in Arduino IDE and Raspberry Pi environments.
3. To explore cloud and fog computing, data analytics, and real-world IoT applications in smart cities, healthcare, agriculture, and industrial automation.

Syllabus

UNIT-I: Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols Sensor Networks Machine-to-Machine Communications Interoperability in IoT.

UNIT-II: Introduction to Arduino Programming Integration of Sensors and Actuators with Arduino Introduction to Raspberry Pi and programming, Implementation of IoT with Raspberry Pi Introduction to SDN, SDN for IoT.

UNIT-III: Data Handling and Analytics, Cloud Computing, and Fog Computing, Introduction to Industrial IoT

UNIT-IV: Preparing the development environment (Arduino IDE), Exploring the Arduino language (C/C++) syntax, Coding, compiling, and uploading to the microcontroller, working with Arduino Communication Modules: Bluetooth Modules, WiFi Modules and I2C and SPI, Interfacing arduino and Blynk via USB: LED Blinking, Controlling a Servomotor.

UNIT-V: Case Studies: Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Agriculture, Healthcare, Activity Monitoring

Course Outcomes:

On successful completion of the course, students will be able to:
1. Conceptualize interaction of IoT device with the physical world environment.
2. Understand individual components of IoT systems.
3. To estimate the requirements of IoT systems from individual components.
4. To conceptualize the sensor node for capturing data from the physical world.
5. To conceptualize complete IoT systems using components of IoT system.

Text Books

Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759 3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

Reference books:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014.

Syllabus for Semester III, B. E. (Computer Science & Engineering)

Course Code: 24CS03TH0402 Course: Design and Analysis of Algorithms
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week Total Credits: 03

Course Objectives
The objective of this course is

1. to introduce students to techniques for effective problem solving in computing.
2. developing skills to solve real life applications which involving algorithm development.
3. making students capable of analyzing different paradigms and their complexities to solve a given problem in efficient way.

Syllabus

Unit I
Mathematical foundations- Recurrence relations and their solutions, Complexity Calculation-Substitution Method, Recurrence tree method, Master Method, Asymptotic notations for analysis of algorithms, Amortized Analysis.

Unit II
Greedy method – Basic strategy, Minimum cost spanning trees- Prim's Algorithm, Kruskal's Algorithm, Fractional Knapsack Problem, Huffman Coding, Activity Selection Problem, K-Centers Problem.

Unit III
Dynamic Programming - Basic strategy, Bellmen ford algorithm, All pairs shortest path, Multistage Graphs, Optimal Binary Search Trees, Traveling Salesman Problem, String Editing, Longest Common Subsequence problem and its variations.

Unit IV
Divide and Conquer- Basic strategy, Merge sort, Strassen's matrix multiplication, Maximum sub-array problem, Closest pair of points problem, Convex hull problem.

Backtracking- Basic strategy, N-Queen's problem, Graph Coloring, Hamiltonian Cycles, Sum of Subset Problem.

Unit V
NP Theory: Non-Deterministic Algorithms, NP, NP-hard and NP-complete problems, Decision and Optimization problems, Graph based problems on NP Principle, vertex cover problem, clique cover problem, Independent Set Problem, etc., Proving NP-completeness of various problems.

Course Outcomes

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

1. Comprehend the foundational principles involved in the design and analysis of algorithms.
2. Identify the algorithmic solution to solve a given problem.
3. Apply algorithmic techniques to solve real-life and complex computational problems.
4. Evaluate efficiency and complexity of various algorithms using mathematical analysis.

Text Books

1. Thomas H. Cormen et.al; “Introduction to Algorithms”; 3 Edition; Prentice Hall, 2009.
2. Horowitz, Sahani and Rajasekaram; “Computer Algorithms”, Silicon Press, 2008.
3. Sridhar S.; “Design and Analysis of Algorithms”, Oxford University Press.
4. Brassard and Bratley; “Fundamentals of Algorithms”, 1 Edition; Prentice Hall, 1995.

Reference Books

1. Parag Himanshu Dave, Balchandra Dave, “Design and Analysis of Algorithms” Pearson Education, O'relly publication.
2. Jon Kleinberg, Éva Tardos, “Algorithm design”, Pearson, 2005.
3. Richard Johnsonbaugh, “Algorithms”, Pearson Publication, 2003.

Syllabus for Semester III, B. E. (Computer Science & Engineering)

Course Code: 24CS03PR0402 Course: Design and Analysis of Algorithms Lab
L: 0Hrs, T: 0 Hr, P: 02Hr, Per Week Total Credits: 01

Course Objectives

The objective of this course is

1. to introduce students to techniques for effective problem solving in computing.
2. developing skills to solve real life applications which involving algorithm development.
3. making students capable of analyzing different paradigms and their complexities to solve a given problem in efficient way.

Syllabus:

Practicals are based on the above Theory Syllabus 24CS03TH0402

Course Outcomes

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

1. Comprehend the foundational principles involved in the design and analysis of algorithms.
2. Identify the algorithmic solution to solve a given problem.
3. Apply algorithmic techniques to solve real-life and complex computational problems.
4. Evaluate efficiency and complexity of various algorithms using mathematical analysis.

Text Books

1. Thomas H. Cormen et.al; “Introduction to Algorithms”; 3 Edition; Prentice Hall, 2009.
2. Horowitz, Sahani and Rajasekaram; “Computer Algorithms”, Silicon Press, 2008.
3. Sridhar S.; “Design and Analysis of Algorithms”, Oxford University Press.
4. Brassard and Bratley; “Fundamentals of Algorithms”, 1 Edition; Prentice Hall, 1995.

Reference Books

1. Parag Himanshu Dave, Balchandra Dave, “Design and Analysis of Algorithms” Pearson Education, O'relly publication.
2. Jon Kleinberg, Éva Tardos, “Algorithm design”, Pearson, 2005.
3. Richard Johnsonbaugh, “Algorithms”, Pearson Publication, 2003.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0403 **Course : Artificial Intelligence**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

The objective of this course is to familiarize the prospective engineers with:

1. Introduction of problem-solving techniques, task domains and intelligent agent structures in AI.
2. Representation of given problem using state space representation and solve it by using different search techniques.
3. Understanding of adversarial search, game-playing strategies and constraint satisfaction problems
4. Understand of knowledge representation and uncertainty theory in designing AI systems.

Syllabus

UNIT I:

Introduction to Artificial Intelligence: History, applications, task domains, Basics of problem solving, problem characteristics, problem representation (toy problems and real-world problems); Structure of agent, rational agent, specifying task environment, Properties of task environment, measuring problem solving performance.

UNIT II:

Uninformed search techniques: Depth, Breadth, Uniform Cost, Depth Limited, Iterative deepening DFS, Bidirectional Search.

UNIT III:

Informed search techniques: Heuristic Based Search, Greedy Best First Search, A* Search; Local Search algorithms: Hill-climbing, Genetic Algorithms.

UNIT IV:

Adversarial Search: Two player Games, The min-max algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems: Constraint propagation, backtracking search.

UNIT V:

Knowledge Representation and Uncertainty theory: Propositional logic, First Order Logic: Syntax and Semantics of FOL, Inference in FOL: Unification Algorithm, Resolution, Forward Chaining, Backward Chaining. Probability and Bayes' Theorem, Statistical reasoning: Bayesian networks, Bayes optimal classifier, Naïve bayes algorithm, Introduction to expert system.

Course Outcomes:

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

1. Explain the historical evolution, applications and problem-solving characteristics of AI.
2. Apply uninformed and informed search techniques and represent given problem using state space representation.
3. Utilize different AI techniques to solve fully informed two player games and constraint satisfaction problems.
4. Demonstrate knowledge representation techniques and Uncertainty theory in AI decision-making scenarios.

Text Books:

1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Fourth Edition; Pearson Education, 2022.
2. E. Rich, K. Knight, S.B. Nair; Artificial Intelligence ,3rd Edition, Tata McGraw Hill, 2009.

Reference Books:

1. Dan W Patterson, Introduction to Artificial Intelligence & Expert System, Pearson Education India; First Edition, 2015.
2. By Patrick D. Smith, David Dindi, Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation, First edition, Packt Publishing Ltd, 2018.
3. Richard E. Neapolitan, Xia Jiang, Artificial Intelligence with an Introduction to Machine Learning, Chapman and Hall/CRC; 2nd edition, 2018.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0403 **Course : Artificial Intelligence Lab**

L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Syllabus:

Practicals Based On above Artificial Intelligence 24CS03TH0403 Syllabus

Course Outcomes:

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

1. Implement different AI toy problems by using search techniques.
2. Design two player games using min-max algorithm with Alpha-Beta pruning.
3. Simulate AI problems using logic programming.
4. Implement probabilistic based methods to solve classification problems.

Text Books:

1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Fourth Edition; Pearson Education, 2022.

Reference Books:

1. By Patrick D. Smith, David Dindi, Hands-On Artificial Intelligence for Beginners: An introduction to AI concepts, algorithms, and their implementation, First edition, Packt Publishing Ltd, 2018.
2. Richard E. Neapolitan, Xia Jiang, Artificial Intelligence with an Introduction to Machine Learning, Chapman and Hall/CRC; 2nd edition, 2018.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0404 Course : Programming Laboratory- II

L: 0Hrs, T: 0 Hr, P: 4Hrs, Per Week Total Credits: 02

Course Objectives

1. Introduce students to basic Python programming concepts
2. Students will learn different data structures supported by Python and its applications
3. to develop complex real-life python applications.

