RAMDEOBABA UNIVERSITY
[RBU]
NAGPUR – 440013

RAMDEOBABA UNIVERSITY, NAGPUR
Formerly Shri Ramdobaba College of Engineering & Management (RCOEM) Est. 1984

PROGRAMME SCHEME & SYLLABI

B. Tech Computer Science & Engineering
[Artificial Intelligence & Data Science]

2024-25

School of Computer Science & Engineering

Department Vision

To achieve excellent standards of quality-education in computer science and engineering with a specialized focus on data science, foster innovation, nurture collaborative culture and contribute in the field of data science to serve the industry and society.

Department Mission

To empower the next generation of computer scientists and engineers with the knowledge, skills, and tools essential to excel in the rapidly evolving field of data science.
To impart the ability to devise globally recognized solutions for the problems of society and industry,
To provide an environment for interdisciplinary collaboration, research, and lifelong learning.

Programme Outcomes

Engineering graduates will be able to:

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

2. **Problem Analysis:** Identify, formulate, review literature, and analyze complex engineering problems 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 safety, societal and environmental considerations.

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

5. **Modern Tool usage:** Select, and apply appropriate techniques, resources, and modern engineering and IT tools for analyzing the engineering activities with an understanding of the limitations

6. **The engineer, industry and society:**Apply contextual knowledge to assess industrial, societal and safety related issues and understand consequent relevance to the professional engineering practice

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

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

9. **Communication:** Communicate effectively on complex engineering activities such as, being able to understand and write effective reports, make effective presentations and give and receive clear instructions

10. **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 in multidisciplinary environments.

11. **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 & Data Science)
[2024-25]
Teaching & Evaluation Scheme [B. Tech CSE-AIDS]

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	24HS03PR0103	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 Indian Civilization	1	0	1	50	-	50	-

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	-
14	CCA	24HS02PR0206-1 to 16/ 24HS04PR0202-1 to 4/	Liberal/Performing Art	0	2	1	25	25	50	-
			TOTAL	**14**	**16**	**22**	**-**	**-**	**900**	**-**

- **Courses Highlighted in Yellow [05 credits] will be swapped between Group-1 and Group-2 sections.**

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 Basic 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	24HS02PR0105-15	Sanskrit	0	2	1	25	25	50	-

		Sambhashan Spoken Sanskrit							
16	24HS02PR0105-16	Kirtan Kala	0	2	1	25	25	50	-
17	24HS04PR0202-1	Adventure Sports	0	2	1	25	25	50	-
18	24HS04PR0202-2	Introduction to Defense Forces & Obstacle Training	0	2	1	25	25	50	-
19	24HS04PR0202-3	Self Defense and Indian Martial Arts	0	2	1	25	25	50	-
20	24HS04PR0202-4	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	24CS02TH0301	Theory of Computation	3	0	3	50	50	100	3
2	PCC	24CS02TH0302	Database Management System	3	0	3	50	50	100	3
3	PCC	24CS02PR0302	Database Management System Lab	0	2	1	25	25	50	-
4	PCC	24CS02PR0303	Data Exploration and Visualization Lab	0	4	2	25	25	50	-

5	PCC	24CS02TH0304	Network and Communication	3	0	3	50	50	100	3
6	PCC	24CS02PR0304	Network and Communication 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	3
9	MDM		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	24CS02TH0401	Data Science and Programming	3	0	3	50	50	100	3
2	PCC	24CS02PR0401	Data Science and Programming Lab	0	4	2	25	25	50	-
3	PCC	24CS02TH0402	Design and Analysis of Algorithms	3	0	3	50	50	100	3
4	PCC	24CS02PR0402	Design and Analysis of Algorithms Lab	0	2	1	25	25	50	-
5	PCC	24CS02TH0403	Artificial Intelligence	3	0	3	50	50	100	3
6	PCC	24CS02PR0403	Artificial Intelligence Lab	0	2	1	25	25	50	-
8	OE	24CSOEC01TH0405	Open Elective-II	2	0	2	50	50	100	3
9	CEP	24CS02PR0404	Community Engagement Project	0	4	2	25	25	50	-
10	VEC	24CS02TH0405	Creativity, Innovation & Design Thinking	2	0	2	50	-	50	-
11	AEC	24CS02PR0406	Basic Competitive Coding	0	2	1	50	-	50	-
12	MDM		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			Maximum marks			ESE Duration (Hrs)
				L	P	Credits	Continuous Assessment	End Sem Exam/Internal Evaluation	Total	
1	PCC	24CS02TH0501	Machine Learning	3	0	3	50	50	100	3
2	PCC	24CS02PR0501	Machine Learning Lab	0	2	1	25	25	50	-
3	PCC	24CS02PR0502	Statistical Inference Lab	0	4	2	25	25	50	-
5	PCC	24CS02TH0503	Big Data Analytics	3	0	3	50	50	100	3
6	PCC	24CS02PR0503	Big Data Analytics Lab	0	2	1	25	25	50	-
7	PCC	24CS02TH0504	Software Engineering and Testing Methodologies	3	0	3	50	50	100	3
8	PCC	24CS02PR0504	Software Engineering and Testing Methodologies Lab	0	2	1	25	25	50	-
9	EEM	24CS02PR0505	Idea Lab	0	2	1	25	25	50	-
10	PEC	24CS02TH0506	Program Elective-I	3	0	3	50	50	100	3
11	OE	24CSOEC01TH0505	Open Elective-III	2	0	2	50	50	100	3
12	MDM		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	24CS02TH0601	Deep Learning	3	0	3	50	50	100	3
2	PCC	24CS02PR0601	Deep Learning Lab	0	2	1	25	25	50	-
3	PCC	24CS02TH0602	Computer Vision	3	0	3	50	50	100	3
4	PCC	24CS02PR0602	Computer Vision Lab	0	2	1	25	25	50	-
5	PEC	24CS02TH0603	Program Elective –II	3	0	3	50	50	100	3
6	PEC	24CS02TH0604	Program Elective –III	3	0	3	50	50	100	3
7	PCC	24CS02PR0605	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	24CS02PR0606	Mini Project	0	4	2	25	25	50	-
11	AEC	24CS02PR0607	Advanced Competitive Coding	0	2	1	50	-	50	-
12	MDM		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	24CS02TH0701	Knowledge Discovery & Mining	3	0	3	50	50	100	3
2	PCC	24CS02PR0701	Knowledge Discovery & Mining Lab	0	2	1	25	25	50	-
3	PCC	24CS02TH0702	Large Language Model	3	0	3	50	50	100	3
4	PCC	24CS02PR0702	Large Language Model Lab	0	2	1	25	25	50	-
5	PCC	24CS02TH0703	Cloud Powered AI	2	0	2	50	50	100	3
6	PEC	24CS02TH0704	Program Elective-IV	3	0	3	50	50	100	3
7	PRJ	24CS02PR0705	Major Project-I	0	8	4	50	50	100	-
8	AEC	24CS02PR0706	Participative Learning	0	2	1	50	-	50	-
9	Internship	24CS02PR0707	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	24CS02TH0801	Program Elective-V	3	0	3	50	50	100	3
2.	PEC	24CS02TH0802	Program Elective-VI	3	0	3	50	50	100	3
3.	PRJ	24CS02PR0803	Major Project-II	0	12	6	50	50	100	-
			TOTAL	**6**	**12**	**12**	**-**	**-**	**300**	**-**
OR										
							Continuous Evaluation	**Industry Evaluation**	**Total**	
1.	INTR	24CS02PR0804	Industry Internship/Research Internship/TBI	**0**	**24**	**12**	**100**	**100**	**200**	

Electives Basket

Elective-I [V Sem]	Elective-II [VI Sem]	Elective-III [VI Sem]	Elective-IV [VII Sem]	Elective-V [VIII Sem]	Elective-VI [VIII Sem]
Next Generation Databases	Cloud Computing	Introduction to DevOps	Information Retrieval	Blockchain Technology	Human Computer Interaction
Design Patterns	Business and Web Analytics	Information Security and Privacy	Healthcare Analytics	Generative AI	Optimization for Data Science
Cryptography	Basics of Ethical Hacking	Time Series Analysis	Cloud Security	Bioinformatics	Security and Network Analysis

Open Electives Track
Session: 2025-26

Coursera Tracks for RBU Students (AIDS B1, B2, B3, DSA B4)

Sem	Course Code	Google Project Management: Professional Certificate Track
3 35-45 hours	24CSOEC01TH0305	1)Foundations of Project Management 2)Project Initiation: Starting a Successful Project
4 35-50 hours	24CSOEC01TH0405	1)Project Planning: Putting It All Together 2)Project Execution: Running the Project
5 35-50 hours	24CSOEC01TH0505	1)Agile Project Management 2)Capstone: Applying Project Management in the Real World 3)Accelerate Your Job Search with AI

RAMDEOBABA UNIVERSITY, NAGPUR

B.Tech in Computer Science and Engineering
(Data Science)

Honors in Data Science

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	24CS02TH0301	Data Science Essentials	3	0	3	100	-	100	-
2	IV	24CS02TH0401	Software Architecture Analysis	3	0	3	100	-	100	-
3	V	24CS02TH0501	Data Engineering	4	0	4	100	-	100	-
4	VI	24CS02TH0601	Business and Web Analytics	4	0	4	100	-	100	-
5	VII	24CS02TH0701	Project	0	8	4	50	50	100	-
			TOTAL	**14**	**8**	**18**	**450**	**50**	**500**	

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

Course Code: 24CS01TH0101 **Course: Fundamentals of Programming**

L: 3Hrs, 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 logical solutions for problem statements using flowcharts and algorithms.
2. Develop solution for problem statements involving decision-making and loops.
3. Apply the concept of functions for modular programming.
4. Implement solutions 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 & Data Science]

Course Code: 24CS01PR0101 **Course: Fundamentals of Programming Lab**

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

- 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.
2. Code problem statements involving decision-making and loops
3. Apply the concept of functions for modular programming
4. Implement problems using arrays and structures
5. Perform file operations

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

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

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

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

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.

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 & Data Science]

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

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

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.
4. Develop websites using MS Excel, HTML and CSS

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

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 & Data Science]

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.

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.

Linux Operating System:

- Introduction and history of Linux OS
- Basic commands
- File system and file handling commands
- User, Group management commands
- Process handling commands
- Package management
- Shell and shell script Introduction to popular IDEs, Git

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 & Data Science]

Course Code: 24CS01TH0105 Course: Cyber Laws & Ethics in IT L: 2 Hrs, P: 0 Hr, Per Week Total Credits: 2

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.

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.

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 & Data Science]

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.

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.

Syllabus

Module 1:
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.

Module 2:
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.

Module 3:
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.

Module 4:
Sampling Distributions, Point and Interval Estimations, Testing of Hypothesis for single mean and proportion.

Module 5:

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.

Text Books:

1. M R. Spiegal , Theory and Problems of probability and statistics :,2nd 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 & Data Science]

Course Code: 24HS03PR0211 Course: Computational Mathematics Lab

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

CO1: Utilize mathematical software as an advanced calculator to create and manipulate 2D and 3D plots in SageMath, enabling effective visualization and interpretation of data

CO2 Recognizing, solving, and applying recurrence relations to a wide range of computational problems

CO3: Use partial derivatives and gradients for optimizing multivariable functions

CO4 :Apply linear algebra concepts, including matrix representations and Singular Value Decomposition (SVD), for image processing and dimensionality reduction.

CO5 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.

CO6 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 & Data Science]

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

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

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.

Reference Material

The primary resource material for teaching this course consists of

1. Text book: 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

2. Reference books:

   a) B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
   b) PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
   c) Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
   d) Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
   e) Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
   f) Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.

g) A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
h) E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
i) A.N. Tripathy, 2003, Human Values, New Age International Publishers.

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

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

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.

Module 1:

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.

Module 2:

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.

Module 3:

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.

Module 4:

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.

Module 5:

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.

Module 6:

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.

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 201

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

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

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

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

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 behaviour 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.

Reference Books

1. Lab manual prepared by Physics Department, RCOEM, Nagpur.
2. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008.

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

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.

S

yllabus

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, 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 expression as Argument

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. Illustrate 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 application 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

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

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

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

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- 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 concepts such as classes, objects, methods, wrapper classes, and packages to enhance code reusability and modularity.
2. Develop reusable and modular code solutions by implementing inheritance and interfaces
3. Implement robust programming practices using exception handling mechanisms 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 & Data Science]

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 queues.

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 and Graphs

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.

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

UNIT-V:

Sorting and 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.

Course Outcomes:

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

1. Analyze the efficiency of algorithms by evaluating their time and space complexities.
2. Design solutions to problems using linear data structures, such as stacks and queues.
3. Implement real-life problems using arrays and linked lists with dynamic memory allocation.
4. Demonstrate nonlinear data structures and their operations, such as trees and graphs.
5. Apply different searching, sorting, and hashing techniques for efficient data organization and retrieval.

Textbooks

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.

References

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 & Data Science]

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.

Course Outcomes

On completion of the course the student will be able to demonstrate

1. Design solutions to problem using array and dynamic memory allocation.
2. Develop solutions for real life problems using stacks and queues.
3. Implement real-life problems using linked lists.
4. Demonstrate nonlinear data structures and their operations, such as trees and graphs.

