RAMDEOBABA UNIVERSITY
[RBU]
NAGPUR – 440013

RBU

RAMDEOBABA UNIVERSITY, NAGPUR

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

PROGRAMME SCHEME & SYLLABI

B. Tech Computer Science & Engineering
[Data Science & Analytics]

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, and an engineering specialization to the solution of complex engineering problems.

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

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

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

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

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

B. Tech. Computer Science and Engineering
(Data Science & Analytics)
[2024-25]
Teaching & Evaluation Scheme [B. Tech CSE-DSA]

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	0	2	1	25	25	50	-
6	VEC	24CS01TH0105	Cyber Laws & Ethics in IT	2	0	2	50	50	100	2
7	BSC	24HS03TH0103	Probability and Statistics	3	0	3	50	50	100	3
8	BSC	24HS03PR0101	Computational Mathematics Lab for CSE	0	2	1	25	25	50	-
9	VEC	24HS02TH0104	Foundational Course in Universal Human Values	1	0	1	50	-	50	-
10	BSC	24HS05TH0102	Introduction to Quantum Computing	3	0	3	50	50	100	3
11	BSC	24HS05PR0102	Introduction to Quantum Computing Lab	0	2	1	25	25	50	-
			TOTAL	**15**	**10**	**20**	**-**	**-**	**800**	**-**

Semester – II

Sr. No	Course Type	Course code	Course Name	Hours/ Week		Credits	Maximum marks			ESE Duration (Hrs)
				L	P		Continuous Assessment	End Sem Exam/Internal Evaluation	Total	
1	ESC	24CS01TH0201	Object Oriented Programming	3	0	3	50	50	100	3
2	ESC	24CS01PR0201	Object Oriented Programming Lab	0	2	1	25	25	50	-
3	PCC	24CS01TH0202	Data Structures	3	0	3	50	50	100	3
4	PCC	24CS01PR0202	Data Structures Lab	0	2	1	25	25	50	-

5	VSEC	24CS01PR0203	Computer Workshop–II Lab	0	2	1	25	25	50	-
6	PCC	24CS01TH0204	Operating Systems	3	0	3	50	50	100	3
7	PCC	24CS01PR0204	Operating Systems Lab	0	2	1	25	25	50	-
8	BSC	24HS03TH0213	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	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 Digital Photography	0	2	1	25	25	50	-
5	24HS02PR0206-05	Art of Theatre	0	2	1	25	25	50	-
6	24HS02PR0206-06	Introduction to French Language	0	2	1	25	25	50	-
7	24HS02PR0206-07	Introduction to Spanish Language	0	2	1	25	25	50	-
8	24HS02PR0206-08	Art of Painting	0	2	1	25	25	50	-
9	24HS02PR0206-09	Art of Drawing	0	2	1	25	25	50	-
10	24HS02PR0206-10	Nature Camp	0	2	1	25	25	50	-
11	24HS02PR0206-11	Developing Self-awareness	0	2	1	25	25	50	-
12	24HS02PR0206-12	Art of Poetry	0	2	1	25	25	50	-
13	24HS02PR0206-13	Creative and content writing	0	2	1	25	25	50	-
14	24HS02PR0206-14	Science of life through Bhagwad Gita	0	2	1	25	25	50	-
15	24HS02PR0206-15	Sanskrit Sambhashan	0	2	1	25	25	50	-

		Spoken Sanskrit							
16	24HS02PR0206-16	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	24CS04TH0301	Theory of Computation	3	0	3	50	50	100	3
2	PCC	24CS04TH0302	Database Management System	3	0	3	50	50	100	3
3	PCC	24CS04PR0302	Database Management System Lab	0	2	1	25	25	50	-
4	VSEC	24CS04PR0303	Data Handling and Visualization Lab	0	4	2	25	25	50	-
5	PCC	24CS04TH0304	Artificial Intelligence	3	0	3	50	50	100	3
6	PCC	24CS04PR0304	Artificial Intelligence Lab	0	2	1	25	25	50	-
7	BSC	24HS03TH0301	Discrete Mathematics	3	0	3	50	50	100	3
8	OE	24CSOEC01TH0305	Open Elective-I	2	0	2	50	50	100	2
9	MDM	24CS04TH0305	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	24CS04TH0401	Compiler Design	3	0	3	50	50	100	3
2	PCC	24CS04TH0402	Design and Analysis of Algorithms	3	0	3	50	50	100	3
3	PCC	24CS04PR0402	Design and Analysis of Algorithms Lab	0	2	1	25	25	50	-
4	PCC	24CS04TH0403	Machine Learning for Data Analytics	3	0	3	50	50	100	3