Syllabus

Advanced-Data Types and Operations

List comprehensions and generator expressions. Nested lists, tuples, and dictionary operations.

Object-Oriented Programming (OOP) in Python

Creating and using classes and objects. Implementing constructors, destructors, and instance methods.

Exception Handling and Debugging

Handling errors using try-except-else-finally, raising exceptions with raise, Debugging techniques and using assert statements.

File Handling and Data Processing

Working with different file formats (CSV, JSON, XML), Reading and writing binary files. Using pandas for data analysis and manipulation.

Functional Programming Concepts

Using lambda, map(), filter(), and reduce(), Decorators and generators, List comprehensions vs. generator expressions.

Advanced Libraries and Frameworks:

Working with NumPy for numerical computing, Using Matplotlib and Seaborn for data visualization, and Introduction to Flask/Django for web development.

Web Scraping and API Handling

Extracting data from websites using BeautifulSoup and Scrapy

Course Outcomes:

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

1. Efficiently manipulate and process data using list comprehensions, generator expressions, and advanced dictionary operations.
2. Design and develop Python applications using classes, objects, constructors, destructors, and OOP principles.
3. Implement robust error handling using try-except blocks, raise custom exceptions, and apply debugging techniques.
4. Read, write, and manipulate structured data (CSV, JSON, XML) and perform data analysis using the pandas library
5. Apply functional programming techniques, use NumPy for numerical computing, and create visualizations with Matplotlib and Seaborn.

Text Books

1. Python Programming: An Introduction to Computer Science (3rd Edition) – John Zelle, Franklin, Beedle & Associates

Reference Books

1. Fluent Python (2nd Edition) – Luciano Ramalho, O'Reilly Media
2. Python Programming: An Introduction to Computer Science (3rd Edition) – John Zelle, Franklin, Beedle & Associates
3. Web Scraping with Python – Ryan Mitchell, O'Reilly Media
4. Python for Data Analysis – Wes McKinney, O'Reilly Media

Syllabus for Semester IV, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0405 **Course : Community Engagement Project**

L: 0Hrs, T: 0 Hr, P: 4Hrs, Per Week **Total Credits: 02**

Course Objectives

1. Develop an understanding of rural society, lifestyle, gender roles, social structures, and traditional values.
2. Analyze rural livelihoods, agriculture, water management, non-farm activities and economic challenges.
3. Explore governance structures, Panchayati Raj institutions, self-help groups, and local administrative mechanisms.
4. Engage in field visits, social audits, awareness programs, and problem-solving initiatives for rural development.

Syllabus:

Week 1-2: Appreciation of Rural Society: Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages' (Gandhi), rural infrastructure.

Week 3-4: Understanding rural and local economy and livelihood: Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.

Week 5-8: Rural and local Institutions: Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.

Week 9-12: Rural and National Development Programmes: History of various development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, SHRAM, Jal Jeevan Mission, SFURTI, Atma Nirbhar Bharat, etc.

Teaching/ Learning Methodology

- Visit Rural Schools / mid-day meal centres, study academic and infrastructural resources and gaps
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the site

- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem-solving measures
- Interaction with self-help groups women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan (GPDP)
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing
- Classroom discussions, Group discussions, Field visit, Group presentation, Written assignment, Idea and project proposals for solving community issues

Course Outcomes

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

1. Understand the functioning of rural governance, Panchayati Raj, and self-help group initiatives and their impact on community welfare.
2. Gain applied knowledge of rural society, its social dynamics, and traditional community values.
3. Develop analytical skills to assess rural economies, livelihoods, and challenges faced by local communities.
4. Apply participatory approaches through fieldwork, social audits, and problem-solving for sustainable rural development.

Textbooks / Reference Books

1. Katar Singh, Anil Shishodia, Rural Development: Principles, Policies and Management, Fourth Edition, Atlantic Publishers and Distributors (P) Ltd, 2024, ISBN: 978-8126936786
2. Abhijit Guha, Nation-Building in Indian Anthropology: Beyond the Colonial Encounter, Routledge, Taylor & Francis, First Edition, 2022, ISBN: 978-1003341581
3. Surinder S. Jodhka, The Indian Village : Rural Lives in the 21st Century, Aleph Book Company; First Edition, 2023, ISBN: 978-9391047191
4. Parikshit Sahu, Rural Development in Modern India: Foundation and Pathways, Kaveri Books, 2021, ISBN: 978-9385719196

5. Manish Didwania, Sanjeev Prashar, Nitin Kishore Saxena, Rural Development & Management in India: Opportunities & Challenges (Countries and Cultures of the World), Nova Science Publishers Inc., 2017, ISBN: 978-1536118643
6. Jeet Ram Sharma, Leadership Dynamics in Panchayati Raj Institutions, IIP Iterative International Publishers, 2024, ISBN: 978-9357479585

Online Reference Course

1. https://onlinecourses.swayam2.ac.in/ugc23_ge04

Syllabus for Semester IV, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0406 Course : Creativity, Innovation & Design Thinking

L: 2Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 02

Course Objectives

1. Develop a human-centred approach when designing, innovating, developing, and testing new products, services, and processes.
2. Understand the significance of innovation in the digital age and lead disruptive advancements.
3. Foster a culture of design thinking to encourage innovation within an organization.
4. Conceptualize and develop innovative solutions both individually and collaboratively to enhance business impact.
5. Develop the ability to design and evaluate prototypes that prioritize customer needs and drive innovation.

Syllabus

Unit I

Introduction: Meaning and concept of creativity - Creativity Process- Nature and characteristics of creativity, Factors affecting creativity, Recognizing and avoiding mental blocks, understanding creativity from studying the profiles of most creative personalities.

Unit II

Pattern Breaking: Thinking preferences. Lateral Thinking, Different techniques of creative problem solving- Brain storming, SCAMPER, Mind Mapping & Simulation, Metaphoric thinking, Outrageous thinking, other (new approaches)

Unit III

Decision and Evaluation: Focused Thinking Framework, Six Thinking Hats, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

Unit IV

Innovation: Meaning and Importance — Difference with Creativity, Invention and Discovery Process, Nine lessons for Innovation,

Design Thinking: Understanding the design thinking approach, Human centered design Case Studies on Innovation business ideas like Amazon, Swiggy, Red bus, Flip fart, Ola, Big Basket, methods and techniques — organizational Aspects, Economic Aspects like\ venture capital, angel investors, Evaluation of Effectiveness of Innovation

Unit V

Ethical Considerations: Introduction to intellectual property rights - Patents, Copyrights© Trademarks®, Trade Secret, Unfair Competition.

Course Outcomes:

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

1. Practice the processes and methods of creative problem solving: observation, definition, representation, ideation, evaluation and decision making
2. Develop their creative and innovative thinking skills
3. Create building blocks of innovation
4. Practice and value teaming, communication, and creative problem solving
5. Design using human centered approach

Text Books/ Reference Books

1. Design Thinking by Hasso Plattner, Christoph Meinel, Larry Leifer
2. The 7 Habits of Highly Effective People, by Stephen R. Covey
3. Creative Problem Solving for Managers - Tony Proctor - Routledge Taylor & Francis Group
4. The art of Innovation, by Tom Kelley and the Deep Dive story

Syllabus for Semester V, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0501 **Course : Machine Learning**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To introduce the basic concepts and techniques of machine learning.
2. To understand major machine learning algorithms.
3. To identify machine learning techniques suitable for a given problem.

Syllabus

Unit – I

Concept Learning: The concept learning task, General-to-specific ordering of hypotheses, Version spaces, Inductive bias, Decision Tree Learning, Rule Learning: Propositional and First-Order, Over-fitting, Cross Validation, Experimental Evaluation of Learning Algorithms.

Unit - II

Instance-Based Learning: K-Nearest neighbor algorithm, Radial basis functions, Case- based learning. Computational Learning Theory: probably approximately correct (PAC) learning, Sample complexity, Computational complexity of training, Vapnik Chervonenkis dimension.

Unit - III

Artificial Neural Networks: Linear threshold units, Perceptron, Multilayer networks and backpropagation, recurrent networks.

Unit - IV

Probabilistic Machine Learning: Maximum Likelihood Estimation, MAP, Bayes Classifiers Naïve Bayes, Bayes optimal classifiers, Minimum description length principle.

Bayesian Networks, Inference in Bayesian Networks.

Unit - V

Expectation Maximization algorithm, preventing over fitting, Gaussian Mixture Models, K- means and Hierarchical Clustering. Hidden Markov Models, Reinforcement Learning, Support Vector Machines, Ensemble learning: boosting, bagging.

Course Outcomes:

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

1. Solve the problems related to the fundamental concepts in machine learning.
2. Apply machine learning algorithms to solve classification, regression and clustering problems.
3. Analyse the strengths and weaknesses of various machine learning approaches.
4. Apply various machine learning models to efficiently solve real-world problems.

Text Books

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan Kaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0501 **Course : Machine Learning Lab**
L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Course Objectives

1. To implement basic machine learning algorithm for solving problem.
2. To understand the usage of datasets in implementing machine learning problems.
3. To learn various modern tools, packages and techniques for machine learning.

Technology: Python. Syllabus

1. To implement Find-S algorithm to find maximally specific hypothesis on given dataset.
2. To implement Candidate Elimination algorithm on Enjoy Sports dataset and find candidate hypothesis.
3. To implement linear regression algorithm on given dataset.
4. To implement decision tree classifier on given dataset and display generated tree.
5. To Implement KNN algorithm for classification and regression on given datasets.
6. To implement the perceptron algorithm for AND, OR and NOR Boolean functions.
7. To implement the backpropagation algorithm for machine learning using suitable dataset.
8. To implement the Naïve Bayes algorithm on given dataset.
9. To implement the support vector machine algorithm on given dataset.