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

Course Code: 24CS01PR0203 Course: Computer Workshop-II Lab

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

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

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

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 & Data Science]

Course Code: 24CS01TH0204 **Course: Operating Systems**

L: 3Hrs, 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 & Data Science]

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 completion of the course the student will be able to demonstrate:

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 & Data Science]

Course Code: 24HS03TH0214 **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.

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.

Syllabus

Module 1 :
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.

Module 2:
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,

Module 3:
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.

Module 4:
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.

Module 5:
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.

Textbooks/References

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 & Data Science]

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

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

Course outcome:

At the end of the course the students will be able to achieve the following:
CO1: Understand the Indian knowledge system and its scientific approach
CO2: Get introduced to the Vedic corpus and recognize the multi-faceted nature of the knowledge contained in the Vedic corpus
CO3: Understand the salient features of the philosophical systems of the Vedic and non-Vedic schools
CO4:Develop and understanding about the foundation of vedic mathematics.

S

yllabus

Unit 1:

Overview of Indian Knowledge System:Importance of ancient knowledge, defining IKS, Historicity of IKS, Some unique aspects of IKS.

Unit 2:

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

Unit 3:

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 4:

Vedic Maths -1:Introduction of Vedic Mathematics, Bodhyan geometry, circular functions, inverse circular functions.

Unit -5:

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*.

Reference material

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 & Data Science]

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

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

Syllabus

List of practicals

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

Practical 9:
Writing Practices:This practical will cover the following topics: Sentence and paragraph structures, Note-making

Practical 10:
Writing Practices: This practical will cover the following topics: Academic Correspondence

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
[Artificial Intelligence & Data Science]

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 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.

Syllabus:

Unit 1:

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

Unit 2:

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

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:

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 & Data Science]

Course Code : 24HS01TP0202 **Course : Environmental Science**

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

Syllabus:

Unit 1:

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 2:

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.

Environmental Science Lab:

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.

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] To study chemical kinetics of peroxydisulphate and iodide ions reactions and to find out order of the reaction and analysis of experimental data using Computational Software.
[10] Determination of rate of the reaction at room temperature and analysis of experimental data using Computational Software
[11] Use of various open online search tools for Environmental Case Studies.

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.
(5) Ashutosh Kar , Advanced Practical Medicinal Chemistry, New Age International Publisher.

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 & Data Science]

Course Code : 24HS01PR0202 **Course : Environmental Science Lab**

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

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.

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.

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 & Data Science]

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: Bharatnatayam	I/II	2	1	25	25
2	24HS02PR0206-02	Fundamentals of Indian Classical Dance: Kathak	I/II	2	1	25	25
3	24HS02PR0206-03	Introduction to Digital Photography	I/II	2	1	25	25
4	24HS02PR0206-04	Introduction to Japanese Language and Culture	I/II	2	1	25	25
5	24HS02PR0206-05	Art of Theatre	I/II	2	1	25	25
6	24HS02PR0206-06	Introduction to French Language	I/II	2	1	25	25
7	24HS02PR0206-07	Introduction to Spanish Language	I/II	2	1	25	25
8	24HS02PR0206-08	Art of Painting	I/II	2	1	25	25
9	24HS02PR0206-09	Art of Drawing	I/II	2	1	25	25
10	24HS02PR0206-10	Nature camp	I/II	2	1	25	25
11	24HS02PR0206-11	Developing Self Awareness	I	2	1	25	25

12	24HS02PR0206-12	Art of Poetry	I	2	1	25	25
13	24HS02PR0206-13	Creative and Content Writing	I	2	1	25	25
14	24HS02PR0206-14	Science of Life through	I	2	1	25	25
		Bhagwad Gita					
15	24HS02PR0206-15	Sanskrit Sambhashan Spoken Sanskrit	I	2	1	25	25
16	24HS02PR0206-16	Kirtan Kala	I	2	1	25	25
17	24HS04PR0202-1	Adventure Sports	I	2	1	25	25
18	24HS04PR0202-2	Introduction to Defense Forces & Obstacle Training	I	2	1	25	25
19	24HS04PR0202-3	Self Defense and Indian Martial Arts	I	2	1	25	25
20	24HS04PR0202-4	Basic Nutritional Course	I	2	1	25	25

Syllabus for Semester II, B. Tech. Computer Science & Engineering
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Course Code: 24HS02PR0206-01 Course: Fundamentals of Indian Classical Dance: Bharatnatayam

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.

Course Outcomes

On completion of the course, students will be able to achieve the following:
1. Understand the importance of dance and Bharatnataym 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 *Pratham* (1st level formal exam of Bharatnatayam).

Syllabus

Practical -1: Orientation in Bharatnatayam
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.

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

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

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).

Syllabus

Practical -1: Orientation in Kathak. Correct posture of kathak, Basic Movements and exercise Stepping, Chakkar of 5 count (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.

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 & Data Science]

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.

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.

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.

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 & Data Science]

Course Code: 24HS02PR0206-04 Course: Introduction to Basic 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.

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

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.

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 & Data Science]

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.

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.

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

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 & Data Science]

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.

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

Syllabus

List of Practicals

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

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 & Data Science]

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.

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

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

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 & Data Science]

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.

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.

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)

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 & Data Science]

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.

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.

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

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 & Data Science]

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.

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.

Course content

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 NGOs

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

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

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:

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

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

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

Course Outcomes:

To familiarize the students with the art of poetry and develop a sense of appreciation for the art 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

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

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 & Data Science]

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.

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
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

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

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

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

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

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

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

Course outcome

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:

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। (कांचित् कथा सरलया भाषया वक्तव्या)।
- रटनाभ्यासः (पूर्वमेव लिखितानि पठितानि च कानिचित् वाक्यानि वाचनीयानि)।
- एकं वाक्यम् (प्रत्येकं छात्रः एकं वाक्यं वदेत्।)
- सूचना।
- ऐक्यमत्यः।

द्वितीयं दिनम्

- गीतम्।
- पुनरस्मारणम्।
- 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।
- ऐक्यमत्यः।

तृतीयं दिनम्

- गीतम्।
- पुनस्स्मारणम्।
- क्रियापदानां बहुवचनरूपाणि।
  गच्छन्ति - गच्छामः - गच्छन्तु (Chart दर्शनीयम्)
  पिबन्ति - पिबामः - पिबन्तु।
  लिखन्ति - लिखामः - लिखन्तु।
  इत्यादिपरिवर्तनाभ्यासः कारणीयः।
- द्वितीयाविभक्तिः - स्फोरकपत्राणाम् उपयोगः।
  (वाक्यपत्राणि उपयुज्य वाक्यानि वाचनीयानि।)
- कृपया ददातु - वस्तूनि प्रदर्श्य।
  शिक्षकः एकैकं वस्तु प्रदर्शयति।
  उदा. – ग्रन्थः, घटी,.....
  छात्राः - कृपया ग्रन्थं ददातु, कृपया घटीं ददातु इत्यादि वदेयुः। (स्फोरकपत्रस्य उपयोगः)
- पुरतः, पृष्ठतः, वामतः, दक्षिणतः, उपरि, अधः।
  (चित्रं दर्शनीयम्)
- इतः, ततः, ...तः, गृहतः, कुतः?
  (स्फोरकपत्राणाम् उपयोगः)
  वाक्यपत्राणि उपयुज्य वाक्यानि वाचनीयानि।
- गीतम्।
- कथम्? सम्यक्।
- शीघ्रम् × मन्दम्। उच्चैः × शनैः।
- पठनार्थम्, किमर्थम्?
- सप्तककाराः - किम्, कुत्र, कति, कदा, कुतः, कथम्, किमर्थम् (Chart प्रदर्शनीयम्)।
  एकैकम् उपयुज्य परस्परं प्रश्नाः।
- अपि।
- अस्तु।
- अहं न जानामि। - कानिचन वाक्यानि।
- भूतकालीनक्रियापदानां पाठनम्।
  गतवान् - पठितवान् - लिखितवान्।
  गतवती - पठितवती - लिखितवती।
- क्रियापदकोष्ठकस्य प्रथमपृष्ठस्य अभ्यासः।
- द्वितीयपृष्ठस्य सर्वाणि क्रियापदानि उपयुज्य छात्राः वर्तमानकाले वाक्यानि वदन्ति। (ए.व - ब.व.)
- विशिष्टक्रियापदानाम् अभ्यासः -
  करोमि - कुर्मः। करोति - कुर्वन्ति।
  ददामि - दद्मः। ददाति - ददति।
  शृणोमि – शृणुमः। शृणोति - शृण्वन्ति।
  जानामि – जानीमः। जानाति – जानन्ति।
- सम्बोधनम् - भोः !, श्रीमन् !, मान्ये !, भगिनि!, मित्र !, ...महोदय!, राम !, सीते ! इत्यादि।
- सङ्ख्या- 1-100।
- समयः - 1.00, 2.00, 3.00, 4.00।
- सम्भाषणप्रदर्शनम् (मित्रसंलापः)।
- कथा।
- वाक्यत्रयम् एकैकोऽपि छात्रः वदेत्।
- सूचना।
- ऐक्यमन्त्रः।

चतुर्थं दिनम्

- गीतम्।
- पुनःस्मारणम्।
- च
- अतः
- एव
- इति
- अस्मि
- यदि -तर्हि
- यथा - तथा
- तः - पर्यन्तम् (वाक्यपत्रस्य उपयोगेन वाक्यानि वाचनीयानि।)
- अद्य आरभ्य
- कृते (वाक्यपत्रस्य उपयोगः करणीयः)
- क्तवतुप्रत्ययान्तानाम् अभ्यासः
  गतवान् - पठितवान् - लिखितवान् (ए.व. पुंलिङ्गे)।
  गतवती - पठितवती - लिखितवती (ए.व. स्त्रीलिङ्गे)।
  गतवन्तः - पठितवन्तः - लिखितवन्तः (ब.व. पुंलिङ्गे)।
  गतवत्यः - पठितवत्यः - लिखितवत्यः (ब.व. स्त्रीलिङ्गे)।
- सः गतवान् - सा गतवती - लिङ्गपरिवर्तनाभ्यासः।
- अहं गतवान् - अहं गतवती - लिङ्गपरिवर्तनाभ्यासः।
- क्रियापदानां कालपरिवर्तनाभ्यासः।
  यथा - गच्छति - गतवान्, गतवती।
- गीतम्।
- विशेषपाठनम् - आसीत्, आसन्, आसम्।
- एकः, एका, एकम् - लिङ्गभेदः ज्ञापनीयः।
  (स्फोरकपत्रस्य उपयोगः)

- भोजनसम्बन्धिशब्दाः यथा - सूपः, शाकम्, इत्यादयः।
- सङ्ख्या।
- समयः।
- ॐ – सङ्ख्याक्रीडा।
- कथा।
- सम्भाषणप्रदर्शनम्।
- चत्वारि वाक्यानि।
- सूचना।
- ऐक्यमत्यः।

पञ्चमं दिनम्

- गीतम्।
- पुनःस्मारणम्।
- वाहनानां नामानि।
- तृतीयाविभक्तिः - दण्डेन, मापिकया, लेखन्या, पुष्पेण।
  (वाक्यपत्रस्य आधारेण वाक्यानि वाचनीयानि।)
- सह, विना।
- अद्यतन, ह्यस्तन, श्वस्तन, पूर्वतन, इदानीन्तन
- भविष्यत्कालीनक्रियापदानां पाठनम्।
  गमिष्यति, पठिष्यति, लेखिष्यति।(कोष्ठकस्य साहाय्येन)
- गत,आगामि।
- गीतम्।
- स्म।
- अभवत्।
- क्त्वाप्रयोगः (कोष्ठकस्य साहाय्येन)।
- यदा – तदा।
- बन्धुवाचकशब्दाः।
- वेशभूषणानां नामानि।
- वर्णाः।
- रुचयः।
- क्रीडा - एकश्वासेन सङ्ख्याकथनम्।
- कथा।
- पञ्च वाक्यानि।
- सूचना।
- ऐक्यमत्यः।

षष्ठं दिनम्

- गीतम्।
- पुनःस्मारणम्।
- नूतनम् x पुरातनम्,
- बहु x किञ्चित्,
- दीर्घः x ह्रस्वः।
- उन्नतः x वामनः।
- स्थूलः x कृशः।
- एतादृश, तादृश, कीदृश?
- तुमुन् (कोष्ठकस्य साहाय्येन)।
- किन्तु।
- निश्चयेन।
- बहुशः / प्रायशः।
- किल / खलु।
- शक्नोति।
- गीतम्।
- विशेषणविशेष्यभावस्य अभ्यासः।(प्रथमाविभक्तौ)
  सः उत्तमः बालकः।
  सा उत्तमा बालिका।
  तत् उत्तमं पुस्तकम्।
- इव। विनोदकणिका।(गतवान् 'इव' अभिनयं कृतवान्!)
- अपेक्षया।
- पशूनां नामानि।
- अवयवानां नामानि।
- वाक्यविस्तारणाभ्यासः।
  (सः मम पुस्तकं प्रातःकाले पञ्चवादने पठितवान्।)
- इतः पूर्वम् - इतः परम्।
- 'रामकृष्ण' सङ्ख्याक्रीडा।
- कथा।
- षट् वाक्यानि।
- सूचना।
- ऐक्यमत्यः।

सप्तमं दिनम्

- गीतम्।
- पुनःस्मारणम्।
- क्त्वा - तुमुन् - परिवर्तनाभ्यासः।
- बहिः x अन्तः।
- रिक्तम् x पूर्णम्।
- इतोऽपि।
- इत्युक्ते।
- अन्तो।
- चेत् - नो चेत्।

- 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।
- चित्।
- ....द्वयम्।
- सङ्ख्यासु लिङ्गभेदः।
  एकः - एका - एकम्
  द्वयम् - द्वयम् - द्वयम्
  त्रयः - तिस्रः - त्रीणि
  चत्वारः - चतस्रः - चत्वारि
- शिश्रकः - अहं वैद्यः - मम नाम सुरेशः
  (छात्राः तमुद्दिश्य प्रश्नान् पृच्छेयुः।)
- ..... अर्थम् (समाजार्थम्, संस्कृतकार्यार्थम्...)।
- गीतम्।
- तव्यत् – अनीयर्।
- अनन्त्यकथारचना।
- 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।

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

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.