5	PCC	24CS04PR0403	Machine Learning for Data Analytics Lab	0	2	1	25	25	50	-
6	VSEC	24CS04PR0404	Statistical Programming Lab	0	4	2	25	25	50	-
7	OE	24CSOEC01TH0405	Open Elective-II	2	0	2	50	50	100	2
8	CEP	24CS04PR0405	Community Engagement Project	0	4	2	25	25	50	-
9	VEC	24CS04TH0406	Creativity, Innovation & Design Thinking	2	0	2	50	-	50	-
10	AEC	24CS04PR0407	Basic Competitive Coding	0	2	1	50	-	50	-
11	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	24CS04TH0501	Data Warehousing and Mining	3	0	3	50	50	100	3
2	PCC	24CS04PR0501	Data Warehousing and Mining Lab	0	2	1	25	25	50	-
3	PCC	24CS04TH0502	Software Engineering and Project Management	3	0	3	50	50	100	3
4	PCC	24CS04PR0502	Software Engineering and Project Management Lab	0	2	1	25	25	50	-
5	PCC	24CS04TH0503	Cloud Technologies for Data Analytics	3	0	3	50	50	100	3
6	PCC	24CS04PR0503	Cloud Technologies for Data Analytics Lab	0	2	1	25	25	50	-
7	PCC	24CS04PR0504	Data Science Tools Lab	0	4	2	50	-	50	-
8	EEM	24CS04PR0505	Idea Lab	0	2	1	25	25	50	-
9	PEC	24CS04TH0506	Program Elective-I	3	0	3	50	50	100	3
10	OE	24CSOEC01TH0505	Open Elective-III	2	0	2	50	50	100	2
11	MDM		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	24CS04TH0601	NoSQL Databases	3	0	3	50	50	100	3
2	PCC	24CS04PR0601	NoSQL Databases Lab	0	2	1	25	25	50	-
3	PCC	24CS04TH0602	Deep Learning-I	3	0	3	50	50	100	3
4	PCC	24CS04PR0602	Deep Learning-I Lab	0	2	1	25	25	50	-
5	PEC	24CS04TH0603	Program Elective –II	3	0	3	50	50	100	3
6	PEC	24CS04TH0604	Program Elective –III	3	0	3	50	50	100	3
7	PCC	24CS04PR0605	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	24CS04PR0606	Mini Project	0	4	2	25	25	50	-
11	AEC	24CS04PR0607	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	24CS04TH0701	Big Data Analytics	3	0	3	50	50	100	3
2	PCC	24CS04PR0701	Big Data Analytics Lab	0	2	1	25	25	50	-
3	PCC	24CS04TH0702	Deep Learning-II	3	0	3	50	50	100	3
4	PCC	24CS04PR0702	Deep Learning-II Lab	0	2	1	25	25	50	-
5	PEC	24CS04TH0703	Program Elective-IV	3	0	3	50	50	100	3
6	PCC	24CS04TH0704	Data Privacy	2	0	2	50	50	100	2
7	PRJ	24CS04PR0705	Major Project-I	0	8	4	50	50	100	-
8	AEC	24CS04PR0706	Participative Learning	0	2	1	50	-	50	-
9	INTR	24CS04PR0707	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	24CS04TH0801	Program Elective-V	3	0	3	50	50	100	3
2.	PEC	24CS04TH0802	Program Elective-VI	3	0	3	50	50	100	3
3.	PRJ	24CS04PR0803	Major Project-II	0	12	6	50	50	100	-
			TOTAL	6	12	12	-	-	300	-
OR										
							Continuous Evaluation	Industry Evaluation	Total	
1.	INTR	24CS04PR0804	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]
Computer Vision	Computer Networks	Natural Language Processing	Information Retrieval	Blockchain Technology	Human Computer Interaction
Design Patterns	Business and Web Analytics	Introduction to DevOps	Healthcare Analytics	Multi-modal Data Processing	Optimization for Data Science
Mobile Application Development	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
[Data Science & Analytics]