Course Outcomes:

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

1. Implement fundamental concepts used in machine learning algorithms.
2. Implement python programs for various learning algorithms.
3. Apply appropriate machine learning algorithms to various data sets.
4. Apply machine learning algorithms to solve real world problems.

Text Books

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan Kaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0502 **Course : Cloud & Edge Computing for AI**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To build a strong foundation in cloud computing concepts and architectures.
2. To understand the role of edge computing in AI-driven systems.
3. To explore AI/ML deployment across cloud-edge continuum.
4. To learn distributed data processing, virtualization, and resource management.
5. To analyze security, privacy, and scalability challenges in cloud-edge AI systems.

Syllabus

Unit I: Foundations of Cloud and Edge Computing: Evolution of computing: centralized, distributed, cloud, edge, Distributed systems, cluster computing, grid computing, Cloud computing fundamentals: characteristics, service models (IaaS, PaaS, SaaS), deployment models, Introduction to edge computing, fog computing, and cloud-edge continuum, Need for edge AI: latency, bandwidth, privacy, real-time processing, Overview of AI workloads

Unit II: Virtualization, Containers and Cloud Infrastructure: Virtualization concepts: hypervisors, VMs, containerization (Docker basics), Resource provisioning and scheduling in cloud, VM migration, load balancing, auto-scaling, Cloud platforms overview: AWS, Azure, Google Cloud, Storage systems: distributed storage, object storage, Introduction to serverless computing (FaaS)

Unit III: Cloud Computing for AI and Data Processing: AI/ML lifecycle on cloud platforms, Data pipelines and big data processing (MapReduce concept, Spark overview), Parallel and distributed computing for AI, GPU/TPU acceleration in cloud, Cloud-based AI services (ML APIs, AutoML concepts), Case studies: AI applications on cloud

Unit IV: Edge Computing and Edge AI: Edge computing architecture and components, Edge devices: IoT sensors, microcontrollers, embedded systems, Edge AI frameworks: TensorFlow Lite, TinyML basics, Model optimization: pruning, quantization, compression, Distributed training and inference (cloud-edge collaboration), Edge analytics and real-time decision systems, Case studies: smart cities, autonomous vehicles, industrial IoT

Unit V: Security, Privacy, and Advanced Topics: Cloud security: authentication, authorization, IAM, Data privacy and compliance (GDPR basics, data protection concepts), Security challenges in edge environments, Fault tolerance, reliability, SLA in cloud systems, Cloud-edge orchestration and interoperability, Emerging trends: Federated learning, Edge intelligence, Serverless AI, Green cloud computing

Course Outcomes

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

1. Explain cloud computing architecture, service models, and virtualization techniques.
2. Analyze the role of edge computing in AI systems and real-time applications.
3. Implement AI workflows using cloud platforms and distributed systems.
4. Design and evaluate edge AI solutions with optimized models.
5. Assess security, privacy, and performance challenges in cloud-edge environments.

Text Books:

1. Rajkumar Buyya et al., Cloud Computing: Principles and Paradigms, Wiley.
2. Kai Hwang et al., Distributed and Cloud Computing, Elsevier.
3. Pete Warden & Daniel Situnayake, TinyML, O'Reilly.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0502 **Course : Cloud & Edge Computing for AI Lab**
L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Course Objectives

This course aims to provide hands-on experience with cloud platforms, edge computing frameworks, and deployment of AI/ML models. Students will learn to build, deploy, and manage scalable AI applications across cloud and edge environments.

Syllabus:

Experiments based on the above syllabus **24CS03TH0502**

Course Outcome:
On completion of the course the student will be able to

1. Demonstrate the use of cloud platforms for deploying applications and services
2. Implement containerized and serverless applications in cloud environments
3. Develop and deploy machine learning models using cloud infrastructure
4. Apply edge computing techniques for real-time AI applications
5. Design and implement integrated cloud-edge AI solutions

Syllabus for Semester V, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0503 **Course : Computer Networks**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in network protocols.
3. To provide an opportunity to do network programming

Unit 1: Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division

Unit2: Data Link Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ.

Unit 3: Medium Access Sub Layer: Switching, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA, IEEE 802 standard protocols.

Unit 4: Network Layer: Internet Protocol (IP) – Logical Addressing: IPV4, IPV6; Address mapping: ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit 5: Transport Layer: Elements of Transport protocols: Addressing, Connection establishment, Connection release, Crash recovery, User Datagram Protocol (UDP), Transmission Control Protocol(TCP), TCP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm. Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP).

Course Outcome:
On completion of the course the student will be able to

1. Understand basics of computer networks and reference models
2. Identify the Design issues of each layer of OSI model
3. Implement the protocols of OSI model

Text Books:

1. Computer Networks: 5th ed by Andrew. S. Tanenbaum. PHI Publication.
2. Data Communications and Networks: 3rd ed by Behrouz A. Forouzan. Tata McGraw Hill Publication.

Reference Books:

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition.
2. William Stallings, “Data and Computer Communications”, PHI 6th Edition

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0503 | **Course : Computer Networks Lab**
L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week | **Total Credits: 01**

Course Objectives:

1. To introduce use of different network simulation software.
2. To analyze performance of different protocols at various layers of a network architecture.
3. To demonstrate the implementation of various networking concepts.

Syllabus:

Experiments based on 24CS03TH0503 Syllabus.

Course Outcome:
On completion of the course the student will be able to

1. Understand basics of computer networks and reference models
2. Identify the Design issues of each layer of OSI model
3. Implement the protocols of OSI model

Text Books:

1. Computer Networks: 5th ed by Andrew. S. Tanenbaum. PHI Publication.
2. Data Communications and Networks: 3rd ed by Behrouz A. Forouzan. Tata McGraw Hill Publication.

Reference Books:

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition.
2. William Stallings, "Data and Computer Communications", PHI 6th Edition

Tools used: Nersim, Wireshark

Course Code : 24CS03PR0504 **Course : Data Analytics & Visualization Lab**
L: 0Hrs, T: 0 Hr, P: 4Hrs, Per Week **Total Credits: 02**

Course Objectives

1. To apply statistical methods for data analytics to provide business solutions.
2. To develop insights based on analytical results to facilitate better understanding of consumer attitude, perceptions and behavior.
3. To create data visualizations for effective communication to user.

Syllabus

Experiments based on Data Visualization and Analytics Theory Syllabus preferably using R, Python.

Course Outcomes:
On successful completion of the course, students will be able to:
1. Apply different data preparation techniques.
2. Apply various data analysis techniques.
3. Apply analytics on time series data.
4. Design effective presentations and visualizations.

Reference Books

1. David Dietrich, Barry Heller and Beibel Yang, - Data Science and Big Data Analytics – Discovering, Analyzing, Visualizing, and Presenting Data, John Wiley and Sons [EMC Education Services], 2015.
2. Kyran Dale, - Data Visualization with Python and JavaScript – Scrape, Clean and transform Your Data, O'Reilly, 2016.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0505	**Course : Idea Lab**
L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week	**Total Credits: 01**

Course Objectives

1. The course aims to provide participants with a comprehensive understanding of design thinking principles, prototyping fundamentals, entrepreneurship essentials, and business development strategies.
2. Through a combination of theoretical learning and hands-on exercises, participants will gain the knowledge and skills necessary to identify market needs, develop innovative solutions, and successfully launch entrepreneurial ventures.

Syllabus:

Module 1: Introduction to Design Thinking and Ideation, Understanding the design thinking process, Empathy and user-centered design, Ideation techniques: brainstorming, mind mapping, etc., Identifying market needs and opportunities.

Module 2: Prototyping Fundamentals, Introduction to rapid prototyping tools and techniques, Hands-on exercises in prototyping using low-fidelity materials, Iterative design process: testing and refining prototypes

Module 3: Entrepreneurship Essentials, Introduction to entrepreneurship and lean startup methodology, developing a value proposition and business model canvas, Identifying target customers and validating market demand

Module 4: Business Development and Pitching, crafting persuasive pitches and presentations, Financial modeling and revenue projections, Pitching prototypes and business concepts to a panel of experts

Module 5: Project Implementation and Showcase, implementing prototypes and gathering user feedback, Iterating based on feedback and improving prototypes, Final showcase event: presenting prototypes and business ventures to peers, faculty, and industry, professionals.

Course Outcome:
After Completing this course students will be able to:

1. Gain a deep understanding of the design thinking process, generating creative ideas through ideation techniques, and translating ideas into actionable prototypes.
2. Acquire proficiency in rapid prototyping tools and techniques, enabling them to efficiently create and iterate low-fidelity prototypes.
3. Develop skills in testing and refining prototypes through an iterative design process.
4. Implement prototypes, gather user feedback, and iterate based on insights gained.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0506-1 **Course : AI Security Essentials (PE-I)**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To understand the fundamental vulnerabilities inherent in the machine learning lifecycle.
2. To analyze various adversarial attack vectors including evasion, poisoning, and inference.
3. To evaluate and implement defensive strategies to enhance model robustness and data privacy.
4. To explore the application of AI in automating cybersecurity defenses like threat hunting and anomaly detection.