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

- 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.

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

Course Code: 24HS04PR0202-1 **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:

- Understand the principles and benefits of adventure sports.
- Develop basic skills in selected adventure sports.
- Learn and apply safety measures and risk management techniques.
- Foster teamwork, leadership, and problem-solving skills.
- Cultivate a greater appreciation for nature and outdoor activities.

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

Course Code: 24HS04PR0202-2 Course Name: Introduction to Defense Forces & Obstacle Training

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

Course Objective:

1. Understand the Structure and Function of Defense Forces
2. Familiarize with Defense Force Training and Discipline
3. Learn Basic Obstacle Course Techniques
4. Apply Problem-Solving and Teamwork in Obstacle Training
5. 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 & Data Science]

Course Code: 24HS04PR0202-3 **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 & Data Science]

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 source

Syllabus for Semester III, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02TH0301 **Course Name: Theory of Computation**

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. 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

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 & Data Science]

Course Code: 24CS02TH0302 Course Name: Database Management System

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. 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 Storage, Indexing, and Query Processing
Storage and File Organization, Indexing, Query Processing and Optimization, Ordered Indices, B+-Tree Index Files and its Extensions, Static Hashing and Dynamic Hashing, Bitmap Indices

UNIT V 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 & Data Science]

Course Code: 24CS02PR0302 Course Name: Database Management System Lab

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. 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.
4. To recognize the need for transaction management and query processing.

SYLLABUS

Based on the syllabus of 24CS02TH0302

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 & Data Science]

Course Code: 24CS02PR0303 Course Name: : Data Exploration and Visualization Lab

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

Course Objectives:

The course aims to familiarize the students with the process of exploring data, transforming data, and presenting it in a way that is meaningful to others.

Course Outcomes:

On completion of the course the student will be able to

1. Perform data extraction.
2. Understand and apply different data exploration, transformation and loading techniques.
3. Identify and apply appropriate data visualization technique(s).

Syllabus :

Experiments may include, but are not limited to the following :

- Extract data from different sources like text files, APIs, databases.
- Data cleaning techniques
- Data processing techniques
- Data loading techniques
- Data visualization techniques like plots (line plot, scatter plot, etc), charts (bar charts, pie chart, donut chart, etc) , histograms, Box and Whisker Plot, Maps, Word Clouds, Network diagrams, Correlation Matrices, etc

Reference Books :

1. Claus O. Wilke, "Fundamentals of Data Visualization – A Primer on Making Informative and Compelling Figures", O'Reilly, 2019.
2. Kyran Dale, "Data Visualization with Python and JavaScript – Scrape, Clean and transform Your Data", O'Reilly, 2016.

Syllabus for Semester III, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02TH0304 **Course Name: : Network Communication**

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

Course Objectives

1. To understand communication Models OSI and TCP/IP models.
2. To provide understanding of signal transmission, encoding techniques, and the characteristics of transmission media.
3. To examine routing and transport layer protocols.
4. To Investigate modern applications and technologies used in computer networks.

Syllabus

UNIT – I

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.

UNIT – II

Data Link Layer: Error Detection and Error Correction - Fundamentals, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ. Ethernet and Wi-Fi (IEEE 802.3, IEEE 802.11).

UNIT – III

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

UNIT – IV

Transport Layer: Three-way handshaking, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), web Servers and Clients using Sockets (TCP/UDP), Congestion control in TCP, Application Layer: Domain Name Space (DNS), File Transfer Protocol (FTP).

UNIT V

IoT Communication Protocols: MQTT, CoAP. Evaluation of MQTT vs. CoAP for IoT Applications. ML-Based Traffic Prediction in Network Communication. Comparison of Wireless Protocols: Wi-Fi 6 vs. Wi-Fi 5.

Course Outcomes:

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

1. To demonstrate network models, protocols and apply data transmission principles.
2. To implement network routing and IP addressing
3. To Analyze flow control, congestion control, methods in transport layer protocols.
4. To develop and deploy a communication system with socket programming and communication Protocol for IoT devices.

Text Books

1. "Computer Networks" by Andrew S. Tanenbaum, David J. Wetherall (5th Edition), Pearson Education
2. "Data and Computer Communications" by William Stallings (10th Edition), Pearson Education
3. Data Communication and networking by Behrouz Forouzan (4th Edition) Mic Graw Hill Publication.

Reference Books

1. "Computer Networking: A Top-Down Approach" by James F. Kurose, Keith W. Ross (7th Edition), Pearson Education.
2. "Network Security Essentials" by William Stallings (5th Edition), Pearson Education.
3. “Fundamentals of IoT Communication Technologies” by Rolando Herrero (1st ed. 2022) , Springer Publisher.
4. Internet of Things, by Shriram K Vasudevan Abhishek S Nagarajan, RMD Sundaram. 2nd Edition, Wiley Publication.

Syllabus for Semester III, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02PR0304 Course Name: Network Communication Lab

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

Course Objectives:

1. To implement different types of network topologies and configurations, ensuring scalability, reliability, and security.
2. To analyze common network protocols and communication technologies
3. To optimize the allocation of resources in networks and Simulate routing algorithm.

Experiments may include, but are not limited to the following:

- Implementation on Simulation Tools: (CISCO PACKET TRACER).
- Implementation of Packet capture tool: Wireshark.
- Implementation of Data Link Layer (Error Correction).
- Design of Virtual LAN.
- Implementation of IP subnetting
- Routing Implementation at Network Layer.
- Implementation on Transport Layer.
- Application Server configuration on simulation Tools

Tools & Platforms to Use:

- Cisco Packet Tracer
- GNS3
- Wireshark
- Wi-Fi Analyzers (inSSIDer)
- Python & Netmiko for Network Automation
- VMWare/VirtualBox for Virtualized Labs
-

Course outcomes

1. To implement different network topologies, selecting the appropriate configuration based on the specific needs of a network.
2. To perform Troubleshooting for Network Devices
3. To Analyze Networking Protocols and write scripts to perform IP Addressing and Subnetting.
4. To implement server configuration using socket programming

Text Books

1. "Computer Networks" by Andrew S. Tanenbaum, David J. Wetherall (5th Edition), Pearson Education
2. "Data and Computer Communications" by William Stallings (10th Edition), Pearson Education
3. Data Communication and networking by Behrouz Forouzan (4th Edition) Mic Graw Hill Publication.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24HS03TH0301 **Course Name: Discrete Mathematics**
L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. Per Week **Total Credits: 03**

Course Objective

The objective of this course is to expose student to understand the basic importance of Logic, Number theory, Algebraic structures like groups and Field, combinatorics and graph theory in computer science and Information technology.

Course Outcomes

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

1. Explore advanced topics such as recurrence relations, generating functions, and their use in solving combinatorial problems.
2. Applying modular arithmetic to cryptography, coding theory.
3. The fundamental concepts of propositional and predicate logic, including syntax, semantics, and the interpretation of logical expressions.
4. Understand the basic definitions, properties, and examples of groups, subgroups, and related algebraic structures.
5. Use lattice-theoretic concepts to model and solve problems in computer science, logic.

Syllabus

Module 1 (8 Lectures)

Combinatorics

- Addition and multiplication rule in combinatorics
- Linear and Circular permutation
- Combination
- Inclusion and Exclusion Principle
- Recurrence relations
- Ordinary generating function

Module 2 (7 Lectures)

Modular Arithmetic

- Modular Arithmetic
- Euclid's Algorithm
- Primes
- Fermat’s theorem

- Euler’s theorem
- Diophantine equations
- Linear congruences
- Chinese Remainder theorem
- Application to Cryptography

Module 3 (7 Lectures)

Mathematical Logic

- Statement and notations
- Connectives
- Negation
- Conjunction
- Disjunction
- Conditional & bi-conditional statement
- Tautologies
- Equivalence of formulas
- Tautological implications
- Theory of inference for statement calculus

Module 4 (8 Lectures)

Groups

- Group definitions and examples
- Cyclic group
- Permutation groups
- Subgroups and homomorphism
- Co-sets
- Lagrange's theorem

Module 5 (7 Lectures)

Lattice Theory

- Lattices as partially ordered set
- Properties of Lattice
- Lattices as algebraic system
- Sub lattices
- Direct product
- Complimentary lattice
- Distributive lattices

Text Books

1. **Discrete Mathematical Structures with Applications to Computer Science** — J. P. Tremblay and R. Manohar, Tata McGraw-Hill.

2. **Combinatorial Mathematics** — C. L. Liu & D. P. Mohapatra, 3rd Edition, Tata McGraw-Hill.
3. **Elementary Number Theory** — David M. Burton, McGraw Hill, Seventh Edition, 2014.

Reference Books

1. **Foundations of Discrete Mathematics** — K. D. Joshi, New Age International Publication.
2. **Discrete Mathematics** — Kolman, Busby & Ross, Pearson Publication.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02TH0401 Course Name: Data Science and Programming

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. Per Week Total Credits: 03

Course Objectives

- Introduce students to data types, data formats, and basic statistical concepts required for understanding and summarizing structured datasets
- Enable students to explore datasets using descriptive statistics and visualization techniques for identifying data distributions, patterns, and relationships
- Familiarize students with data pre-processing and transformation techniques, including handling missing values, outliers, normalization, and encoding
- Expose students to foundational data mining and machine learning techniques, such as association rule mining, regression, and clustering, for analytical decision-making

Syllabus

Unit-I: Data Essentials

Introduction to data science, Types of data: numerical, categorical, ordinal and time-series, Advanced and Multimodal Data Sources, Structured and unstructured data, Data formats: CSV, JSON and Excel, Modern Data Storage Formats & Compression Techniques, Real-world datasets, Scales of measurement, Basic statistical measures: mean, median, mode, variance and standard deviation, Introduction to data exploration and interpretation.

Unit -II: Exploratory Data Analysis (EDA)

Purpose of EDA, Descriptive statistics, Data distribution characteristics, Skewness and kurtosis, Graphical visualization techniques: doughnut charts, histograms, Advanced Data Visualization Techniques, Pattern identification, Trend analysis, Outlier detection using visual methods, EDA workflow and summary reporting.

Unit -III: Data Handling, Wrangling and Preprocessing

Importing and exporting datasets, Handling missing values using deletion and imputation methods, Merging, reshaping, time-series wrangling, sampling, Treatment of outliers using IQR and z-score techniques, Data transformation: normalization and standardization, Categorical data encoding: label encoding and one-hot encoding, Data cleaning workflow, Basic data integration, Preparing datasets for analysis, pre-processing pipelines for mining and clustering applications, Feature Engineering & Dimensionality Reduction

Unit – IV: Association Rule Mining

Introduction to data mining, Market basket analysis, Support, confidence and lift measures, Frequent itemset generation, Apriori algorithm and rule generation, Interpretation of association rules, Applications in retail analytics, e-commerce recommendation systems, transaction-based analysis and pattern discovery.

Unit -V: Confusion Matrix, Regression and Clustering

Confusion matrix: TP, FP, TN and FN, Evaluation metrics: accuracy, precision, recall and F1-score, Linear regression: best-fit line, error measures and interpretation, Logistic regression: sigmoid function, classification boundary and model evaluation, Clustering techniques: K-means clustering, K-modes clustering, K-medoids clustering, Hierarchical clustering: agglomerative and divisive approaches, Dendrogram analysis, Applications of clustering for segmentation, grouping behaviour, and pattern identification.

Course Outcomes

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

1. Understand essential data concepts, exploratory analysis techniques, and data pre-processing methods.
2. Apply visualization, cleaning, transformation, association mining, regression, and clustering techniques for data analysis.
3. Analyze datasets and extract meaningful insights using data-driven analytical approaches.

Text Books

1. Wes McKinney, Python for Data Analysis, O'Reilly.
2. Pang-Ning Tan, Michael Steinbach & Vipin Kumar, Introduction to Data Mining, Pearson.
3. Jiawei Han, Micheline Kamber & Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann.