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

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

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

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

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

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

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

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

Text Books:

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

Reference Books

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

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

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

Text Books:

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

Reference Books

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

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

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
[Data Science & Analytics]

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 using CSS and Bootstrap.
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
[Data Science & Analytics]

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
[Data Science & Analytics]

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 [Data Science & Analytics]

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

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

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

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

Unit IV: (8 Lectures)

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

Unit V: (7 Lectures):

Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for

goodness of fit and independence of attributes, maximum likelihood estimation

Text Books:

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

Reference Books:

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

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

Course Code: 24HS03PR0101 **Course: Computational Mathematics Lab for CSE**

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

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

Course Outcomes:

By using open source software Students will be able to

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
[Data Science & Analytics]

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:

CO1: Develop a holistic perspective of life

CO2: Better understanding of inter-personal relationships and relationship with society and nature.

CO3: An ability to strengthen self-reflection

Syllabus

Unit 1:- Aspirations and concerns **5 hours**

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 **4 hours**

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

Unit 3:- Relationships and Society **5 hours**

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

Text book

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

Reference books:

1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

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

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.

Unit I: Basic Quantum Theory

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

Unit II: Complex Vector Spaces

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

Unit III: Linear Algebra in Quantum Computing

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

Unit IV: Classical and Quantum Systems

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

Unit V: Quantum representation of systems

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

Unit VI: Architecture and Algorithms

Bits and Qubits, Classical Gates and their equivalent quantum representation, Reversible Gates: CNOT, Toffoli, Fredkin, gates, outline of Pauli X, Y, Z gates, Hadamard gates, Deutsch Gate.

Quantum Algorithms: Deutsch's algorithm, Grover's search algorithm.

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

Text Book

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

Reference Books

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

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

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. Utilize Mathematica software for graph plotting and for least squares fitting of the experimental data.
2. Explore the 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 behavior of Wave packets
3. Understanding the Eigen values, Eigen functions of 1-D Quantum Well.
4. Working with Vectors.
5. Working with Matrices: Real and Complex numbers.
6. Properties of Unitary and Hermitian Matrices, Inner Product, Tensor Product etc.
7. Simulation of Classical gates by Quantum representation of the gates and inputs.
8. Introduction to IBM quantum computer.
9. Simulation of Quantum gates: CNOT gate, Toffoli gate, Fredkin gate, Hadamard gate on IBM quantum computer.
10. Arithmetic operations using IBM Quantum computer.
11. Quantum Half adder and Full adders.

Reference Books

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

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

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

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

Course Objectives

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

Syllabus

Unit I:

Features of Object-Oriented Programming languages, Abstraction, Encapsulation, Inheritance, polymorphism, and late binding. Programming paradigms, Bytecode, JDK, JRE, JVM.

Concept of a class and object, ways of representing objects, access specifiers, constructors and methods, constructor overloading

Unit II:

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

Unit III:

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

Unit IV:

Exceptions: Types of exception, use of try-catch block, handling multiple exceptions, using finally, throw and throws clause, user-defined exceptions.

Introduction to streams, byte streams, character streams, file handling in Java, Serialization.

Unit V:

Generics: type-safety, generic class with two type parameters, bounded generics, wildcard, and generic method.

Collection classes: Arraylist, TreeSet, HashMap, Iterator, ListIterator, Collections class, Comparator, Comparable

Introduction to Design Patterns, Need of Design Pattern, Classification of Design Patterns, Role of Design Pattern in Software design, Creational Patterns, Structural Design Patterns and Behavioral Patterns.