Syllabus

Unit 1: Foundations of AI and Security: Introduction to AI Systems, ML Pipelines, Data Preprocessing, Model Training and Deployment, The CIA Triad in AI, Confidentiality and Integrity, Taxonomy of AI Threats, Evasion Attacks, Poisoning Attacks, Inference and Extraction Attacks, Adversarial Machine Learning, Vulnerability Analysis.

Unit 2: Attacks on Machine Learning Models: Evasion Attacks, Fast Gradient Sign Method (FGSM), Projected Gradient Descent (PGD), Poisoning Attacks, Training Data Manipulation, Model Inversion, Membership Inference, Reverse-Engineering Architectures, Face Recognition Flaws, Autonomous Driving Vulnerabilities, Spam Filter Bypass.

Unit 3: Defensive AI and Robustness: Defensive Distillation, Robustness Optimization, Adversarial Training, Data Augmentation, Input Sanitization, Outlier Detection, Malicious Input Filtering, Model Watermarking, IP Protection, Ownership Verification, Defensive Benchmarking.

Unit 4: AI for Cybersecurity (The "AI-Defender"): Anomaly Detection, Network Intrusion Detection (IDS), User and Entity Behavior Analytics (UEBA), Automated Malware Analysis, Deep Learning for Malware Classification, Phishing Detection, NLP for Social Engineering, Malicious URL Identification, Security Orchestration (SOAR), Automated Incident Response.

Unit 5: Ethics, Privacy, and Emerging Governance: Privacy-Preserving AI, Federated Learning, Differential Privacy, Explainable AI (XAI), LIME and SHAP Methods, Verification of Security Decisions, NIST AI Risk Management Framework, EU AI Act, Generative AI Security, Prompt Injection, Data Leakage, LLM Hallucinations.

Course Outcomes

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

1. Identify and classify potential security threats across different AI architectures.
2. Simulate adversarial attacks to test the resilience of machine learning models.
3. Deploy defensive mechanisms such as adversarial training and input sanitization to mitigate risks.
4. Design AI-driven solutions for real-world cybersecurity challenges like phishing and malware detection.
5. Critique AI systems based on ethical guidelines, privacy laws, and global governance frameworks.

Textbooks:

1. Adversarial Machine Learning by Yevgeniy Vorobeychik and Murat Kantarcioglu.
2. AI and Machine Learning for Coders by Laurence Moroney.
3. Hands-On Artificial Intelligence for Cybersecurity by Alessandro Parisi.

Reference Books

1. Machine Learning Security by Clarence Chio and David Freeman.
2. Deep Learning by Ian Goodfellow (Sections on Adversarial Examples).
3. NIST AI 100-1: Adversarial Machine Learning Taxonomy.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0506-2 Course : Image Processing & Generative Models (PE-I)
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03

Course Objectives

1. To introduce fundamental concepts of digital image processing, including perception, acquisition, and color models.
2. To provide knowledge of image enhancement techniques using spatial and frequency domain methods.
3. To familiarize students with morphological processing, segmentation, and feature representation techniques.
4. To present the fundamentals of neural networks and basic generative models for image data.
5. To expose learners to advanced generative models and their applications, along with ethical considerations in AI.

Syllabus:

Unit – I: Fundamentals of Digital Image Processing

Digital Image Fundamentals: Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Basic relationships between pixels; Color Models: RGB, CMY, HIS; Mathematical tools used in DIP.

Unit – II: Image Enhancement and Filtering

Intensity transformations: Histogram processing, Fundamentals of spatial filtering, Smoothing and Sharpening spatial filters; Filtering in the Frequency Domain: Sampling and the Fourier Transform of sampled functions, Image smoothing and sharpening using frequency domain filters.

Unit – III: Morphological Processing and Segmentation

Morphological Image Processing: Erosion and Dilation, Opening and Closing, Hit-or-Miss transform; Image Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding, Region-Based segmentation; Feature Extraction: Boundary representation and descriptors.

Unit – IV: Introduction to Generative Models

Basics of Neural Networks for Images: CNN architectures; Introduction to Generative Modeling: Discriminative vs. Generative models; Autoencoders: Architecture and Denoising; Variational Autoencoders (VAEs): Reparameterization trick and Latent space mapping.

Unit – V: Advanced Generative Models and Applications

Generative Adversarial Networks (GANs): Generator and Discriminator dynamics, Training challenges, DCGAN, CycleGAN; Introduction to Diffusion Models; Case Studies: Style Transfer, Image Inpainting, Synthetic Data Generation for Healthcare and Autonomous Vehicles; Ethical practices in AI generation.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

CO1: Analyse fundamental image processing techniques and color models.
CO2: Apply spatial and frequency domain filters for image enhancement.
CO3: Implement morphological operations and segmentation algorithms for feature extraction.
CO4: Integrate deep learning architectures for image classification and generation.
CO5: Design generative solutions (VAEs, GANs, Diffusion) for real-world creative and industrial problems.

Textbooks

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Pearson Education, 4th Edition, 2018.
2. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition, 2023.
3. Deep Learning with Python, François Chollet, Manning Publications, 2nd Edition, 2021.

Reference Books

1. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson, 2009.
2. Richard Szeliski, Computer Vision: Algorithms and Applications. Springer, 2010.
3. Deep Learning" – Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0506-3 Course : Programming for Data Science and AI (PE-I)
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per WeekTotal Credits: 03

Course Objectives

1. Apply fundamental programming concepts and computational thinking (sequencing, selection, iteration) to solve real-world data science problems.
2. Develop skills in data analysis and problem-solving using programming techniques and structured approaches.
3. Understand core AI principles, including reasoning (optimal vs human-like), knowledge representation, inference, perception, and learning.
4. Explore key applications of AI, such as intelligent agents, game playing, expert systems, machine learning, and natural language processing.

Syllabus

Unit I: R Studio, R data types and objects, reading and writing data, sub setting R-Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Unit II: -Logical Statements, Loops, Repeats and Functions, Data Wrangling, Interacting with Data in R , Vectors and Scatterplots, Histograms, Barcharts, Boxplots, and Grouping Data

Unit III: : Subsamples and Random variable distributions, Testing, Regression, Create a GIT Repo, Review a Repo History

Unit IV: Introduction: What is AI? Foundations of AI, AI Agents, Problem Solving Agents, Forward and Backward Chaining, Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees, Learning in Neural and Belief networks,

UNIT V: Practical Natural Language Processing: Practical applications, Efficient parsing, scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis

Course Outcomes

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

1. Explain fundamental statistical concepts, including probability, distributions, and descriptive statistics.
2. Apply statistical methods and hypothesis testing to analyze real-world datasets and draw meaningful conclusions.
3. Develop and interpret regression and classification models using statistical and computational techniques.
4. Evaluate models and estimators using simulation, resampling methods, and performance metrics.
5. Demonstrate foundational AI knowledge by modeling real-world problems using intelligent agents, logic-based representation, inference, and planning, and by executing data-driven projects.

Text Books:

1. Elementary Statistics A Step by Step Approach by Allan G. Bluman , McGraw Hill Publications, Seventh Edition.
2. Practical Statistics for Data Scientists by Peter Bruce and Andrew Bruce, O`Reilly Publications.
3. Introduction to Statistical Learning by Gareth James et al.
4. Stuart Russell, Peter Norvig, ―Artificial Intelligence: A Modern Approach‖, 2nd Edition, Pearson Education, 2007
5. Ivan Bratka, ―PROLOG Programming for Artificial Intelligence‖, Pearson Education, 3rd Edition, 2012.

Syllabus for Semester V, B. Tech. Computer Science &Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0506-4 **Course : Intelligent Multiagent System (PE-I)**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. **To introduce the fundamental concepts of intelligent agents and multiagent systems.**
2. **To understand agent architectures, reasoning, and decision-making mechanisms.**
3. **To study interaction, cooperation, and coordination among multiple agents.**
4. **To explore reinforcement learning and game-theoretic approaches in multiagent environments.**
5. **To analyze real-world applications of intelligent multiagent systems.**

Syllabus

Unit I: Introduction to Intelligent Agents: Definition and characteristics of agents, Agents vs objects vs expert systems, Types of agents: reactive, deliberative, hybrid, Environment types and agent design, Problem solving by agents: search, heuristics, game playing, Knowledge representation: propositional logic and first-order logic
Unit II: Agent Architectures and Reasoning: Logical agents and inference mechanisms, Agent architectures: Reactive architectures (Subsumption), Deliberative agents, Hybrid and layered architectures (PRS, InterRAP), Planning in intelligent agents: Classical planning and state-space search, Partial-order planning, Planning under uncertainty, Decision making: utility theory and decision networks
Unit III: Multiagent Systems and Interaction: Introduction to multiagent systems (MAS), Types of agent interactions: cooperative vs competitive, Game theory basics: Prisoner's dilemma, Nash equilibrium, Coordination and cooperation mechanisms, Negotiation and auction mechanisms, Communication in MAS: speech acts, agent communication languages (KQML, FIPA)
Unit IV: Learning in Multiagent Systems: Basics of reinforcement learning (RL), Value iteration, policy iteration, Q-learning, Multiagent reinforcement learning (MARL), Stochastic games and learning dynamics, Advanced methods: Nash-Q learning, policy gradient, mean-field learning, Exploration vs exploitation in MAS
Unit V: Applications of Multiagent Systems: Multiagent systems in online platforms (advertising, auctions), AI agents in games and simulations, Multi-robot systems and swarm intelligence, Distributed problem solving and smart systems, Applications in IoT, smart cities, and autonomous systems, Emerging trends: decentralized AI, collaborative AI systems

Course Outcomes

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

1. Explain the concepts, types, and architectures of intelligent agents.
2. Analyze reasoning, planning, and decision-making mechanisms in agents.
3. Evaluate interaction, cooperation, and negotiation strategies in multiagent systems.
4. Apply reinforcement learning techniques in multiagent environments.
5. Design and assess real-world applications using multiagent system concepts.