Reference Books

1. Jake VanderPlas, Python Data Science Handbook, O'Reilly.
2. Trevor Hastie, Robert Tibshirani & Jerome Friedman, The Elements of Statistical Learning, Springer.
3. Andreas Müller & Sarah Guido, Introduction to Machine Learning with Python, O'Reilly.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02PR0401 Course Name: Data Science and Programming Lab

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

Course Objectives:

- To enable students to explore and summarize datasets by identifying data types and applying descriptive statistical and exploratory data analysis techniques.
- To develop the ability to perform data preprocessing and transformation using techniques such as handling missing values, outlier treatment, normalization, standardization, and categorical encoding.
- To introduce fundamental data mining and machine learning techniques including association rule mining, regression modelling, and clustering for extracting patterns and insights from data.

Syllabus:

Practicals based on syllabus of 24CS02TH0401

Course Outcomes:

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

1. Identify, analyze, and preprocess datasets by handling data types, missing values, outliers, and applying appropriate statistical measures using Python-based tools.
2. Perform exploratory data analysis (EDA) using descriptive statistics and univariate, bivariate, and multivariate visualizations to interpret data distributions, relationships, and trends.
3. Apply data transformation and encoding techniques to prepare structured datasets for analytical and machine learning tasks.
4. Implement data mining and machine learning techniques, including association rule mining, regression, and clustering, and evaluate their results using suitable performance metrics.

Text Books

1. Wes McKinney, Python for Data Analysis, O'Reilly.
2. Jiawei Han, Micheline Kamber & Jian Pei, *Data Mining: Concepts and Techniques*, Morgan Kaufmann.

Reference Books

1. Jake VanderPlas, Python Data Science Handbook, O'Reilly.
2. Andreas Müller & Sarah Guido, *Introduction to Machine Learning with Python*, O'Reilly.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02TH0402 Course Name: Design and Analysis of Algorithms

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. 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
4.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.

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, Binary Search, Quick Sort, Merge sort, 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, 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 IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02PR0402 **Course Name:** Design and Analysis of Algorithms Lab

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

Course Objectives

The objective of the Design and Analysis of Algorithms Lab is to provide hands-on experience in implementing algorithmic techniques to solve computational problems efficiently. It aims to enhance student's skills in analyzing algorithm performance and applying suitable data structures and paradigms for optimization.

Syllabus

Practical's based on syllabus 24CS02TH0402.

Course Outcomes

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

1. Implement various algorithm design techniques such as divide and conquer, greedy, dynamic programming, and backtracking in solving real-world problems.
2. Analyze the time and space complexity of algorithms implemented and compare their efficiency.
3. Apply appropriate data structures and algorithmic paradigms to develop optimized solutions.Design and test solutions for computational problems using recursive and iterative approaches.

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. Brassard and Bratley; "Fundamentals of Algorithms", 1 Edition; Prentice Hall, 1995.
4. Richard Johnsonbaugh, "Algorithms", Pearson Publication, 2003.

Reference Books

1. Parag Himanshu Dave, Balchandra Dave, "Design and Analysis of Algorithms" Pearson Education, O'relly publication
2. Richard Johnsonbaugh, "Algorithms", Pearson Publication, 2003.

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02TH0403 **Course Name:** Artificial Intelligence

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. 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

Syllabus for Semester IV, B. Tech. Computer Science & Engineering
[Artificial Intelligence & Data Science]

Course Code: 24CS02PR0403 **Course Name:** Artificial Intelligence Lab

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

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.

PRACTICALS BASED ON ARTIFICIAL INTELLIGENCE SYLLABUS

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 & Data Science]

Course Code: 24CS02PR0404 **Course Name:** Community Engagement Project

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L: 0Hrs. T: 0 Hrs. P: 2 Hrs. 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 & Data Science]

Course Code:24CS02TH0405 Course Name: Creativity, Innovation & Design

Thinking L: 0Hrs. T: 0 Hrs. P: 2 Hrs. 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, Humancentered 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 and 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 & Data Science)

Course Code: 24CS02TH0501 **Course:** Machine Learning

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

Course Objectives

- Understand basic concepts of machine learning.
- Apply regression and classification algorithms.
- Use model evaluation techniques for performance analysis.
- Understand clustering and ensemble methods.
- Gain knowledge of neural networks and their applications.

Syllabus

Unit-I: Introduction to Machine Learning

Basics of Machine Learning, Supervised Learning, Unsupervised Learning, Cost Function, Regression. Linear Regression, Loss function. Least-squares fit. Parameter estimation. Statistical view on the regression. Gradient descent. Gradient Descent for Linear Regression. Logistic Regression.

Unit -II: Supervised Learning Algorithms

Classification in Machine Learning, k-Nearest Neighbor (KNN) Algorithm, Decision Tree Learning, Support Vector Machine, Naive Bayes Classifier, Overfitting and underfitting, Model evaluation.

Unit -III: Unsupervised Learning and Data Clustering

Clustering concepts and objectives, Cluster analysis: finding similarities in data, Representation of clustering results, Evaluation of clustering results, Partitional clustering, Hierarchical clustering, K-Means clustering, Expectation-Maximization (EM) algorithm, Gaussian Mixture Models (GMM).

Unit- IV: Ensemble Learning and Model Optimization

Ensemble Methods: Bagging, Boosting, Random Forest, AdaBoost, Gradient Boosting, XGBoost, Bias Variance Trade-off, Cross-validation techniques.

Unit-V: Neural Networks and Application

Introduction to Artificial Neural Networks (ANN), Perceptron model, Multilayer neural networks, Recurrent Neural Networks (RNN), Introduction to probabilistic learning, Bayesian learning concepts, Applications of Machine Learning in healthcare, finance, marketing, and recommendation systems.

Course Outcomes

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

1. Understand fundamental concepts of machine learning, including supervised and unsupervised techniques.
2. Apply regression and classification algorithms to solve real-world problems.
3. Analyse model performance using evaluation metrics and identify overfitting or underfitting.
4. Evaluate clustering and ensemble methods for improving model accuracy.
5. Design and develop machine learning solutions using neural networks and advanced techniques.

Text Books

1. Tom M. Mitchell – Machine Learning, McGraw Hill
2. Christopher M. Bishop – Pattern Recognition and Machine Learning, Springer Sebastian Raschka & Vahid Mirjalili – Python Machine Learning, Packt

Reference Books

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press
2. Andreas Müller & Sarah Guido, Introduction to Machine Learning with Python, O'Reilly
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

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

Course Code: 24CS02PR0501 **Course: Machine Learning Lab**

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

Syllabus
Practical's based on syllabus of 24CS02TH0501

Course Outcomes

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

1. Apply data preprocessing techniques such as handling missing values, encoding, scaling, and feature selection on real datasets.
2. Build and evaluate classification and regression models using algorithms like Logistic Regression, KNN, and Naive Bayes.
3. Analyze clustering techniques such as K-Means, Hierarchical Clustering, and GMM using appropriate evaluation methods.
4. Evaluate and compare machine learning models using performance metrics such as accuracy, precision, recall, F1-score, ROC-AUC, and convergence analysis.
5. Design and implement an end-to-end machine learning project integrating preprocessing, model building, evaluation, and deployment.

Text Books

1. Tom M. Mitchell – Machine Learning, McGraw Hill
2. Christopher M. Bishop – Pattern Recognition and Machine Learning, Springer Sebastian Raschka & Vahid Mirjalili – Python Machine Learning.

Reference Books

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press
2. Andreas Müller & Sarah Guido, Introduction to Machine Learning with Python, O'Reilly
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

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

Course Code: 24CS02PR0502 **Course:** Statistical Inference Lab

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

Course Objectives

The objective of this course is to familiarize the students with the use and applications of various statistical tools and packages.

Syllabus

Practical's based on this as well as beyond this syllabus.

- Introduction to different statistical tools and packages
- Reading and writing diverse data formats, including structured, semi-structured, and unstructured datasets, along with data acquisition through web scraping techniques.
- Descriptive statistics: Measures of central tendency and Measures of Variability
- Inferential statistics
- Probability distributions
- Binomial distributions
- Confidence Intervals
- Hypothesis Testing
- Correlation and covariance
- Regression

Course Outcomes

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

1. Understand and apply different statistical techniques on given data.
2. Perform and interpret different distribution.
3. Carry out hypothesis testing and calculate confidence intervals. Create regression models.

Text Books

1. Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.
2. An Introduction to Statistics with Python: With Applications in the Life Science by Thomas Haslwanter, Springer.

Reference Books

1. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce, Peter Gedeck, Reilly Media.

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

Course Code: 24CS02TH0503 **Course: Big Data Analytics**

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

Course Objectives

- To understand the basic concepts of big data analytics and the big data landscape.
- To become proficient in the most popular big data computing frameworks in order to apply technology to solve various big data analytic problems.

Syllabus

Unit-I

Introduction to Big Data: Big Data, its types, Challenges and characteristics, 3Vs, 6Vs definition Consistency Availability Partition Tolerance (CAP), Basically Available Soft State Eventual Consistency (BASE). Introduction to Big Data Platforms, Hadoop: Features, advantages, Hadoop1.0-Hadoop2.0, overview of Hadoop ecosystems. Map Reduce- Introduction, internal working, Map-reduce way of designing solutions with examples- Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.

Unit -II

Hadoop and System optimization for big data processing: Hadoop Eco System- Introduction to Hive, Pig, Big data storage- Hadoop Distributed File System, HBase Architecture, Improvements of map-reduce framework optimization for task scheduling and load balancing of map-reduce, job scheduling of Hadoop and its improvement, performance optimization of HDFS.

Unit -III

Introduction to NoSQL databases, Cassandra: Architecture, Data Replication in Cassandra, Data model: cluster, keyspace, column family, Cassandra Keyspace Operations: Create, Alter, drop, Table Operations: create, alter, drop, truncate, index, CURD Operations, Cassandra CQL: data types, collections

Unit – IV

Hadoop Vs Spark, Big data computing framework: Spark – Introduction, Architecture, Spark's Language APIs, Spark concepts like Data Frames, Transformations, RDD, etc.; Spark toolset, Spark SQL, Spark streaming, programming in Spark.

Unit -V

Machine Learning with Big Data and Link Analytics: Machine Learning with MLlib, classification and clustering with Big Data tool like Spark or Hadoop, Link Analysis - Page Rank, Modified page rank, Search Engine Optimization using page rank; Analyzing a Web Graph.

Course Outcomes

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

1. Demonstrate the understanding of big data characteristics, challenges, and the technologies used to process and analyze large datasets.
2. Develop Big Data Solutions using big data frameworks such as Hadoop, and Spark.
3. Apply various functionalities of the NoSQL database and Machine Learning Techniques to extract insights from large data sets.
4. Perform web analytics and artificial intelligence on web-based systems to improve their performance.

Text Books

1. Rajkamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning", McGraw Hill Publication, 2019.
2. Seema Acharya and Subhashini Chellappan "Big data and Analytics" Wiley India Publishers, 2nd Edition, 2019.
3. Hien Luu; Beginning Apache Spark 2: With Resilient Distributed Datasets, Spark SQL, Structured Streaming and Spark Machine Learning Library, Apress, 2018
4. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.

Reference Books

1. Tom White, "Hadoop: The Definitive Guide" 4th Edition, O'reilly Media, 2015.
2. Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" - O'Reilly 2012
3. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman; Big Data for Dummies; Wiley India, 2015.
4. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.
5. P. Simon, Too Big to Ignore: The Business Case for Big Data; Wiley, 2015.

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

Course Code: 24CS02PR0503 **Course:** Big Data Analytics Lab

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

Course Objectives

- The lab course on big data analytics aims to provide hands-on experience with tools and techniques for managing and analyzing big data. It includes working with Hadoop, MapReduce, Spark, and Cassandra.
- To apply various techniques to perform tasks related to web analytics. Experiments based on syllabus of Big Data Analytics Theory.

Syllabus

Practical's based on syllabus of **24CS02TH0503**

Course Outcomes

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

1. To implement web analytics using appropriate tools and techniques, by analyzing the data to extract insight from it.
2. Perform big data analytics on structured and unstructured data, using suitable technique and use of different tools.
3. To apply appropriate Machine Learning algorithms and big data techniques to address real-world problems.

Reference Books

1. Tom White; Hadoop: The Definitive Guide, 4th Edition, O'Reilly, 2015.
2. Hien Luu; Beginning Apache Spark With Resilient Distributed Datasets, Spark SQL, Structured Streaming and Spark Machine Learning Library, Apress, 2018.
3. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014
4. H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.

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

Course Code: 24CS02TH0504 **Course:** Software Engineering and Testing Methodologies

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

Course Objectives

- To recall fundamental software engineering principles, process models, and the role of requirements and design in software development.
- To understand and apply analysis and design approaches for modelling real-world software systems.
- To apply software project management techniques to plan, monitor, and control software development activities.
- To apply and analyse structured and advanced software testing techniques to systematically detect defects and ensure software quality

Syllabus

Unit-I:

The Evolving Role of Software - Software Characteristics, Applications, Principles and Myths; Software Engineering as a Layered Technology; Software Process Framework. Software Process Models - Waterfall Model, Evolutionary Models, Unified Process Model, Agile Process Models, Extreme Programming (XP), Scrum Model.

Unit -II:

Understanding Requirements: Requirements Engineering, Eliciting Requirements, Analysis Requirements Analysis, Modeling Approaches; Data Modeling, Object-Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, Class-based Modeling, Behavioral Model. Design Concepts, The Design Model, Component Level Design, User Interface Design.