Course Outcomes:

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

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

Text Books

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

Reference Books

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

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

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

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

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

Course Objectives

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

Course Outcomes:

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

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

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

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

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

Course Objectives

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

SYLLABUS

UNIT-I: Data Structures and Algorithm Basics

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

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

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

UNIT-II: Stacks and Queues

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

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

UNIT-III: Linked Lists

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

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

UNIT-IV: Trees

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

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

UNIT-V: Sorting, Searching

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

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

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

Course Outcomes:

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

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

Text Books

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

Reference Books

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

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

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.

Text Books

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

Reference Books

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

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

Course Code: 24CS01PR0203	**Course: Computer Workshop-II Lab**
L: 0 Hrs, 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

Syllabus:

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

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

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

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 [Data Science & Analytics]

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

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

Course Objectives

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

Syllabus

Unit I:

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

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

Unit II:

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

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

Unit III:

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

Unit IV:

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

Virtual Memory: Concept of Virtual Memory, Instruction Interruptibility, Locality of reference, Demand paging: Page fault, Dirty bit, valid-invalid bit, Page Replacement algorithms: First in First Out, Optimal, Least

Recently used, LRU approximation algorithms, counting based page replacement, Page Buffering algorithms, Local Vs Global algorithms, Thrashing, Page allocation strategies to overcome trashing: Working set model and Page Fault Frequency

Unit V:

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

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

Course Outcomes:

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

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

Text Books

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

Reference Books:

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

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

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

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

Course Objectives

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

Course Outcomes:

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

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

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

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

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

Course Objective

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

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

Unit I: (8 Lectures)

Differential Calculus: Functions of univariate, Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem, Taylor's theorem, Taylor's and Maclaurin series.

Unit II: (10 Lectures)

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

Unit III: (8 Lectures)

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

Unit IV: (8 Lectures)

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

Unit V: (6 Lectures)

Infinite series: Sequences, Infinite series of real and complex numbers, Cauchy criterion, tests of convergence, absolute and conditional convergence, uniform convergence, power series, radius of convergence.

Text / References Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Volume I & II, Pune, Vidhyarthi Griha Prakashan, Pune-411030 (India).

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

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 an understanding about the foundation of Vedic Mathematics.

Syllabus

Unit I: Overview of Indian Knowledge System:

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

Unit II: The Vedic corpus:

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

Unit III: Indian Philosophical systems:

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

Unit IV: Vedic Maths -1

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

Unit -V: Vedic Maths – 2

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

Reference Books

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

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

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**:**

CO1: Implement essential language skills- listening, speaking, reading, and writing
CO2: Demonstrate the techniques of effective Presentation Skills
CO3: Evaluate and apply the effective strategies for Group Discussions and Personal Interviews
CO4: Effectively implement the comprehensive principles of written communication

Syllabus

Professional Communication-1

Practical 1: Speaking Skills

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

Practical 2: Listening Skills

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

Practical 3: Reading

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

Professional Communication-2

Practical 4: Presentation Skills: Orientation & Mock Session

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

Practical 5: **Presentation Skills: Practice**

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

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

Practical 7: Group Discussions and Personal Interview: Practice

Professional Communication-3

Practical 8: Writing Practices- 1
This practical will cover the following topics: Vocabulary building, Grammar and mechanics

Practical 9: Writing Practices-2
This practical will cover the following topics: Sentence and paragraph structures, Note-making

Practical 10: Writing Practices- 3
This practical will cover the following topics: Academic Correspondence

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
[Data Science & Analytics]

Course Code :24HS04PR0101 **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.

Course Content:

Unit I:

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

Unit II:

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

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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
[Data Science & Analytics]

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

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

Syllabus:

Unit I: Sustainability Engineering

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

Unit II: E-Waste and Green Computing

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

Text Books:

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

Reference Books:

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

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

Course Code: 24HS01PR0101 **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
[Data Science & Analytics]

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

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

Liberal/Performing arts basket

Sr. No.	Course Code	Course Name	Sem	Hours/week	Credits	Maximum marks	
						Learning Assessment 1	Learning Assessment 2
1	24HS02PR0206-01	Fundamentals of Indian Classical Dance: Bharatnatyam	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	0	2	1	25	25
12	24HS02PR0206-12	Art of Poetry	0	2	1	25	25
13	24HS02PR0206-13	Creative and content writing	0	2	1	25	25
14	24HS02PR0206-14	Science of life through Bhagwad Gita	0	2	1	25	25
15	24HS02PR0206-15	Sanskrit Sambhashan Spoken Sanskrit	0	2	1	25	25
16	24HS02PR0206-16	Kirtan Kala	0	2	1	25	25
17	24HS04PR0202-1		0	2	1	25	25