Text Books:

1. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press.
2. An Introduction to Multi Agent Systems, Wiley.
3. Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, MIT Press.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0601	**Course : Deep Learning**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week	**Total Credits: 03**

Course Objectives

1. To introduce basic deep learning algorithms.
2. To understand real-world problems which can be solved by deep learning methods.
3. To identify deep learning techniques suitable for a real-world problem.

Syllabus:

UNIT I: Basics of Deep Learning: History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons,, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons.
UNIT II: Training of Feedforward Neural Networks: Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Training of Feedforward Neural Networks, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam
UNIT III: Optimization Algorithm: Activation Function and Initialization Methods: Sigmoid, Tanh, ReLU, Xavier and He Initialization, Regularization: Bias and Variance, Overfitting, Hyperparameters Tuning, L1 and L2 Regularization, Data Augmentation and Early Stopping, Parameter Sharing and Tying.
UNIT IV: Convolutional Neural Network (CNN): Convolutional Neural Networks, 1D and 2D Convolution, Visualizing Convolutional Neural Networks, Guided Backpropagation.
UNIT V: Recurrent Neural Network (RNN): Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Long Short-Term Memory (LSTM) Cells, Gated Recurrent Units (GRUs) variants of CNN and RNN,Encoder-Decoder Models, Attention Mechanism, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.

Course Outcomes:
On successful completion of the course, students will be able to:

1. Apply fully connected deep neural networks to real-world problem-solving scenarios.
2. Evaluate the performance of various deep learning models in terms of optimization, bias-variance trade-off, overfitting, and underfitting.
3. Analyze the role of convolutional and recurrent neural networks in addressing different real-world problems.
4. Create advanced deep learning models by designing variants of CNNs and RNNs tailored to specific applications.

Text Books

1. Sandro Skansi, Introduction to Deep Learning, Springer
2. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 2019
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016
4. Dr. S. Lovelyn Rose, Dr. L. Ashok Kumar, Dr. D. Karthika Renuka, Deep Learning using Python, Wiley Publication

Reference Books:

1. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006
2. Yegnanarayana, B., Artificial Neural Networks, PHI Learning Pvt. Ltd., 2009
3. A. Ravindran, K. M. Ragsdell, and G. V. Reklaitis, Engineering Optimization: Methods and Applications, John Wiley & Sons, Inc., 2016

Course Code : 24CS03PR0601 **Course : Deep Learning Lab**
L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Course Objectives

1. To solve problems in linear algebra, probability, optimization using artificial neurons.
2. To understand the usage of publically available datasets.
3. To use various python packages and tools for deep learning.

Course Syllabus:

Experiments based on **Course 24CS03TH0601**

1. Implementation of Linear Algebra, Probability etc.
2. Technology: Python, Tensorflow/Pytorch

Course Outcomes:

On completion of the course the student will be able to

1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2. Implement deep learning models in Python using the PyTorch/Tensorflow library and train them with real-world datasets.
3. Analyze and evaluate deep learning model's.

Text Books:

1. Sandro Skansi, Introduction to Deep Learning, Springer
2. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Reference Books:

1. Francois Chollet, Deep Learning with Python, Manning Publications Co.
2. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0602 **Course : Generative AI Techniques**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives:

1. Understand the fundamental concepts of Generative AI.
2. Explore utility of autoencoders, GAN, LLM in Generative AI.
3. Use prompt engineering techniques to retrieve data from LLM.
4. Explore various techniques of Explainable and Responsible Generative AI.

Syllabus:

Unit-1 Fundamentals of Generative AI: Generative AI, Overview, history, applications, Generative vs. Discriminative models, Latent variables and representation learning, Types of generative models, challenges in Generative AI, Generative Model Lifecycle.

Unit-2 Autoencoders and GANs: Autoencoders (AE): basic, denoising, and variational (VAE), Latent space interpretation and reconstruction loss, GANs: Generator-Discriminator framework, adversarial training, Variants: DCGAN, WGAN, Conditional GAN, CycleGAN, StyleGAN, Training challenges and stabilization techniques.

Unit-3 Large Language Models and Transformer Architectures: Introduction to LLMs, Evolution, Transformer architecture: self-attention, encoder-decoder structure, GPT, BERT, T5, LLaMA, DALL-E, fine-tuning paradigms, Applications: summarization, translation, code generation, chatbots, challenges and limitations, Evaluation metrics.

Unit 4: Introduction to Prompt Engineering: Prompt Engineering basics, prompting strategies: zero-shot, few-shot, chain-of-thought, Self-consistency Meta-prompting, Key Elements of Effective Prompts, Prompting in multimodal models: CLIP, DALL-E, Stable Diffusion, Evaluation of prompts and prompt optimization.

Unit 5: Explainable and Responsible Generative AI: Explainable AI basics, Interpretability, XAI techniques: SHAP, LIME, Evaluation of Interpretability Methods, applications and limitations. Responsible AI: principles, bias and fairness in generative models, Regulatory frameworks and ethical guidelines.

Course Outcomes:

At the end of the course, a student will be able to:

1. Utilize Generative AI fundamentals to apply autoencoders and GANs for image synthesis.
2. Analyze transformer-based architectures and LLMs for diverse applications.
3. Use Prompt Engineering techniques to design and optimize effective prompts.
4. Apply XAI techniques to interpret GenAI models and ensure responsible usage.

Text Books:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition,2022.
2. Prompt Engineering for LLMs, James Phoenix Berryman and Ben Ziegler, O'Reilly Media, 2024.
3. Interpretable Machine Learning,: A Guide for Making Black Box Models Explainable, Christoph Molnar , Shroff publisher, Second Edition,2024.
4. Responsible AI: Best Practices for Creating Trustworthy AI Systems, Qinghua Lu, Liming Zhu, et al, Pearson publisher, Ist Edition, 2024.

Reference Books:

1 Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville MIT Press, 2016.

2 Transformers for Natural Language Processing, Denis Rothman, Packt Publishing, 2nd Edition, 2022.

3 Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, O'Reilly, 2024.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0602 **Course : Generative AI Techniques Lab**
L: 0Hrs, T: 0 Hr, P: 2Hrs, Per Week **Total Credits: 01**

Course Objectives

1. To experiment with basic generative models (Autoencoders, VAEs, GANs) using Gen AI frameworks.
2. To evaluate the performance of generative models using appropriate metrics.
3. To Work with LLMs and apply prompting strategies for real-world applications.
4. To Apply XAI techniques and examine bias, fairness, and responsible AI practices in generative systems.

Syllabus:

Experiments based on the above syllabus **24CS03TH0602**
Technology: Python, Tensorflow / Pytorch , Gen AI Libraries.

Course Outcomes:

At the end of the course, a student will be able to:

1. Utilize Generative AI fundamentals to apply autoencoders and GANs for image synthesis.
2. Analyze transformer-based architectures and LLMs for diverse applications.
3. Use Prompt Engineering techniques to design and optimize effective prompts.
4. Apply XAI techniques to interpret GenAI models and ensure responsible usage.

Text Books:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition,2022.
2. Prompt Engineering for LLMs, James Phoenix Berryman and Ben Ziegler, O'Reilly Media, 2024.
3. Interpretable Machine Learning,: A Guide for Making Black Box Models Explainable, Christoph Molnar , Shroff publisher, Second Edition,2024.
4. Responsible AI: Best Practices for Creating Trustworthy AI Systems, Qinghua Lu, Liming Zhu, et al, Pearson publisher, Ist Edition, 2024.

Reference Books:

1 Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville MIT Press, 2016.
2 Transformers for Natural Language Processing, Denis Rothman Packt Publishing, 2nd Edition, 2022.
3 Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, O'Reilly, 2024.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0603-1 **Course : Data Privacy and Ethical AI (PE-II)**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To recognize the need for data privacy.
2. To identify statistical and computational techniques for secure data sharing, especially in social, behavioural, and health domains.
4 To develop architectural, algorithmic, and technological approaches to protect individual, organizational, and sensitive data during public or semi-public data release.
3. To understand ethical principles, societal impacts, and regulatory frameworks of AI, and apply them to address governance challenges and responsible system design.

Syllabus

Unit I: Fundamentals of Data Privacy and Microdata Protection: Need for sharing bata Methods of Protecting Data, Importance of Balancing Data Privacy and utility, Disclosure. Tabular Data, Micro data, Approaches to Statistical disclosure control, Ethics. Principles, guidelines and regulations. Disclosure, Disclosure risk, Estimating re-identification risk, Non-perturbative microdata masking.

Unit II: Data Anonymization Techniques for Structured Data: Privacy Preserving Methods, Classification of Data in a Multidimensional Data Set, Group Based Anonymization, k-Anonymity, Diversity, I-closeness. Privacy Preserving Graph Data, Privacy Preserving Time Series Data, Time Series Data Protection Methods, Privacy Preservation of Longitudinal Data, Privacy Preservation of Transaction Data.

Unit III: Data Anonymization Threats: Threats to Anonymized Data, Threats to Data Structures, Threats by Anonymization Techniques, Randomization, k- Anonymization, 1-Diversity, 1-Closeness. Dynamic Data Protection: Tokenization, Understanding Tokenization, Use Cases for Dynamic Data Protection, Benefits of Tokenization Compared to Other Methods, Components for Tokenization.