Unit -III:

Software Project Management - Plans, Methods and Methodology; Project Success and Failure Factors; Project Scheduling; Software Quality Management, Quality Attributes; Software Effort Estimation - Albrecht Function Point Analysis, Cost Estimation - COCOMO Model;
Product Metrics - Metrics for Analysis & Design Models, Metrics for Source Code, Defect Metrics; Process & Project Metrics - Productivity Metrics, Software Measurement;

Unit – IV:

Software Testing Fundamentals: Software Testing life cycle; Verification & Validation; Testing Levels: Unit, Integration, System, Acceptance; White-Box Testing: Basis Path, Control Structure, Condition Coverage, Loop Testing; Black-Box Testing: Equivalence Partitioning, Boundary Value Analysis, Decision Table, State Transition, Use Case Testing. Debugging & Defect Management; Test Case Design, Test Data & Environment Setup; Web

Testing; Automated Testing; Ad hoc & Exploratory Testing; Agile & Extreme Testing; Test Metrics; Testing Standards; Test Process Improvement (TPI).

Unit -V:

Software Quality Assurance (SQA), Software Configuration Management (SCM), SCM Process, SCM Repository, Version Control, Change Management; Reactive vs. Proactive Risk Strategies, Software Risks, Risk Identification. Defect Prevention & Root Cause Analysis; Software Maintenance and Software Reengineering, Reverse Engineering, Restructuring and Forward Engineering.

Course Outcomes

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

1. Elucidate software engineering practices and various process models.
2. Use software design approaches for designing real-time solutions.
3. Integrate software project management practices in software product development.
4. Demonstrate White Box Testing and Black Box Testing for building bug-free quality software.

Text Books

1. Roger S. Pressman and Bruce R. Maxim; Software Engineering – A Practitioner's Approach; Eighth Edition, McGraw Hill; 2015.
2. Software Testing – Principles and Practices, Srinivasa Desikan & Gopalaswamy Ramesh, Pearson Education, 2007
3. Ian Somerville; Software Engineering; Seventh Edition; Pearson Education. 2008.

Reference Books

1. Rajib Mall; Software Project Management, 5th Edition, McGrawHill
2. Software Testing Techniques, Baris Beizer, 2nd Edition, Dreamtech
3. Software Testing Techniques, SPD, O'Reilly..

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

Course Code: 24CS02PR0504 **Course:** Software Engineering and Testing Methodologies Lab

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

Course Objectives

- To construct software requirement and design artefacts using CASE tools, applying structured and object-oriented analysis methods.
- To apply project management and process quality to produce planning and control documents for realistic software projects.
- To design and execute White-Box and Black-Box test cases for given programs
- To build automated test suites, conduct specialised testing and produce a complete test plan with metrics and a requirements traceability matrix.

Syllabus

Practical's based on syllabus of 24CS02TH0504

Course Outcomes

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

1. Analyze the software engineering problem(s) to build Software Requirement Specification document
2. Design different structural and behavioural models for the underlying problem.
3. Understand the role of project management tools and techniques for the underlying problem.
4. Design test-cases using white box testing and black box testing.

Text Books

1. Roger S. Pressman and Bruce R. Maxim; Software Engineering – A Practitioner's Approach; Eighth Edition, McGraw Hill; 2015.
2. Software Testing – Principles and Practices, Srinivasa Desikan & Gopalaswamy Ramesh, Pearson Education, 2007
3. Ian Somerville; Software Engineering; Seventh Edition; Pearson Education. 2008.

Reference Books

1. Rajib Mall; Software Project Management, 5th Edition, McGrawHill
2. Software Testing Techniques, Baris Beizer, 2nd Edition, Dreamtech
3. Software Testing Techniques, SPD, O'Reilly.

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

Course Code: 24CS02PR0505 **Course:** Idea Lab

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

Course Objectives

This course provides students with a unique opportunity to engage, explore, experience, express and excel in innovative thinking. The course will accelerate the development of indigenous solutions by inculcating creative skills, problem-solving skills and entrepreneurship skills in students. The ultimate goal is to help students build his/her creative acumen to address real life challenges

Execution Plan

- Conduction of lectures/guest lectures to familiarize the students with concepts of principles of design thinking, innovative and business-oriented solution building.
- Students will identify the potential areas or real-world problems that require innovative solution.
- Students will contribute to the creation and presentation of their solution. The developed solution can be a prototype or an idea or a business plan or a software solution, etc.
- Students will analyze and provide constructive feedback on the ideas and solutions presented by self and peers.

Course Outcomes:

1. On successful completion of the course, students will be able to:
2. Identify a real-world challenge or potential opportunities that demand consideration.
3. Design and propose original ideas or innovative solutions to identified real-world challenge.
4. Build a plan to develop proof of concept (POC)/ prototype/minimum viable product (MVP) for the idea.
5. Critically evaluate the feasibility and viability of proposed idea, considering its impact on various stakeholders.

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

Course Code: 24CS02TH0506-1 **Course: Next Generation Databases**

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

Course Objectives

- To understand the limitations of traditional relational databases and the need for NoSQL databases in modern data-intensive applications.
- To explore different NoSQL data models including key-value, document, column-family, and graph models for handling diverse data types.
- To analyze distributed database architectures, data distribution strategies, and consistency models in scalable systems.
- To develop the ability to design and implement efficient data storage and retrieval solutions using appropriate NoSQL models.
- To apply NoSQL concepts for building scalable, high-performance applications for real-world use cases involving large and connected data.

Syllabus

Unit I: Introduction to NoSQL and Data Modeling

Why NoSQL: The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL

Aggregate Data Models: Aggregates, Column-Family Stores, Summarizing Aggregate Oriented Databases

More Details on Data Models: Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access.

Unit II: Distributed Systems and Consistency Models

Distribution Models: Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication

Consistency: Update Consistency, Read Consistency, Relaxing Consistency, Relaxing Durability, Quorums

Version Stamps: Business and System Transactions, Version Stamps on Multiple Nodes.

Unit III: Key-Value Databases and Document-Oriented Databases

Key-Value Store: What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases
Storing Session Information: User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets, NoSQL Key/Value databases using Redis

Document-Oriented Databases: Document oriented database: Document, Collection, Naming, Features of document database, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies-document oriented database, MongoDB.

Unit IV: Column-Family Databases
Columnar data: Data warehousing schemas: Comparison of columnar and row-oriented storage, Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking, Column-oriented NoSQL databases using Apache Cassandra

Unit -V: Graph Databases

Graph Database: Comparison of Relational and Graph Modeling, What Is a Graph Database, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use, Graph NoSQL databases using Neo4j.

Course Outcomes

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

1. Explain the need for NoSQL databases and describe various data modeling approaches, including aggregate-oriented models.
2. Analyze distributed database architectures, data distribution strategies, and consistency models based on the CAP Theorem.
3. Apply key-value and document-oriented database concepts for efficient data storage, retrieval, and real-time applications.
4. Examine column-family database architecture and evaluate columnar storage techniques for scalable data processing.
5. Design graph-based data models for handling complex and connected data applications.

Text Books

1. Luc Perkins, Eric Redmond, Jim R. Wilson. Seven Databases in Seven Weeks. The Pragmatic Bookshelf, 2018 3. Guy Harrison.
2. Next GenerationDatabases: NoSQL, NewSQL, and Big Data. Apress, 2015

Reference Books

1. Pramod J. Sadalage, Martin Fowler. NoSQL Distilled, Addison Wesley 2013

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

Course Code: 24CS02TH0506-2 **Course: Design Patterns**

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

Course Objectives

1. To learn the fundamentals of software design by referring a catalog of design patterns
2. Demonstrate how to use design patterns to address code development issues.
3. Identify the most suitable design pattern to address a given application design problem.
4. Apply design principles (e.g., open-closed, dependency inversion, substitution, etc).
5. Critique code by identifying and refactoring anti-patterns.

Syllabus

Unit-I

Elements of Design Pattern, Describing Design Pattern, Design Pattern Classification, Role of design patterns in software design, Selection and usage of Design Patterns, Example implementation of design pattern using UML, Case Study: Designing a Document Editor.

Unit -II

Creational Patterns: Introduction, Role of Creational patterns, Creational Pattern types: Factory method, Abstract Factory, Builder, Prototype, Singleton, Comparative study of creational patterns, and examples based on real life applications.

Unit -III

Structural Design Patterns: Introduction, Role of Structural patterns, Encapsulating complex structures to simplify interactions between components, Decoupling Components, Structural Pattern types: Adapter, Bridge, Composite, Decorator, Façade, Proxy, Comparative study of structural patterns, and examples based on real life applications.

Unit – IV

Behavioral Patterns-I: Introduction, Role of Behavioral pattern, Encapsulation of Behavior, Behavioral Pattern types: Chain of Responsibility, Template Method, State, Strategy, and Iterator.

Unit -V

Behavioral Patterns-II: Effect of single object on set of objects, Analysis of mutual behavior of classes and object's state, Reference control between objects, Behavioral Pattern types: Observer, Mediator, Memento, Interpreter, Comparative study of Behavioral patterns, and examples based on real life applications.

Course Outcomes

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

1. Analyze the need and ability of design patterns in the software design process.
2. Implement various solutions for creation of objects, their structure and the interaction between objects.
3. Develop a loosely coupled application using design patterns.
4. Analyze the tradeoffs of applying a design pattern to a given problem.

Text Books

1. Design Patterns: Elements of reusable object-oriented software by Gamma Erich, Helm Richard, Johnson Ralph, and Vlissides John, Pearson Education
2. Design Patterns Explained by Alan Shallowly and James Trott, Addison-Wesley

Reference Books

1. Pattern's in JAVA Vol-I by Mark Grand, WileyDreamTech.
2. JAVA Enterprise Design Patterns Vol-III by Mark Grand, WileyDreamTech.
3. Head First Design Patterns by Eric Freeman, O'Reilly.

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

Course Code: 24CS02TH0506-3 **Course: Cryptography**

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

Course Objectives

1. To understand basics of Cryptography.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of data
4. To understand various protocols to protect against the threats in the networks.

Syllabus

UNIT – I: Introduction to Cryptography
Introduction to security attacks - services and mechanism, Mathematics of Cryptography- Integer Arithmetic, Modular Arithmetic, introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography

UNIT – II: Stream & Block Ciphers
Mathematics of Symmetric-key Cryptography- Algebraic Structures- Groups, ring & Finite field, stream and block ciphers - Modern Block Ciphers: Block ciphers principals – Shannon's theory of confusion and diffusion - fiestal structure - data encryption standard (DES) - strength of DES – block cipher modes of operations - DES – AES.

Unit – III: Asymmetric-Key Cryptography
Confidentiality using conventional encryption - traffic confidentiality, Mathematics of Asymmetric-key cryptography, RSA algorithm– Diffie-Hellman key exchange algorithm- Elliptic curve cryptography– Elgamal encryption – Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks.

Unit – IV: Hash Functions & Authentication
Message Authentication and Hash Function: Authentication requirements – authentication functions - message authentication code - hash functions - birthday attacks. MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service

Unit – V: Application Layer Security, IP Security and Key Management
Electronic mail security-pretty good privacy (PGP), S/MIME, IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations – key management.

Course Outcomes

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

1. Understand various cryptographic techniques.
2. Apply symmetric and asymmetric cryptographic algorithms.
3. Implement hashing and digital signature techniques.
4. Develop secure authentication mechanisms.
5. Apply cryptographic methods for network and application security.

Text Books

1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson /PHI, 5th Edition
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.
3. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security" 3rd Edition, McGrawHill.

Reference Books

1. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

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

Course Code: 24CS02TH0601 **Course: Deep Learning**

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

Course Objectives

- To understand the evolution of neural networks from simple Perceptrons to deep Feedforward architectures.
- To understand Gradient Descent variants and adaptive optimizers for training stable and efficient models.
- To apply Regularization and Hyperparameter tuning strategies to improve model generalization and prevent overfitting.
- To explore specialized networks like CNNs for spatial data and RNNs/Transformers for sequential data processing.

Syllabus

UNIT I: Basic of Deep Learning

History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptron, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed forward Neural Networks

UNIT II: Feedforward Neural Network : Representation, Training, and Global Optimization

Representation Power of Feed forward Neural Networks, Training of feed forward neural network, Gradient Descent, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam

UNIT III: Foundations of Neural Network Stability and Generalization

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: Convolution Neural Network (CNN)

Convolutional Neural Networks, 1D convolution network, 2D convolution network Visualizing Convolutional Neural Networks, Guided Backpropagation. Region Based CNN and Variants of CNN : LeNet, AlexNet, VGGNet, GoogLeNet, ResNet.

UNIT V: Recurrent Neural Network (RNN)

Recurrent Neural Networks, Backpropagation through Time (BPTT), Vanishing and Exploding Gradients, Gated Recurrent Units (GRUs), Long Short-Term Memory (LSTM) Cells, Encoder Decoder Models, Introduction to transformers, Attention Mechanism, ConvRNNs.

Course Outcomes

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

1. Evaluate the evolution of artificial neuron model, identifying their constraints and representation power.
2. Construct Feedforward Neural Network (FNN) architectures and implement efficient training using Backpropagation and Optimization Algorithms.
3. Construct and visualize Convolutional Neural Networks (CNNs) for spatial data processing and distinguish between landmark architectures such as AlexNet, VGGNet, and ResNet.
4. Synthesize sequence-based models using RNNs, LSTMs, and GRUs, and explain the role of Attention Mechanisms and Transformers in processing complex temporal data.