		Adventure Sports					
18	24HS04PR0202-2	Introduction to Defense Forces & Obstacle Training	0	2	1	25	25
19	24HS04PR0202-3	Self Defense and Indian Martial Arts	0	2	1	25	25
20	24HS04PR0202-4	Basic Nutritional Course	0	2	1	25	25

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

Course Code: 24HS02PR0206-01 Course: Fundamentals of Indian Classical Dance: Bharatnatyam
L: 00 Hrs, T: 0 Hr, P: 2 Hrs, Per Week Total Credits: 01

Course objective

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

Course Outcomes

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

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

Syllabus

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

Recommended Reading

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

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

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:
CO1: Understand the importance of dance and Kathak as an Indian dance form
CO2: Develop skills to perform the dance form at its basic level.
CO3: Evaluate their strengths and interest to take bridge course to give *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 counts (Bhramari),
Practical -2: practice sessions of practical 1
Practical -3: Hastaks, Hastaks and Steppings, Reciting asamyukta Mudra shloka, Hastak and steppings
Practical -4: practice sessions of practical 3
Practical -5: Todas and Asamyukta hasta mudra shlok, Vandana of Shlok, 2 Todas and Vandana, Ghante Ki Tihai,
Practical -6: practice sessions of practical 5
Practical -7: 2 1 Chakkardar Toda and Ginnti Ki Tihai, 2 Todas and 1 Chakkardar Toda, practice sessions
Practical -8: Final performances.

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
[Data Science & Analytics]

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:
CO1: Develop an understanding of the technical aspects and aesthetics of Photography.
CO2: Apply the rules of digital photography for creating photographs.
CO3: Develop skills to enhance photographs through post processing.
CO4: 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
[Data Science & Analytics]

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:
CO1: Basic understanding about Japan as a country and Japanese culture.
CO2: Ability to use vocabulary required for basic level communication in Japanese language.
CO3: 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
[Data Science & Analytics]

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:
CO1: Understand and synthesize the working of the prominent genres of theatre across the world.
CO2: Apply the skill of voice and speech in theatre and public speaking
CO3: 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.
CO4: 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
[Data Science & Analytics]

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:
CO1. Demonstrate basic knowledge about France, the culture and similarities/differences between India and France
CO2. Learn to use simple language structures in everyday communication.
CO3. Develop ability to write in basic French about themselves and others.
CO4. Develop ability to understand beginner level texts in French

Syllabus
List of Practical's

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

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
[Data Science & Analytics]

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:
CO1. Demonstrate basic knowledge about Spain, the culture and similarities/differences between India and France
CO2. Learn to use simple language structures in everyday communication.
CO3. Develop ability to write in basic Spanish about themselves and others.
CO4. 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
[Data Science & Analytics]

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:
CO1: Become familiar with the basic methods, techniques & tools of painting.
CO2: Train the eye and hand to develop sense of balance, proportion and rhythm.
CO3: Develop the ability to observe and render simple natural forms.
CO4: 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
[Data Science & Analytics]

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:
CO1: Become familiar with the basic methods, techniques & tools of drawing.
CO2: Train the eye and hand to develop sense of balance, proportion and rhythm.
CO3: Develop the ability to observe and render simple natural forms.
CO4: 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
[Data Science & Analytics]

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:
CO1: Develop an affinity with nature by observing and understanding it marvels with guidance from experts
CO2: 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
[Data Science & Analytics]

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:

CO1: Gain foundational understanding of graphology and through self-analysis will achieve greater awareness about their strengths and weaknesses & areas for personal growth
CO2: students will be equipped with tools and techniques for continuous self-improvement, using signature analysis and graphotherapy as part of their personal development journey
CO3: understand how to use Neuro Linguistic Programming (NLP) strategies to set and achieve goals effectively, overcoming mental blocks and limiting beliefs.
CO4: 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
[Data Science & Analytics]