Unit IV: **Ethical initiatives in the field of Al:** Definition of morality and ethics in Al-impact on society, Impact on human psychology, Impact on the legal system, Impact on the environment and the planet, Impact on trust. International ethical initiatives. Ethical harms and concerns are tackled by these initiatives. Harms in detail, case studies.

Unit V: Al standards and regulations: National and international strategies in AI, Government readiness for AI, Model Process for Addressing Ethical Concerns During System Design Transparency of Autonomous Systems-Data Privacy Process, Algorithmic Bias Considerations Ontological Standard for Ethically Driven Robotics and Automation Systems.
Emerging themes: Addressing ethical issues through national and international strategies. Addressing governance challenges posed by Al.

Course Outcomes
On successful completion of the course, the students will be able to:

1. Characterize basic rules and principles for protecting privacy and personal information.
2. Design enhanced privacy protection methods by envisioning the basic attacks to happen.
3. Formulate data that supports useful statistical interface while minimizing the disclosure of sensitive information.
4. Apply ethical principles and regulatory frameworks to analyze and design responsible, transparent, and privacy-preserving AI systems.

Text Books:

1. Nataraj Venkataramanan, AshwnShriram, Data Privacy: Principles and Practice, Taylor Francis, 2016. (ISBN No.: 978-1-49-872104-2).
2. AncoHundepool, Josep Dominigo-ferrer, Luisa Francona, Sarah Giessing, Eric Schulte Nordholt, Keith Spicer. Peter-Paul de Wolf Statistical Disclosure Control. Wiley (ISBN No, 978--11-9978I5-2)
3. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkanp and Alan Winfield, The ethics of artificial intelligence: Issues and initiatives, EPRS European Parliamentary Research
4. Service Scientific Foresight Unit (STOA) PE 634.452 - March 2020.

Reference Books:

1. George T. Duncan, Mark Elliot, Juan-Jose Salazar-(Gonzalez, Statistical Confidentiality: Principle and Practice. Springer, 2011. (ISBN No, 978-1-44-197801-1).
2. Patrick Lin, Keith Abncy, George A Bekey, Robot Ethics: The Ethical and Social Implications of Robotics, The MIT Press- January 2014.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0603-2 **Course : Computer Vision (PE-II)**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To Learn the core principles of computer vision, image formation, transformations, camera geometry, including stereo vision and depth estimation.
2. To gain proficiency in image alignment techniques, feature detection and feature matching for object recognition and tracking.
3. To explore motion analysis, optical flow methods, and object tracking using algorithms such as Lucas-Kanade, Kalman filter, and background subtraction.
4. To utilize classification and clustering techniques for pattern analysis, along with dimensionality reduction methods.

Syllabus

Unit I: Introduction to Computer Vision & Image Formation: Introduction to computer vision, Digital Image Formation and Camera Geometry: Fundamentals of Image Formation, Transformations in 2D: translation, rotation, scaling, shearing; affine and rigid transformations, Transformations in 3D: translation, rotation about X,Y,Z axis, rotation about arbitrary axis, 3D affine, homogeneous coordinates in 2D and 3D, Concept of pinhole camera, camera calibration, Homography, Stereo Geometry, Binocular Stereopsis: Camera and Epipolar Geometry, Depth estimation.

Unit II: Image Alignment & Feature Detection: Image Alignment: Physically and digitally corresponding points, Feature detection and description: Line detectors (Hough Transform), Corners-Harris and Hessian Affine, SIFT, SURF, HOG, Feature matching and model fitting, RANSAC, Control point-based image alignment using least squares - derivation for pseudo-inverse, Applications of image alignment.

Unit III: Motion Analysis & Object Tracking: Motion and Optical Flow: Motion Analysis: Background Subtraction and Modeling, Horn and Shunck method, Lucas-Kanade algorithm, Feature Point Tracking, moving object detection and tracking; Kalman filter

Unit IV: Object Detection & Recognition: Adaboost algorithm: binary classification, face detection, Adaboost for Computation of Haar- like features; Image Segmentation; Object recognition and shape representation, Viola Jones algorithm for face detection and Boosting: Features, Integral images, Boosting, cascade; Activity Recognition in videos.

Unit V: Pattern Analysis & Dimensionality Reduction: Pattern Analysis: Image Clustering Methods based on K-Means, K-Medoids, Image Classification: Supervised, Un-supervised, Semi-supervised; Image Classifiers: KNN, ANN models. Dimensionality Reduction in Image and videos: PCA, LDA; Non-parametric methods; deep neural architectures and applications.

Course Outcomes:
On successful completion of the course, students will be able to:

1. Use the fundamental concepts of computer vision to solve different problems.
2. Apply feature detection, image alignment, motion analysis, and object tracking techniques to solve real-world problems.
3. Analyze the different object detection and recognition techniques to determine their effectiveness in different real-world scenarios.
4. Apply machine learning based techniques to perform pattern analysis and dimensionality reduction.

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2nd edition, 2022.
2. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education; Fourth edition, 2018.
3. D. Forsyth and J. Ponce, Computer Vision: A modern approach, Pearson Education India, 2nd ed., 2015.
4. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Pearson, 1998.

Reference Books

1. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, 1982.
3. E. R. Davies, Computer & Machine Vision: Theory, Algorithms, Practicalities, Academic Press, Fourth Edition, 2012

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0603-3
Course : Applied Artificial Intelligence and Expert Systems (PE-II)
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week Total Credits: 03

Course Objectives

1. To understand the foundations and applications of Artificial Intelligence techniques.
2. To apply search, reasoning, and learning methods to real-world problems.
3. To develop knowledge-based systems and expert systems.
4. To explore tools and techniques for building intelligent systems.

Syllabus

Unit I: Introduction to Applied Artificial Intelligence: Introduction to AI, AI programming languages (LISP, Prolog), Overview of AI applications in real-world systems, Inconsistencies and uncertainties, Truth maintenance systems, default reasoning and closed world assumption, Model and temporary logic.

Unit II: Introduction to Artificial Intelligence Agents: Intelligent Systems: Representing and Using Domain Knowledge, Introduction to modern intelligent systems, Intelligent agents and environments. Agents: Definition of agents, Agent architectures (e.g., reactive, layered, cognitive), Multi-agent systems- Collaborating agents, Competitive agents, Swarm systems and biologically inspired models.

Unit III: Knowledge Representation and Reasoning: Semantic networks, Frames and inheritance, Rule-based systems, Resolution and inference mechanisms, Reasoning under uncertainty, Knowledge organization- Indexing and retrieval techniques, integration of knowledge in memory organization systems, Matching techniques.

Unit IV: Expert Systems Design and Development: Introduction to expert systems, Architecture of expert systems, Knowledge acquisition techniques, Knowledge base design, Inference engine, Explanation systems, Tools for expert system development (CLIPS, Prolog), Stages in expert system development.

Unit V: Applications and Advanced Topics
Applications of AI and expert systems in healthcare, finance, and industry, Machine learning integration in expert systems, Case studies (MYCIN, DART), Limitations and challenges of expert systems, Ethical and societal issues in AI, types of learning- general learning model, performance measures, learning automate genetic algorithm, learning by induction -LEX, ID3, INDUCE systems.

Course Outcomes
On successful completion of the course, the students will be able to:

1. Explain core concepts of Artificial Intelligence, intelligent agents, and problem-solving techniques.
2. Apply search algorithms and knowledge representation methods for real-world problems.
3. Design and develop basic expert systems with appropriate inference mechanisms.
4. Analyze AI applications, including expert systems, with consideration of limitations and ethical issues.

Text Books:

1. Stuart Russell & Peter Norvig – *Artificial Intelligence: A Modern Approach*.
2. Elaine Rich & Kevin Knight – *Artificial Intelligence*.
3. D.A. Waterman – *A Guide to Expert Systems*.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0603-4 **Course : Business Intelligence (PE-II)**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To learn about Business Intelligence
2. To learn about how to take effective and timely decisions in an organization.
3. To learn how to extract knowledge from data and information.
4. To learn how to draw conclusions, predictions and take futuristic actions.
5. To learn the architecture of BI system.

Syllabus

Unit – I : Business intelligence: Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence Decision support systems (DSS): Definition of system, Representation of the decision-making process, Evolution of information systems, Development of a DSS.

Unit –II : Mathematical models for decision making: Structure of mathematical models, Development of a model, Classes of models Data mining: Definition of data mining, Representation of input data , Data mining process, Analysis methodologies Data preparation: Data validation, Data transformation, Data reduction

Unit –III : BI applications: Marketing models: Relational marketing, Sales force management, Logistic and production models: Supply chain optimization, Optimization models for logistics planning, Revenue management systems. Data envelopment analysis: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices

Unit –IV : DSS modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons.

Unit –V: Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation, Roles of People in Knowledge Management, Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.

Course Outcomes:

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

1. Able to analyze Business Intelligence, Analytics and Decision Support
2. Explain the technologies for decision making
3. Apply predictive modelling techniques
4. Understand the use of BI in real world applications
5. Understand the expert systems.