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 and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
4. Dr. S Lovelyn Rose,Dr. L Ashok Kumar,Dr.D Karthika Renuka ,Deep Learning using Python,WilleyPublication

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. Ravindran, K. M. Ragsdell , and G. V. Reklaitis, Engineering Optimization: Methods and Applications ,John Wiley & Sons, Inc. , 2016.

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

Course Code: 24CS02PR0601 **Course:** Deep Learning Lab

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

Course Objectives

- To provide practical experience in building and testing basic neural units to understand their computational limits and decision boundaries.
- To implementation of Backpropagation and various Optimization Algorithms (like Adam and RMSProp) using deep learning frameworks.
- To develop the skill of architecting and visualizing CNNs, enabling the application of industry-standard models like ResNet to real-world image datasets.
- To gain proficiency in designing and training sequence-based models, including LSTMs and Attention Mechanisms, for temporal data analysis.

Syllabus

Practical's based on syllabus of 24CS02TH0601

Course Outcomes

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

1. Implement and Validate Foundational Neurons: Design and code basic neural models, including Perceptrons and MLPs, to demonstrate their logical representation power and boundary constraints.
2. Develop and Tune Optimized FNNs: Build Feedforward Neural Networks using modern frameworks, applying backpropagation and comparing various Optimization Algorithms to achieve efficient model convergence.
3. Deploy and Interpret Vision Architectures: Construct and visualize Convolutional Neural Networks (CNNs) for image-based tasks, leveraging landmark architectures like ResNet or VGGNet to solve spatial data problems.
4. Synthesize Sequence and Attention Models: Create and evaluate temporal models using RNNs, LSTMs, and Attention Mechanisms to process complex sequential data and long-term dependencies.

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 and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
4. Dr. S Lovelyn Rose,Dr. L Ashok Kumar,Dr.D Karthika Renuka ,Deep Learning using

Python,WilleyPublication

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. Ravindran, K. M. Ragsdell , and G. V. Reklaitis, Engineering Optimization: Methods and Applications ,John Wiley & Sons, Inc. , 2016.

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

Course Code: 24CS02TH0602 **Course**: Computer Vision

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

Course Objectives

- To equip students with the ability to analyze and interpret visual data using fundamental concepts of computer vision.
- To build proficiency in designing solutions for real-world applications involving image analysis and vision-based systems.
- To develop an understanding of various computational approaches for processing images, including enhancement and structural analysis.
- To enable learners to explore and apply techniques for detecting, tracking, and categorizing objects within digital images and videos.

Syllabus

Unit I:

Fundamental Steps in Image Processing, Image representation, Components of digital image processing systems, Sampling and Quantization, Relationship between pixels – neighborhoods, adjacency connectivity, regions, boundaries, and distance measures, Concept of pinhole camera, camera calibration

Unit II:

Image Enhancement in the Spatial Domain: Basic Gray Level Transformations, Transformations in 2D: translation, rotation, scaling, shearing; Histogram Equalization, Histogram Processing, Local Enhancement, Image Subtraction, Image Averaging, smoothing Spatial Filters, Sharpening Spatial Filters.

Unit III:

Color models: RGB, HSV, Grayscale, Image Segmentation: segmentation fundamentals, edge detection (Sobel, Canny), thresholding techniques (global, adaptive), region-based segmentation. Feature descriptors: Feature detection and description: Line detectors (Hough Transform), Feature matching and model fitting, RANSAC.

Unit IV:

Motion analysis: Optical Flow, Lucas-Kanade algorithm, feature point tracking, motion-based object detection, background subtraction, tracking using Kalman filter, classification using Adaboost algorithm, face detection

Unit V:

Pattern Analysis: Image pattern analysis by K-Means/K-Medoids, Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods, Light at Surfaces; Phong Model; Reflectance Map

Course Outcomes

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

1. Demonstrate the knowledge of image fundamentals, basic terminologies in the field of image processing.
2. Apply different image enhancement methods for improving image quality.
3. Understand various colour models, image segmentation and subtraction techniques.
4. Apply algorithms for object detection, tracking, and classification in computer vision systems.
5. Formulate, suggest designs for various computer vision applications.

Text Books

1. Digital Image Processing: Rafael Gonzalez and Richard Woods, 3Ed., Pearson Pub.
2. Computer Vision: Algorithms and Applications by R. Szeliski, Springer, 2011.
3. Computer Vision: A Modern Approach, by David A. Forsyth and Jean Ponce, 1st edition, Prentice Hall, 2002.
4. Robot Vision, by Berthold Klaus Paul Horn, 1st edition, MIT Press, 1986.

Reference Books

1. Fundamentals of Digital Image Processing: A.K.Jain, Prentice Hall.
2. Image Processing Principles & Applications: Tinku Acharya & Ajoy K. Ray, Willey
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press.

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

Course Code: 24CS02PR0602 **Course:** Computer Vision Lab

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

Course Objectives

- To provide hands-on experience in performing fundamental image processing operations such as filtering, enhancement, and geometric transformations.
- To enable students to apply spatial and frequency domain techniques for effective analysis of digital images.
- To develop practical skills in implementing algorithms for edge detection, segmentation, and morphological processing.
- To familiarize learners with the use of image processing tools and libraries for real time object tracking and related applications.

Syllabus

Practical's based on syllabus of 24CS02TH0602

Course Outcomes

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

1. Understand and implement fundamental image processing operations such as image enhancement, filtering, and transformation.
2. Apply spatial and frequency domain techniques to process and analyze digital images.
3. Develop and evaluate algorithms for edge detection, image segmentation, and morphological operations.
4. Utilize image processing libraries to implement motion tracking techniques.
5. Analyze the performance of image processing techniques for real-world applications such as object recognition and image compression.

Text Books

1. Digital Image Processing : Rafael Gonzalez and Richard Woods, 3Ed., Pearson Pub.
2. Computer Vision: Algorithms and Applications by R. Szeliski, Springer, 2011.
3. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill, 2nd ed., 2011

Reference Books

1. Fundamentals of Digital Image Processing : A.K.Jain, Prentice Hall.
2. Image Processing Principles & Applications: Tinku Acharya & Ajoy K. Ray, Willey
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press.

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

Course Code:24CS02TH0603-1 **Course:** Cloud Computing

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

Course Objectives

- Understand virtualization and containerization technologies used in cloud environments.
- Explain and apply cloud architecture principles and service models.
- Design and configure secure cloud networking and infrastructure.
- Use AWS and Azure services for deploying applications and managing data.
- Develop and evaluate scalable cloud-based application solutions.

Syllabus

Unit-I: Virtualization & Containerization

Traditional vs virtualized infrastructure, Hypervisors (Type 1 & Type 2), Types of virtualization: server, storage, OS-level, Limitations of virtualization, Containerization concepts, Containers vs virtual machines, Docker basics: images, containers, lifecycle, Introduction to container orchestration, Kubernetes basics: Pods, Deployments, Services, Industry use cases

Unit -II : Cloud Fundamentals & Architecture

Introduction to cloud computing, Cloud service models: IaaS, PaaS, SaaS, Deployment models: public, private, hybrid, multi-cloud, Cloud architecture principles: scalability, high availability, fault tolerance, elasticity, Cloud infrastructure: regions, availability zones, edge locations, high availability within datacenter, Cloud migration, Shared responsibility model, Introduction to public cloud platforms: AWS, Microsoft Azure, Google Cloud Platform, Introduction to core services in public cloud platforms, Different methods of deploying services in AWS and Azure, Concept of subscription and resource groups in Microsoft Azure

Unit -III: Cloud Networking, Security & Costing

Cloud networking: Virtual Private Cloud (VPC) / Virtual Network, Subnets and CIDR, Internet Gateway, NAT Gateway, Cloud security: Identity and Access Management (IAM), Security groups, Network ACLs, Data security basics, Costing: pay-as-you-go pricing, Total Cost of Ownership (TCO), Cost optimization basics

Unit – IV: Core Cloud Services (AWS & Azure)

Compute services: AWS EC2, Azure Virtual Machines, VM configuration (Windows/Linux), Remote access: SSH, RDP, Storage services: AWS S3, EBS, EFS, Azure Blob Storage, Database services: AWS RDS, DynamoDB, Azure Cosmos DB

Unit -V: Cloud Application Deployment & Modern Practices

Application deployment in cloud: hosting web applications on VM, Platform services: Elastic Beanstalk, Azure App Services, Serverless computing: AWS Lambda, Azure Functions, Load balancing and auto scaling, Infrastructure as Code: CloudFormation, ARM Templates, Cloud application architecture: monolithic vs microservices, Basic API-based applications, Case studies: cloud architecture examples (e-commerce, media applications)

Course Outcomes

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

1. Explain virtualization and container technologies in cloud computing.
2. Analyze and design cloud architectures based on performance and availability needs.
3. Implement cloud networking and security configurations.
4. Deploy and manage applications using cloud platforms (AWS/Azure).
5. Evaluate cloud solutions based on scalability, cost, and efficiency.

Text Books

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson, 1st Edition, 2013.
2. Thomas Erl, Eric Barceló Monroy, Cloud Computing: Concepts, Technology, Security and Architecture, Pearson, 2nd Edition, 2023.
3. Rajkumar Buyya et al., Mastering Cloud Computing, McGraw Hill, 1st Edition, 2013.
4. A. Srinivasan, J. Suresh, Cloud Computing: A Practical Approach, Pearson India, 1st Edition, 2014.

Reference Books

1. Naresh Kumar Sehgal, P.C.P. Bhatt, Cloud Computing: Concepts and Practices, Springer, 1st Edition, 2018.
2. Kai Hwang et al., Distributed and Cloud Computing, Elsevier, 1st Edition, 2012.
3. Kris Jamsa, Cloud Computing, Jones & Bartlett Learning, 1st Edition, 2012.
4. Kelsey Hightower et al., Kubernetes Up and Running, O'Reilly, 2nd Edition, 2022.
5. Nigel Poulton, Docker Deep Dive, Latest Edition, 2023.

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

Course Code:24CS02TH0603-2 **Course:** Business and Web Analytics

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

Course Objectives

- To understand the fundamentals of business analytics and its role in decision-making
- To learn data collection, preprocessing, and visualization techniques
- To apply statistical and predictive models for solving business problems
- To understand web analytics concepts and analyze user behavior
- To use modern analytics tools such as Excel, Power BI, and Google Analytics

Syllabus

Unit-I

Introduction to Business Analytics; Types of Analytics: Descriptive, Diagnostic, Predictive, and Prescriptive. The Business Analytics Process Cycle. Data Management for Analytics: ETL processes, Data Quality, and Big Data integration in business contexts.

Unit -II

Segmentation and Targeting: RFM (Recency, Frequency, Monetary) Analysis. Customer Lifetime Value (CLV) calculation. Market Basket Analysis (Association Rules). Predictive modeling for Customer Churn and Sales Forecasting

Unit -III

How Web Analytics works: Log files vs. Page tagging. Key Performance Indicators (KPIs): Bounce Rate, Exit Rate, Conversion Rate, and Session Duration. Traffic Sources: Organic, Paid Search (SEM), Referrals, and Social.

Unit – IV

Setting up Google Analytics 4 (GA4): Data Streams and Event Tracking. Analysis of User Journeys and Funnel Visualizations. Tracking E-commerce conversions and Revenue Attribution models. A/B Testing for web optimization.

Unit -V

Principles of Data Storytelling. Dashboard design using Tableau, Power BI, or Google Looker Studio. Automating business reports. Heatmaps and Click-stream analysis for UX improvement.

Course Outcomes

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

1. Understand the role of analytics in business decision-making and identify different types of business data.

2. Apply descriptive and predictive modelling to solve business problems such as churn, segmentation, and forecasting.
3. Implement web analytics frameworks to track user behaviour, traffic sources, and conversion funnels.
4. Design and develop automated business dashboards using visualization tools like Tableau or Power BI.
5. Evaluate the legal and ethical frameworks surrounding data privacy and "cookie-less" web tracking.

Text Books

1. Evans, J. R., Business Analytics, 3rd Edition, Pearson Education.
2. Kaushik, A., Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, Sybex.
3. Sharda, R., Delen, D., and Turban, E., Business Intelligence and Analytics: Systems for Decision Support, 10th Edition, Pearson.

Reference Books

1. Rovost, F., and Fawcett, T., Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly Media.
2. Hemann, C., and Burbary, K., Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, Que Publishing.
3. Nussbaumer Knaflic, C., Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley

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

Course Code: 24CS02TH0603-3 **Course: Basics of Ethical Hacking**

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

Course Objectives

- Learn about the hacker mindset and the history of hackers
- Understand basic networking and security technologies
- Gain a basic understanding of security policy
- Explore various vulnerability analysis techniques

Syllabus

Unit-I:

Introduction and Ethics: Ethical Hacking, Types of Hackers, Phases of Ethical Hacking, Fundamentals of computer networking. TCP/IP protocol stack, IP addressing and routing, Common Network Threats/Attacks

Unit -II:

Cryptography: Introduction to cryptography, private-key encryption, public-key encryption, Key exchange protocols, cryptographic hash functions, applications, Digital signatures, Attacks on cryptosystems

Unit -III:

Vulnerability Analysis & System Hacking: Vulnerability Analysis, Types of Vulnerability Analysis, Vulnerability Assessment Tools, System Hacking, Password Cracking, Penetration testing, Hiding Files, Clearing logs

Unit – IV:

DoS and Session Hijacking: DoS attack, DDoS attack, Common symptoms of DoS/DDoS attack Categories of DoS/DDoS Attack Vectors, session hijacking, Application and Network level session hijacking. Sniffing: Malware and its propagation ways, Malware components, Types of malware, Concept of sniffing, Types of sniffing, Types of sniffing attacks.