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:
CO1: Understand the origin and development of poetry
CO2: Appreciate the art of poetry in life
CO3: Develop aesthetic sense
CO4: 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
[Data Science & Analytics]

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:

CO1: Understand and apply fundamental concepts and techniques of creative writing.
CO2: Apply storytelling techniques to create engaging narratives.
CO3: Develop and implement effective SEO and digital content strategies
CO4: Create and refine content using various tools and applying diverse writing styles and formats.
CO5: 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
[Data Science & Analytics]

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

CO1: To understand the methodology to correctly interpret and analysis the scripture
CO2: To understand the application of various teaching of the Bhagwad Gita
CO3: 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
[Data Science & Analytics]

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:
CO1: Enhanced writing skills in Sanskrit
CO2: Enhanced speaking skills in Sanskrit
CO3: Enhanced listening skills in Sanskrit
CO4: 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। (काचित् कथा सरलया भाषया वक्तव्या)।
- रटनाभ्यासः (पूर्वमेव लिखितानि पठितानि च कानिचित् वाक्यानि वाचनीयानि)।
- एकं वाक्यम् (प्रत्येकं छात्रः एकं वाक्यं वदेत्।)
- सूचना।
- ऐक्यमत्यः।

द्वितीयं दिनम्

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

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।
- अन्ते।
- 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
[Data Science & Analytics]

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:
CO1: Learn from the inspiring spiritual journey of the saints and the history of Kirtan tradition
CO2: Learn about the musical instruments used in the art of Kirtan
CO3: 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
[Data Science & Analytics]

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
[Data Science & Analytics]

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:

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

Syllabus:

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

Pattern of Classes: 2 Days and 1 Night Camp

Course Outcome:

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

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

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

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:

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

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

Course Code: 24HS04PR0202-4 **Course Name: Basic Nutritional Course**
L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per Week **Total Credits: 01**

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

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

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

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

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

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

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

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

[Data Science & Analytics]

Course Code: 24CS04TH0301 **Course: Theory of Computation**

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

Course Objectives

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

Syllabus

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

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

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

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

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

Course Outcomes:

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

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

Text Books

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

Reference Books

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

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

[Data Science & Analytics]

Course Code: 24CS04TH0302 **Course: Database Management System**
L: 3Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

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 I, B. Tech. Computer Science & Engineering

[Data Science & Analytics]

Course Code: 24CS04PR0302 **Course: Database Management System Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week **Total Credits: 1**

Course Objectives

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

SYLLABUS

Practical will be conducted based on 24CS04TH0302

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

[Data Science & Analytics]

Course Code: 24CS04PR0303 **Course: Data Handling and Visualization Lab**
L: 0 Hrs, T: 0 Hr, P: 4 Hr, Per Week **Total Credits: 2**

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 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

[Data Science & Analytics]

Course Code: 24CS04TH0304 **Course: Artificial Intelligence**
L: 3 Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

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 and Reference Books:

Text Books:

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

Reference Books:

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

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

[Data Science & Analytics]

Course Code: 24CS04PR0304 **Course: Artificial Intelligence Lab**
L: 0 Hrs, T: 0 Hr, P: 2 Hr, Per Week **Total Credits: 1**

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 and Reference Books:

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 III, B. Tech. Computer Science & Engineering

[Data Science & Analytics]

Course Code: 24HS03TH0301 **Course: Discrete Mathematics**
L: 3 Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

Course Objective

The objective of this course is to expose students 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, students shall be able to:

1. Explore advanced topics such as recurrence relations, generating functions, and their use in solving combinatorial problems.
2. Apply modular arithmetic to cryptography and coding theory.
3. Understand the fundamental concepts of propositional and predicate logic, including syntax, semantics, and 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 and 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
- Prime numbers
- Fermat’s theorem
- Euler’s theorem
- Diophantine equations
- Linear congruences
- Chinese Remainder theorem

- Applications to Cryptography

Module 3 (7 Lectures)

Mathematical Logic

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

Module 4 (8 Lectures)