Textbooks

1. Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Vercellis, Wiley
2. Decision support and Business Intelligence Systems, Efraim Turban, Ramesh Sharda, Dursun Delen, Pearson
3. Fundamental of Business Intelligence, Grossmann W, Rinderle-Ma, Springer

Reference Books

1. Ramesh Sharda, Dursun Delen, Efraim Turban, J.E. Aronson, Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0604-1 **Course : Block chain and Security in AI (PE-III)**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

1. To provide a technical foundation of blockchain mechanics and its relevance to decentralized AI.
2. To investigate the role of Smart Contracts in governing AI data exchange and model execution.
3. To demonstrate how blockchain ensures data integrity, provenance, and auditability in AI training.
4. To examine the convergence of Federated Learning and Blockchain for privacy-preserving computation.

Syllabus

Unit 1: Blockchain Fundamentals for AI

Distributed Ledger Technology (DLT), Decentralization vs. Centralization, Cryptographic Hash Functions, Merkle Trees, Public and Private Keys, Digital Signatures, Consensus Mechanisms (PoW, PoS, PBFT), Blocks and Chain Structure, Immutability, Transparency in Data Management, Node Architecture.

Unit 2: Decentralized Identity and Access Control

Decentralized Identifiers (DIDs), Self-Sovereign Identity (SSI), Verifiable Credentials, Zero-Knowledge Proofs (ZKP) in AI, Role-Based Access Control (RBAC) via Blockchain, Securing AI Model Access, Multi-Signature Authorization for Model Updates, Sybil Attack Mitigation.

Unit 3: Smart Contracts for AI Governance

Self-Executing Contracts, Solidity Programming Basics, Automated Security Enforcement, Smart Contracts for Data Sharing Agreements, Oracle Networks (Bringing off-chain AI data on-chain), Verification of AI Model Outputs, Governance Tokens for AI DAOs (Decentralized Autonomous Organizations).

Unit 4: Blockchain for AI Data Integrity and Privacy

Secure Data Provenance, Audit Trails for Training Data, Tamper-Proof Model Versioning, Federated Learning with Blockchain, Incentivized Data Sharing, Differential Privacy Integration, Secure Multi-Party Computation (SMPC) via Blockchain, Preventing Data Poisoning through Ledger Verification.

Unit 5: Use Cases and Future Trends

Decentralized AI Marketplaces, Blockchain in Healthcare AI, Supply Chain Transparency with AI/Blockchain, Secure IoT-AI Ecosystems, Regulatory Compliance and Auditing (GDPR/EU AI Act), Scalability Challenges (Layer 2 Solutions), Quantum-Resistant Cryptography for Blockchain.

Course Outcomes

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

1. Explain the core cryptographic and consensus principles that enable secure, decentralized ledgers.
2. Develop basic Smart Contracts to automate access control and governance in AI ecosystems.
3. Implement blockchain-based audit trails to verify the integrity of AI training datasets.
4. Design a decentralized framework that utilizes Zero-Knowledge Proofs for private AI model verification.

5. Propose blockchain-AI integrated solutions for industry-specific use cases like healthcare or supply chain.

Text Books:

1. Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications" by Imran Bashir.
2. "Blockchain and Artificial Intelligence" by Tom James.
3. "Hands-On Artificial Intelligence for Cybersecurity" by Alessandro Parisi (Includes chapters on Blockchain-AI integration).

Reference Books

1. "The Blockchain Developer" by Elad Elrom.
2. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher.
3. "NIST IR 8202: Blockchain Technology Overview" (Foundational Government Report).
4. "Deep Learning with Blockchain" (Research Papers from IEEE/ACM on Federated Learning).

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0604-2 | **Course : Natural Language Processing (PE-III)**

L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week | **Total Credits: 03**

Course Objectives

1. To familiarize the concepts and techniques of natural language processing.
2. To learn computational techniques that enable machines to process, understand, and generate human language efficiently.
3. To apply the statistical learning methods and cutting-edge research models to solve natural language processing problems.
4. To integrate natural language processing into real-world systems to develop, evaluate, and enhance applications.

Syllabus:

Unit I: Introduction to NLP, Definition and Scope, A Brief History, Importance, Challenges, Tasks, Significance, NLP Pipeline and Applications, Morphological Analysis and Generation using Finite State Automata, Finite State Transducer, Hidden Markov model, Viterbi Algorithm, Applications of Tagging.

Unit II: Lexical Analysis, Part-of-Speech (POS) Tagging, Approaches for POS Tagging, Rule-Based, Stochastic, Hybrid Approach, Taggers Evaluations, Tokenization with NLTK.
Syntax and Parsing, Types of Constituents in Sentences, Context-Free Grammar (CFG), CFG Parsing, Top-Down Parser, Bottom-Up Parser, Shallow Parsing and Chunking, Thematic Roles, Lexical and Probabilistic Parsing, Probabilistic Context Free Grammars, The Probability of a String, Inside-Outside Algorithm, CKY Parsing.

Unit III: Semantic Analysis, Lexical Vs Compositional Semantic Analysis, Word Senses and Relations, Types of Lexical Semantics, Word Sense Disambiguation, WordNet and Online Thesauri, Word Similarity and Thesaurus Methods, Text Representation, Word Embedding, TF-IDF, Bag of Words, Word2Vec, Skip-gram.
Pragmatic Analysis and Discourse, Discourse Phenomena, Coherence and Coreference, Importance of Coreference Relations, Discourse Segmentation, Algorithms for Coreference Resolution.

Unit IV: N-Gram Language Model, Language Modeling and Chain Rule, Markov Chain in N-Gram Model, Shannon's Method in N-Gram Model, Smoothing Techniques, Extrinsic Evaluation Scheme, Zero Counts Problems, Smoothing Techniques, Laplace (Add-One) Smoothing, Add-k Smoothing.
The Transformer, Large Language Models, Language Model Evaluation, Entropy, Perplexity, ROUGE, BLEU.

Unit V: Major NLP Applications, Information Retrieval Systems, Social Network Analysis, Sentiment Analysis, Information Extraction, Named Entity Recognition, Text Classification, Text Summarization Systems, Machine Translation, Word Alignment, Content Recommendation System, Answering Questions, Applications in Finance, E- Commerce, Travel and Hospitality, Marketing, Insurance, Healthcare, Law, Supply Chain, Telecommunication, Education and Research, any others.

Course Outcomes

On Successful completion of course, students will be ableto:

1. Understand core NLP concepts and techniques.
2. Apply various POS tagging approaches and parsing techniques to analyze sentence structure and utilize probabilistic models for syntactic analysis.
3. Analyze various semantic and pragmatic analysis techniques and discourse phenomena to enhance text representation and understanding.
4. Implement N-Gram language models and Transformer-based models for effective language modeling and text generation.
5. Design and develop innovative NLP solutions to address real-world challenges across industries like finance, healthcare, e-commerce, education and research.

Textbooks

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, Third Edition, 2025, https://web.stanford.edu/~jurafsky/slp3.
2. Raymond ST. Lee, Natural Language Processing: A Textbook with Python Implementation, Springer Nature Singapore Pte Ltd. 2024, ISBN: 978- 9819919987.
3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana, Practical Natural Language Processing: A Comprehensive Guide to Building
4. Real-World NLP Systems, O'Reilly Media, Inc., USA, First edition, 2020, ISBN: 978-1492054054.
5. Dipanjan Sarkar, Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition, Apress Media, LLC, California, 2019, ISBN: 978-1484243534.

Reference Books

1. Natural Language Processing with Python: From Basics to Advanced Projects, Second Edition, 2024, Cuantum Technologies LLC. Plano, ISBN: 979- 8894968483.
2. Jyotika Singh, Natural Language Processing in the Real World: Text Processing, Analytics, and Classification, First edition, 2023, CRC Press is an imprint of Taylor & Francis Group, LLC, ISBN: 978- 1003264774.
3. Gerhard Paaß and Sven Giesselbach, Foundation Models for Natural Language Processing: Pre-trained Language Models Integrating Media, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer Nature Switzerland Pte Ltd. 2022, ISBN: 978-3031231896.
4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, Inc., USA, Revised First edition, May 2022, ISBN: 978- 1098136796.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0604-3 **Course : Artificial Intelligence for Robotics (PE-III)**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week **Total Credits: 03**

Course Objectives

The course aims to provide a strong foundation in the fundamentals of robotics and intelligent systems, including kinematics, perception, and control. It focuses on applying Artificial Intelligence techniques for robot perception, decision-making, learning, and motion planning. Additionally, the course explores real-world applications of intelligent robotic systems, including autonomous systems, human-robot interaction, and ethical considerations.

Syllabus

Unit I: Fundamentals of Robotics: Introduction to robotics: classification and applications, Components of robots: sensors, actuators, controllers, Data flow in robotics systems, Coordinate frames and transformations, Forward and inverse kinematics, Degree of Freedom (DOF), Basics of robot dynamics, Types of mobile robots (holonomic and non-holonomic).

Unit II: Artificial Intelligence for Robotics: Intelligent agents and environments, State-space representation, Search algorithms for robotics, logic-based knowledge representation, Planning in robotics, Introduction to probabilistic robotics, finite state machines (FSM) for behavior-based control.

Unit III: Perception and Computer Vision: Sensors for robotic perception (Ultrasonic, IR, Camera, LiDAR), Image formation basics, Feature detection and matching, Object recognition and tracking, Introduction to basic localization concepts, Odometry, GPS vs indoor localization, SLAM (Simultaneous Localization and Mapping), Sensor fusion concepts.

Unit IV: Machine Learning, Motion Planning and control: Machine learning in robotics: supervised and unsupervised learning, Reinforcement learning (MDP, Q-learning), TinyML for embedded robotics, Path planning algorithms (Dijkstra, A*), Motion planning and trajectory generation, Introduction to Open-loop and closed-loop control, PID control and feedback systems, PID tuning basics.