Unit -V:

IDS & Firewall: Intrusion Detection System (IDS), Types of Intrusion Detection Systems, Introduction to Firewalls, Types of Firewalls, Introduction to Honeypots, Case studies: various attacks scenarios and their remedies.

Course Outcomes

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

1. Develop the core foundations of ethics and cryptography in regards to computer security
2. Analysing the vulnerability with respect to hacking, DDOS attack and session hijacking
3. Classify various types of malware and sniffing attacks on network
4. Analysing various attacks scenario and remedies and detecting the attack with IDS.

Text Books

1. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, 2nd Edition, Patrick Engebreston, ISBN: 0124116442

Reference Books

1. Penetration Testing: A Hands-On Introduction to Hacking, Georgia Weidman, ISBN: 1593275641
2. ETHICAL HACKING: A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking, Hein Smith, Hilary Morrison

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

Course Code: 24CS02TH0604-1 **Course: Introduction to DevOps**

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

Course Objectives

- Understand DevOps culture, principles, and lifecycle
- Gain hands-on expertise in CI/CD, containerization, and cloud deployment
- Build scalable, automated infrastructure using modern tools
- Prepare students for real-world DevOps roles (SRE, DevOps Engineer, Cloud Engineer)

Syllabus

Unit-I: Introduction to DevOps & Version Control

Evolution of Software Development: Waterfall → Agile → DevOps, DevOps principles: CI/CD, automation, collaboration, feedback loops, DevOps lifecycle, Introduction to Git and GitHub, Git commands: clone, commit, push, pull, branch, merge, Git workflows: GitFlow, trunk-based development, Code collaboration: pull requests, code reviews, Setting up Git repositories, Branching and merging strategies, Resolving merge conflicts

Unit -II: CI/CD Pipelines & AWS DevOps Tools

CI/CD concepts and pipeline stages, Jenkins pipelines: declarative and scripted, AWS DevOps services: AWS CodeCommit, AWS CodeBuild, AWS CodeDeploy, AWS CodePipeline, Build tools: Maven, Gradle, Automated testing integration, End-to-end CI/CD pipeline: Git to build to test to deploy, Comparison of Jenkins and AWS-native CI/CD

Unit -III: Containerization & Orchestration

Virtualization vs containerization, Docker architecture and components, Dockerfile, images, containers, Docker Compose, Kubernetes architecture: master, node, pods, Kubernetes objects: pods, services, deployments, Scaling and load balancing, Building Docker images, Deploying multi-container applications, Kubernetes cluster deployment using Minikube or cloud

Unit – IV: Infrastructure as Code (IaC) & Cloud DevOps

Infrastructure as Code concepts, Tools: Terraform, AWS CloudFormation, Configuration management: Ansible, Cloud platforms: AWS and Azure basics, Serverless basics, Writing Terraform scripts, Automating server provisioning, Deploying applications on AWS and Azure

Unit -V: Monitoring, Logging, Security & DevSecOps

Monitoring tools: Prometheus, Grafana, AWS CloudWatch, Logging tools: ELK Stack including Elasticsearch, Logstash, Kibana and CloudWatch Logs, DevSecOps principles, Security in CI/CD pipeline, Container security, Security tools, Site Reliability Engineering

basics, Incident management and alerting, Setting up monitoring dashboards, Log analysis, Securing pipelines and applications

Course Outcomes

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

1. Understand DevOps principles, Agile integration, and SDLC automation
2. Implement version control and CI pipelines using Git and Jenkins
3. Build and manage containerized applications using Docker & Kubernetes
4. Automate infrastructure using Infrastructure as Code (IaC) tools
5. Monitor, secure, and deploy applications in cloud environments

Text Books

1. Gene Kim, Jez Humble, Patrick Debois, John Willis – The DevOps Handbook
2. Nicole Forsgren, Jez Humble, Gene Kim – Accelerate: The Science of Lean Software and DevOps
3. Kief Morris – Infrastructure as Code

Reference Books

1. Nigel Poulton – Docker Deep Dive
2. Brendan Burns – Kubernetes Up and Running
3. Jeff Geerling – Ansible for DevOps
4. Michael Hausenblas – Cloud Native DevOps with Kubernetes
5. AWS Documentation & Azure DevOps Documentation

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

Course Code: 24CS02TH0603-2 **Course:** Information Security Privacy

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

Course Pre-requisite • Computer Network

Course Objectives

This course will provide students with a practical and theoretical knowledge of Information security and Privacy. By the end of the course, students should be able to:

- To build strong fundamental of Information Security and algorithm to realize goals of Security.
- Understand authentication, intrusion detection and prevention and privacy issues.
- Identify and mitigate software security vulnerabilities in existing systems.

Syllabus

Unit-I: Fundamentals of Information Security

Introduction to Information Security, Security Goals (Confidentiality, Integrity, Availability), Types of Network Attacks, Threats and Vulnerabilities, Data Integrity and Confidentiality, Authentication (Message and Entity), Authorization, Non-repudiation, Network Security Model, Classical Encryption Techniques.

Unit -II: Symmetric Key Cryptography

Introduction to Cryptography, Stream Ciphers and Block Ciphers, Symmetric Key Algorithms, Data Encryption Standard (DES) and its Strength, Block Cipher Modes of Operation (ECB, CBC, CFB, OFB, CTR), Limitations and Security Issues.

Unit -III: Asymmetric Cryptography and Key Management

Basic Mathematical Foundations (Number Theory, Modular Arithmetic), Asymmetric Key Algorithms (RSA, Diffie-Hellman), Key Exchange Mechanisms, Applications, Cryptographic Attacks on Public Key Systems.

Unit – IV: Authentication and Security Mechanisms

Hash Functions and their Security, Message Authentication Codes (MAC), Digital Signatures, Authentication Protocols, Password-based Authentication, Biometrics, Kerberos System, Message Digest Algorithms (MD5, SHA).

Unit -V: Data Privacy and Protection Techniques

Introduction to Data Privacy, Privacy Definitions and Policies, Privacy in Domains (Healthcare, Finance), Challenges in Data Anonymization, Disclosure Risk, Suppression and Generalization Techniques, k-Anonymity, Overview of Differential Privacy and Protection Models.

Course Outcomes

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

1. Identify and investigate network security threats.
2. Apply encryption techniques to build security-related applications.
3. Solve the problems related to key generation and key exchange algorithms.
4. Analyse the privacy attacks for real-life application
5. Apply privacy-related algorithms for risk assessment.

Text Books

1. William Stallings; Cryptography & Networks Security Principles and Practice; 6th Edition Pearson Education, 2013.
2. Behrouz A. Forouzan, Cryptography and network security MC Graw Hill 3rd Edition
3. L. Sweeney, Computational Disclosure Control: A Primer on Data Privacy Protection, MIT Computer Science, 2002.
4. The Algorithmic Foundations of Differential Privacy, by Cynthia Dwork and Aaron Roth
5.Raghunathan, The Complete Book of Data Anonymization: From Planning to Implementation, Auerbach Pub, 2013.

Reference Books

1. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
2. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
3. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

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

Course Code: 24CS02TH0604-3 **Course:** Time Series Analysis

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

Course Objectives

- To provide fundamental knowledge of time series data, its components, and basic statistical properties.
- To develop skills for visualizing and analysing time series data to identify patterns such as trend and seasonality.
- To introduce basic time series models such as AR, MA, ARMA, and ARIMA for analysis and forecasting.
- To enable students to apply suitable forecasting techniques and evaluate models for solving real-world problems using various tools.

Syllabus

Unit-I: TIME SERIES DATA

Introduction to Time Series Data, Real-world Examples (Finance, IoT, Healthcare, E-commerce), Components of Time Series (Trend, Seasonality, Cyclic, Irregular), Understanding Autocorrelation (ACF) and Partial Autocorrelation (PACF), White Noise and Wold Decomposition Concept, Impulse Response Function, Superposition Principle, Parsimonious Models, Data Preprocessing (Handling Missing Values, Smoothing, Noise Reduction), Introduction to Python libraries such as Pandas and NumPy.

Unit -II: VISUALIZING TIME SERIES DATA STRUCTURES

Introduction to Data Visualization, Graphical Analysis of Time Series, Graph Terminology and Perception, Principles of Graph Construction and Aspect Ratio, Time Series Plots, Moving Averages and Smoothing Techniques, Identification of Trends, Seasonality and Outliers, Good vs Bad Graphics, Visualization using tools like Matplotlib and Seaborn, Introduction to dashboards using Power BI/Tableau.

Unit -III: STATIONARY MODELS

Basics of Stationary Time Series Models (Strict and Weak Stationarity), Autoregressive (AR), Moving Average (MA), and Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility Conditions, Model Identification using ACF and PACF, Checking for Stationarity using Variogram, Transformation of Data (Log Transformation, Differencing), Model Estimation and Evaluation.

Unit – IV: NONSTATIONARY AND ADVANCED MODELS

Introduction to Nonstationarity, Detecting Nonstationarity, Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA Models, Seasonal ARIMA (SARIMA) Models, Exponential Smoothing Techniques (EWMA, Holt-Winters), Introduction to Machine Learning approaches for Time Series using Machine Learning, Implementation basics using Scikit-learn and TensorFlow.

Unit -V: TIME SERIES MODEL SELECTION AND APPLICATIONS

Introduction to Model Selection, Finding the "Best" Model, Model Selection Criteria (AIC, BIC, RMSE, MAE), Cross-validation Techniques for Time Series, Impulse Response Function for Model Comparison, Comparing Competing Models, Case Studies (Stock Market Forecasting, Sales Forecasting, IoT Data Analysis), Deployment Basics and Dashboard Integration, Mini Project for Real-world Time Series Forecasting.

Course Outcomes

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

1. Understand the fundamental concepts of time series data, its components, and basic statistical properties.
2. Apply visualization and analytical techniques to identify patterns such as trend, seasonality, and autocorrelation using tools like Matplotlib.
3. Analyze and build basic time series models such as AR, MA, ARMA, and ARIMA for forecasting.
4. Evaluate and implement appropriate forecasting models using performance metrics and basic tools like Scikit-learn for real-world applications.

Text Books

1. Robert H. Shumway and David S. Stoffer, Time Series Analysis and Its Applications, 5th Edition, Springer, 2025.
2. Peter J. Brockwell and Richard A. Davis, Introduction to Time Series and Forecasting, 3rd Edition, Springer, 2016.

Reference Books

1. Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, 3rd Edition, OTexts, 2021.
2. Aileen Nielsen, Practical Time Series Analysis, 1st Edition, O'Reilly Media, 2019.
3. Terence C. Mills, Applied Time Series Analysis, Revised Edition, Academic Press, 2019.
4. B. V. Vishwas Batra, Hands-On Time Series Analysis with Python, 1st Edition, Packt Publishing, 2020.

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

Course Code: 24CS02PR0605 **Course: Comprehensive Viva Lab**

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

Course Objectives

- To reinforce and integrate fundamental concepts from core IT subjects covered throughout the curriculum.
- To develop analytical and critical thinking skills for evaluating IT engineering systems and their interrelationships.
- To enable students to apply theoretical knowledge in solving real-world engineering problems effectively.

Course Outcomes

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

1. Demonstrate comprehensive understanding of key concepts from core IT courses.
2. Analyze and evaluate IT engineering systems, including their components and interactions.
3. Apply acquired knowledge and problem-solving skills to design appropriate solutions for real-world challenges.

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

Course Code: 24HS02TH0601 **Course: Business Communication**

L: 1 Hrs, **T:** 0 Hrs, **P:** 0 Hrs **Per Week** **Credits: 01**

Course Objectives

The course aims to develop the skills of students to proficiently craft compelling business documents and employ strategic verbal communication techniques. By honing these skills, students will gain the ability to convey ideas persuasively and interact confidently in diverse business contexts

Syllabus

Unit-I: Fundamentals of Business Communication

Definition of communication, Emergence of communication as a key concept in the Corporate and Global world, Types- Internet, Blogs, E-mails, social media, Channels- Formal and Informal: Vertical, Horizontal, Diagonal, Grapevine, Persuasive Communication- Negotiation Skills, PAC concept

Unit -II: Business Correspondence

Planning, Writing, and Completing Business Messages

Personnel Correspondence: Job Application Letter, Letter of Acceptance of Job Offer, Letter of Resignation, Letter of Appointment, Promotion and Termination, Letter of Recommendation Trade Correspondence: Inquiry, Order, Credit and Status Enquiry, Complaints, Claims, Adjustments, Consumer Grievance Letters

Unit -III: Visual and Content Creation

Visual design principles, Ethics of visual communication, selecting visuals for presenting data, Content Creation: Website, Help file, User Guides, Promotional leaflets and fliers

Unit – IV: Report

Basic formats and types of reports - Feasibility, Progress, Project, Case Study Evaluation, Agenda, Notices, Minutes of Meeting, Organizational announcements, Statement of Purpose.

Unit -V: Communication for Employment

Pre-interview technique- NOISE Analysis, Job Description and Resume, Creating LinkedIn Profile, Effective use of job portals, Business etiquette.

Course Outcomes

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

1. Understand the fundamentals of business communication.
2. Apply tools and techniques to create effective workplace correspondence.
3. Analyze and apply visual design principles to create business documents.
4. Understand and evaluate information to draft reports.
5. Apply and evaluate strategies for effective communication for employment

Text Books

1. Sharon Gerson, Steven Gerson, “Technical Communication: Process and Product”, 2018, Pearson
2. Courtland L Bovee, John V Thill and Roshan Lal Raina “Business Communication Today”, 14th edition Pearson
3. P.D. Chaturvedi and Mukesh Chaturvedi, Fundamentals of Business Communication, Pearson Publications, 2012.

Reference Books

1. Shalini Verma, Business Communication, Vikas Publishing House Pvt. Ltd., 2015.
2. Sanjay Kumar, Pushpa Lata, Communication Skills, 2nd Edition, Oxford Publication, 2018
3. William Strunk Jr. and E.B. White, The Elements of Style, Allyn & Bacon, A Pearson Education Company, 2000

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

Course Code: 24HS02PR0601 **Course: Business Communication Lab**

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

Course Objectives

Develop effective verbal and written communication skills in professional contexts, enable students to draft business correspondence and formal documents, enhance presentation, visual communication, and interpersonal skills, and prepare students for employment communication such as interviews and professional networking.

Syllabus

Practical's based on syllabus of **24HS02TH0601**

Course Outcomes

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

1. Demonstrate effective verbal and non-verbal communication skills in professional scenarios.
2. Draft various types of business correspondence including letters, emails, and reports.
3. Create and present business documents using visual and content design principles.
4. Apply communication skills for employment including resume writing, interviews, and professional etiquette.

Reference Books

1. Shalini Verma, Business Communication, Vikas Publishing House Pvt. Ltd., 2015.
2. Sanjay Kumar, Pushpa Lata, Communication Skills, 2nd Edition, Oxford Publication, 2018
3. William Strunk Jr. and E.B. White, The Elements of Style, Allyn & Bacon, A Pearson Education Company, 2000

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

Course Code: 24CS02PR0606 **Course: Mini project**

L: 0 Hrs, **T:** 0 Hrs**, P:** 4 Hrs **Per Week** **Credits: 2**

Course Outcomes

On successful completion of the course, the student 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.

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

Course Code: 24CS02PR0607 **Course: Advanced Competitive Coding**
L: 0 Hrs, **T:** 0 Hrs**,** **P:** 2 Hrs **Per Week** **Credits: 1**

Course Objectives

- Explain fundamental concepts of hash tables, trees, graphs, heaps, and disjoint sets.
- Apply data structures and algorithms like BFS, DFS, greedy methods, and dynamic programming to solve problems.
- Analyze and compare different data structures and hashing techniques for efficient problem-solving.
- Design and evaluate optimized algorithmic solutions using advanced techniques like greedy and dynamic programming.

Syllabus

Hash tables, collision handling, and hashing in STL/Java collections. Binary trees, binary search trees, tree traversals, basic tree problems. Graph representation, BFS, DFS, basic graph problems. Basics of heaps, priority queues, disjoint sets, greedy algorithms, and Dynamic Programming

Course Outcomes

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

1. Demonstrate understanding of fundamental data structures such as hash tables, trees, graphs, heaps, and disjoint sets.
2. Implement and apply algorithms like BFS, DFS, greedy methods, and dynamic programming to solve computational problems.
3. Analyze and compare different data structures and hashing techniques to select efficient solutions for given problems.
4. Design and evaluate optimized algorithmic solutions using appropriate techniques such as greedy strategies and dynamic programming.

SYLLABUS

RAMDEOBABA UNIVERSITY, NAGPUR

B.Tech in Computer Science and Engineering
(Data Science)

Honors in Data Science

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	24CS02TH0301	Data Science Essentials	3	0	3	100	-	100	-
2	IV	24CS02TH0401	Software Architecture Analysis	3	0	3	100	-	100	-
3	V	24CS02TH0501	Data Engineering	4	0	4	100	-	100	-
4	VI	24CS02TH0601	Business and Web Analytics	4	0	4	100	-	100	-
5	VII	24CS02TH0701	Project	0	8	4	50	50	100	-
			TOTAL	**14**	**8**	**18**	**450**	**50**	**500**	

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

(Honors in Data Science)

Course Code: 24CS02HT0301 **Course: Data Science Essentials**

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

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Course Objectives:

1. Develop proficiency in using Excel for data analysis and visualization, including advanced techniques like pivot tables, charts, and statistical functions.
2. Understand the fundamental concepts and techniques of data science, including data types, sources, cleaning, pre-processing, and exploratory analysis.
3. Apply data science skills to real-world problems and datasets through case studies and projects.
4. Learn how to utilize Plotly Dash for data modeling, transformation, visualization, and creating interactive dashboards and reports.

Syllabus:

Unit 1: Introduction to Data Science

Definition and overview of Data Science; Data Science workflow and processes; Applications of Data Science across various domains; Understanding different data types and sources; Ethics, privacy, and responsible data handling; Case studies and real-world examples of data science applications; Understanding the data science project lifecycle; Project ideation, planning, and management

Unit 2 : Data Analysis with Excel

Excel basics: workbooks, worksheets, formulas, and data formatting; Data cleaning and transformation techniques in Excel; Pivot tables for data summarization and analysis; Creating effective charts and graphs for data visualization; Statistical functions in Excel (e.g., AVERAGE, STDEV, CORREL); Introduction to Excel VBA and macros for automation

Unit 3: Advanced Data analysis with Excel

What-if analysis: Goal Seek & Scenarios, Introduction to Solver / optimization; Advanced formulas: nested and array functions; Advanced charts: scatter, histograms, map charts, Sparklines & trendlines, Dynamic dashboards with slicers & timelines, Power View / Pivot Charts in dashboards, Interactive controls : dropdowns, sliders, Geospatial visuals: map charts Dashboard planning & layout principles, Report templating & presentation-ready formatting, Exporting dashboards & sharing best practices

Unit 4: Data Pre-processing and Exploratory Analysis

Important Python libraries; Data cleaning and formatting techniques; Handling missing data and outliers; Feature engineering and selection; Descriptive statistics and summary measures; Correlation analysis and identifying relationships; Exploratory data analysis (EDA) techniques and best practices

Unit 5: Dash

Dash fundamentals; Callbacks and interactivity; Graphing and Visualization with Plotly; Web based dashboards; Real world applications and best practices.

Course Outcomes:

By the end of this course, students will be able to:

1) Explain core concepts and applications of data science, and describe the data science project lifecycle.
2) Apply data analysis, cleaning, and visualization techniques using Excel and Python, including advanced data processing, dashboard creation, and automation.
3) Design and construct interactive, web-based data dashboards using Dash

Recommended Resources:

- Excel Data Analysis for Dummies by Paul McFedries
- Power BI Desktop for Dummies by Brian Larson
- Python for Data Analysis by Wes McKinney
- Python Data Science Handbook by Jake VanderPlas
- The Book of Dash: Build Interactive Data Analysis and Visualization Apps with Python and Plotly by Adam Schroeder, Christian Mayer, and Ann Marie Ward
- Interactive Dashboards and Data Apps with Plotly and Dash by Packt Publishing

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

(Honors in Data Science)

Course Code: 24CS02HT0401 **Course: Software Architecture Analysis**

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

Course Objectives

1. To implement ReactJs programming in end-to-end application development.
2. To comprehend the fundamentals of web development using MERN Stack.
3. To establish students as an expert web developer using this full stack developer course.

SYLLABUS

Unit I: Key issues in design and architecture fundamentals (general concepts, context, process, principles), Architectural structure and viewpoints: architectural styles, patterns, and frameworks, architectural trade-offs among various attributes,

Unit II: Hardware and systems engineering issues in software architecture, requirements traceability in architecture, service-oriented architectures, architectures for network, mobile, and embedded systems, Architecture in the Cloud.

Unit III: User interface: General human-computer interaction design principles, use of modes and navigation, coding techniques and visual design, response time and feedback, design modalities, localization and internationalization, human-computer interaction design methods, interface modalities, metaphors and conceptual models, HCI.

Unit IV: Detailed design for software: database design, design notations, Developing secure software, secure design principles and patterns

Unit V: Creating systems which can evolve, Documenting designs, Software design tools, Reinforce design issues and strategies

Unit VI: Design concepts, process and principles, concurrency, control and handling of events, error and exception handling, interaction and presentation, data structure centered design, aspect-oriented design

Text Books:

Software Architecture in Practice, 3/E, by Len Bass, Paul Clements, and Rick Kazman

Course Outcomes:

On successful completion of the course Students will be able to:

1. Understand the need for software architecture and relationship to low-level Design
2. Develop architectural approaches from requirements and manage traceability between architecture and requirements
3. Analyse trade-offs among multiple architectural alternatives
4. Utilize quality attributes when designing software architectures
5. Recognize architectural patterns and apply them appropriately

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

(Honors in Data Science)

Course Code: 24CS02HT0501 **Course: Data Engineering**

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

Course Objectives

1. Understand the foundational concepts and significance of data engineering in data-driven enterprises.
2. Explore various data storage and processing technologies and their applications.
3. Gain hands-on skills in data ingestion, transformation, and storage using modern tools and Python.
4. Comprehend the design and orchestration of data pipelines for real-world data workflows.
5. Identify and apply best practices, governance principles, and tools in cloud-based data engineering environments.

Syllabus

Unit I

Introduction to Data Engineering: What is Data Engineering, Roles and responsibilities of a Data Engineer, Data Engineering vs. Data Science, Overview of the data lifecycle

Unit 2

Data Storage Technologies: Relational databases (SQL, PostgreSQL), NoSQL databases (MongoDB), Introduction to data lakes and data warehouses

Unit 3:

Data Processing: Introduction to batch and stream processing, Python for data processing, Basic data transformation and cleaning

Unit 4

Data Ingestion: Data sources (files, databases, APIs), Data ingestion tools (Python libraries, Apache Kafka), Introduction to data pipelines

Unit 5

Data Pipelines and Orchestration: Components of a data pipeline, Introduction to Apache Airflow, Scheduling and monitoring data pipelines

Unit 6

Data Engineering Tools and Practices: Introduction to cloud data platforms (AWS, GCP), Data governance and security basics, Best practices in data engineering

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

1. Explain the fundamentals of data engineering and its importance.
2. Describe different data storage and processing technologies.
3. Perform basic data ingestion, transformation, and storage operations using Python.
4. Understand the concept of data pipelines and their orchestration.
5. Identify various tools and best practices used in data engineering.

Text Books

1. "Fundamentals of Data Engineering" by Joe Reis and Matt Housley, Publisher: O'Reilly Media
2. "Data Engineering with Python" by Paul Crickard, Publisher: Packt Publishing
3. "Data Engineering with Python" by Jesse Anderson, Publisher: Manning Publications

Reference Books

1. "Designing Data-Intensive Applications" by Martin Kleppmann, Publisher: O'Reilly Media
2. "Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing" by Tyler Akidau, Slava Chernyak, and Reuven Lax, Publisher: O'Reilly Media
3. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross, Publisher: Wiley
4. "Cloud Data Management" by Divyakant Agrawal, Amr El Abbadi, and Sudipto Das Publisher: Morgan & Claypool Publishers

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

(Honors in Data Science)

Course Code: 24CS02HT0601 **Course: Business and Web Analytics**
L : 4 Hrs, T : 0 Hr, P : 0 Hr, Per Week **Total Credits: 4**

Course Objectives

1. To familiarize students with the concepts of business and web analytics.
2. To enable students to deploy business and web intelligence to improve the outcomes of marketing or business plan.
3. Students will gain an understanding of the strategic and operational aspects of business and web analytics tools and technologies.

SYLLABUS

UNIT – I: Predictive Analytics : Trendlines and Regression analysis, Forecasting techniques

UNIT – II: Simulation and Risk Analysis : Monte Carlo simulation, Random Sampling from probability distributions, dynamic system simulation, spreadsheet modeling and analysis.

UNIT – III: Prescriptive Analytics : Linear Optimization, Interger and nonlinear optimization, optimization analytics.

UNIT – IV: Web Analytic fundamentals: Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

UNIT – V: Web Metrics: Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI.
Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.

UNIT – VI: Web Analytics 2.0:Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.
Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

Course Outcomes:

On completion of the course the student will be able to

1. Apply predictive analytic techniques on real time data.
2. Perform simulation and risk analysis.
3. Explain and discuss web metrics.
4. Examine how different industries across the globe are using web analytics analytics.

Text Books:

1. James R. Evans, Business Analytics Methods, Models and Decisions, Pearson.
2. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed.

3. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed.
4. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

References:

1. Mathew Ganis, Avinash Koihrkar-Social Media Analytics-IBM Press
2. Jim Sterne, Social Media Metrics, Wiley