Unit V: Advanced Robotics Applications: Autonomous robots (self-driving systems, drones), Human-Robot Interaction (HRI), Multi-robot systems and swarm robotics, Robot Operating System (ROS) basic concepts (nodes, topics, communication), Ethical and safety issues in robotics, Case studies of industrial and service robots.

Course Outcomes

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

1. Interpret fundamental concepts of robotics and intelligent systems.
2. Apply AI techniques for robot perception and decision-making.
3. Analyse vision-based perception and localization methods.
4. Design motion planning and learning-based robotic solutions.
5. Evaluate real-world robotic applications with ethical considerations.

Text Books:

1. Saeed B. Niku, Introduction to Robotics: Analysis, Control, Applications, Wiley India.
2. Dr. D. K. Pratihar, Fundamentals of Robotics, Narosa Publishing

Reference Books:

1. Robin R. Murphy, Introduction to AI Robotics, 1st Edition, The MIT Press, Cambridge, USA.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, Probabilistic Robotics, 1st Edition, The MIT Press, Cambridge, USA.
3. Francis X. Govers, Artificial Intelligence for Robotics, Packt Publishing.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Course Code: 24HS02TP0501/ 24HS02TP0601 | **Course: Business Communication**
L: 1 Hr, T: 0 Hr, P: 2 Hrs, Per Week | **Total Credits: 2**

Course Objective

This course aims to develop students' competency in business communication by enabling them to analyze communication processes, apply effective writing and speaking strategies, and create professional content across written, oral, and digital platforms. It integrates practical training in persuasion, negotiation, teamwork, leadership, visual communication, and workplace tools, while emphasizing the ethical use of AI and prompt-based techniques for written communication in multicultural environments.

Course Outcomes:

CO1- Analyse communication processes and models to apply appropriate strategies in formal and informal workplace interactions.
CO2- Apply and demonstrate structured writing strategies and AI-assisted techniques to create effective business correspondence.
CO3- Develop and present structured business reports and visual content by integrating data visualization and AI tools effectively.
CO4- Apply interpersonal and persuasive communication, emotional intelligence, persuasion, negotiation, and leadership strategies to participate effectively in teamwork, conflict resolution, and employment processes.
CO5- Create and demonstrate professional communication across meetings, employment processes, and digital platforms by integrating AI tools ethically and effectively.

Syllabus: (Theory)

UNIT 1: Fundamentals of Business Communication **4 hours**
Introduction to Communication: Nature and Purpose
Communication Models: SBAR Framework (Situation, Background, Assessment, Recommendation), Schramm's Interactive Model, Transactional Model (case-based)

UNIT 2: Business Correspondence **4 hours**
Communication Planning and AI Integration: Planning Business Messages, Language and sensitivity to various audiences, Chat communication etiquette, Human-AI collaboration, Ethical use of AI
Routine Correspondence and prompt engineering: Internal Communication emails, Client emails, Escalation emails, Follow-up emails, Status update emails, Action confirmation emails, Use of AI Prompts for email drafting

UNIT 3: Business Reports **4 hours**
Fundamentals of Business Reports: purpose, structure, and standard formats
Types of Reports and Professional Documents: feasibility, progress, and project reports; agenda, notices, minutes of meetings, and organizational announcements; writing a business case
AI-Assisted Report Writing: Use of AI prompts for planning, drafting, and structuring reports

UNIT 4: Employment and Workplace Tools **3 hours**
Employment Communication: job descriptions, effective use of job portals (LinkedIn, Indeed, etc.), and AI in hiring
Workplace Etiquette and Ethics: professional and communication etiquette, ethical practices in organizational context
Workplace and AI Tools: use of collaboration tools (Slack, Teams, Signal App) and AI tools (Grammarly, Claude) for professional communication

Syllabus: (Practical)

Practical 1: Verbal Communication- Formal
Topics covered: Channels- Formal and Informal: Vertical, Horizontal, Diagonal, Formal discussion, Types of meetings (SCRUM, status, planning, problem-solving, brainstorming), Giving and receiving feedback, communicating ideas when not assigned to a project
Suggested Activities: Client Call Simulations, Meeting and Feedback Exchange Role Plays
Practical 2: Verbal Communication- Informal
Topics covered: Grapevine communication, Informal discussions, Art of Small Talk, Self-Introduction (succinct manner)
Suggested Activities: Speed networking, Small Talk Circles,
Practical 3: Emotional Intelligence
Topics covered: Application of Transactional Analysis in workplace contexts (particularly in team and client interactions)
Suggested Activities: PAC Role Play, Reframing negative communication
Practical 4: Persuasive Communication
Topics covered: Persuasion vs. Manipulation, ARGU strategy, Rhetorical Principle, Strategies
Suggested Activities: Product Pitch, Business Storytelling
Practical 5: Negotiation and Conflict Management
Topics covered: Types of Conflicts, Causes of Conflicts, Concept of BATNA, Negotiation strategies, Understanding the Non-Disclosure Agreement
Suggested Activities: Negotiation and Conflict Resolution Case Scenarios, Diplomacy in Action
Practical 6: Group Dynamics and Leadership Skills
Topics covered: Stages of Group formation, Roles in teams, Leadership Styles, Strategies to be an effective leader
Suggested Activities: Role Plays on Leadership Styles, Role-based Team Discussions, Decision-Making Tasks
Practical 7: Visual Communication
Topics covered: Data Visualization (selecting visuals for presenting data) and Data Verbalisation
Suggested Activities: Data to Visual Task
Practical 8: Employment and Workplace communication
Topics covered: Types of Resumes, Keyword Optimization, ATS-friendly resumes, Interview Questions, Answering structure, Body Language, Strategies for Effective Interviews
Suggested Activities: Resume Review, Mock Interviews (involvement of industry also), LinkedIn Optimization

Text Books

1. Courtland L Bovee, John V Thill and Roshan Lal Raina "Business Communication Today", 14th edition Pearson
2. P.D. Chaturvedi and Mukesh Chaturvedi, Fundamentals of Business Communication, Pearson Publications, 2012.

Reference Books and material

1. Shalini Verma, Business Communication, Vikas Publishing House Pvt. Ltd., 2015.
2. Sanjay Kumar, Pushpa Lata, Communication Skills, 2nd Edition, Oxford Publication, 2018
3. Sharon Gerson, Steven Gerson, "Technical Communication: Process and Product", 2018, Pearson
4. The AI Prompt Handbook for Business Writing: 50+ Prompts for Professionals, Managers & Entrepreneurs (The AI Prompt Handbook Series), Maxwell Striling, 2026
5. Chris Duffey, Prompt Engineering for Business, Wiley 2024
6. Taner Mostafa, AI Prompts for Business Writing, 2023
7. https://txwes.pressbooks.pub/bcomm/

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03TH0604-4 | **Course : Cognitive Systems (PE-III)**
L: 3Hrs, T: 0 Hr, P: 0Hrs, Per Week | **Total Credits: 03**

Course Objectives

1. Understand the fundamentals of cognitive science and cognitive computing for intelligent systems.
2. Apply cognitive modelling and reasoning techniques to represent and solve problems.
3. Develop decision-making solutions using machine learning and inference methods.
4. Explore real-world applications of cognitive computing across various domains.

Syllabus

Unit I: Introduction to Cognitive Science: Cognitive Computing, Cognitive Psychology, The Architecture of the Mind, The Nature of Cognitive Psychology, Cognitive architecture, Cognitive processes

Unit II: **Cognitive Computing with AI:** , The Cognitive Modeling Paradigms, Declarative / Logic based Computational cognitive modeling, connectionist models –Bayesian models. Introduction to Knowledge-Based AI – Human Cognition on AI – Cognitive Architectures

Unit III: - Cognitive Computing with Inference and Decision Support Systems: Intelligent Decision making, Fuzzy Cognitive Maps, learning algorithms: Nonlinear Hebbian Learning, Data driven NHL, Hybrid learning, Fuzzy Grey cognitive maps, Dynamic Random fuzzy cognitive Maps

Unit IV: : Cognitive Computing with Machine Learning: Machine Learning Techniques for cognitive decision making, Hypothesis Generation and Scoring, Natural Language Processing, Representing Knowledge, Taxonomies and Ontologies, N-Gram models, Application

Unit V: Case Studies: Cognitive Systems in health care, Cognitive Assistant for visually impaired, AI for cancer detection, Predictive Analytics, Text Analytics, Image Analytics, Speech Analytics, IBM Watson, Introduction to IBM's Power AI Platform, Introduction to Google's TensorFlow Development Environment

Course Outcomes

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

1. Understand various concepts of cognitive computing
2. Understand the evolution of Watson services from the original DeepQA architecture
3. Describe various case studies related to cognitive computing.
4. Develop cognitive computing related applications, like Chatbot

Text Books:

1. Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Wiley, Indianapolis..
2. Jerome R. Busemeyer, Peter D. Bruza, "Quantum Models of Cognition and Decision", Cambridge University Press.
3. Emmanuel M. Pothos, Andy J. Wills, "Formal Approaches in Categorization", Cambridge University Press.
4. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press.
5. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, "Cognitive Science: An Introduction", MITPress.

Syllabus for Semester VI, B. Tech. Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

Course Code : 24CS03PR0606	**Course : Mini Project**
L: 0Hrs, T: 0 Hr, P: 4Hrs, Per Week	**Total Credits: 02**

Course Objectives

The objective of the mini project is to let the students map and utilize the technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

Course Outcomes:

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

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.