Groups

- Group definitions and examples
- Cyclic groups
- Permutation groups
- Subgroups and homomorphism
- Cosets
- Lagrange's theorem

Module 5 (7 Lectures)

Lattice Theory

- Lattices as partially ordered sets
- Properties of lattices
- Algebraic systems
- Direct product
- Complemented lattice
- Distributive lattices

Text Books

1. Discrete Mathematical Structures with Applications to Computer Science — J. P. Tremblay and R. Manohar, Tata McGraw-Hill, 3rd Edition.
2. Combinatorial Mathematics — C. L. Liu & D. P. Mohapatra, Tata McGraw-Hill, Seventh Edition, 2014.
3. Elementary Number Theory — David M. Burton.

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

[Data Science & Analytics]

Course Code: 24CS04TH0401 **Course: Compiler Design**
L: 3 Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

Course Objectives

The main objective of this course is to introduce the fundamental concepts of compiler design and language translation. It aims to develop an understanding of the structure, function, and complexity of modern compilers. The students will learn the various phases of compilation with practical implementation using compiler writing tools.

Syllabus

UNIT I:
Introduction to Compilers, Phases of Compiler, Relating Compilation Phases with Formal Systems, Lexical Analysis, tokens, pattern and lexemes, Design of Lexical analyser, Regular Expression, transition diagram, recognition of tokens, Lexical Errors.

UNIT II:
Syntax Analysis- Specification of syntax of programming languages using CFG, Top-down parser, design of LL (1) parser, bottom-up parsing technique, LR parsing, Design of SLR, CLR, LALR parsers, Handling Ambiguous Grammars, Applications of the LR Parser.

UNIT III:
Syntax directed translation- Study of syntax directed definitions & syntax directed translation schemes, Type and Type Checking, Implementation of SDTS, Intermediate notations, translation of Assignment Statement, controls structures, Array reference.

UNIT IV:
Code optimization- machine independent Optimisation, Local optimization techniques, loop optimization-control flow analysis, data flow analysis, Loop invariant computation, Induction variable removal, other loop optimization techniques, Machine-dependent Optimization techniques. Code generation- Problems in code generation, Simple code generator, code generation using labelling algorithm, code generation using gencode algorithm

UNIT V:
Storage allocation & Error Handling- Run time storage administration, stack allocation, Activation of Procedures, Storage Allocation Strategies, Garbage Collection, symbol table management,
Error handling, Error detection and recovery- lexical, syntactic and semantic, Error recovery in LL & LR Parser

Course Outcomes:

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

1. Exhibit role of various phases of compilation, with understanding of types of grammars and design complexity of compiler.
2. Design various types of parses and perform operations like string parsing and error handling.
3. Demonstrate syntax directed translation schemes, their implementation for different programming language constructs.
4. Implement different code optimization and code generation techniques using standard data structures.

Text Books

1. Aho, Sethi, and Ullman; Compilers Principles Techniques and Tools; Second Edition, Pearson education, 2008.
2. Alfred V. Ahoand Jeffery D. Ullman; Principles of Compiler Design; NarosaPub.House, 1977.
3. VinuV. Das; Compiler Design using Flex and Yacc; PHI Publication, 2008.
4. Manoj B Chandak, Khushboo P Khurana; Compiler Design; Universities Press, 2018.

Reference Books

1. Vinu V. Das; Compiler Design using Flex and Yacc; PHI Publication
2. V. Raghavan; Principles of Compiler Design, McGraw Hill Education (India)

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

[Data Science & Analytics]

Course Code: 24CS04TH0402 **Course: Design and Analysis of Algorithms**
L: 3 Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

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
[Data Science & Analytics]

Course Code: 24CS04PR0402 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.
4. 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

[Data Science & Analytics]

Course Code: 24CS04TH0403 **Course: Machine Learning for Data Analytics**
L: 3 Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 3**

Course Objectives

1. To introduce fundamental concepts and techniques of Machine Learning and their relevance in data- driven decision making and analytics.
2. To develop ability in preprocessing and transforming data, including data cleaning, feature selection, and dimensionality reduction, to enhance model performance.
3. To enable students to design, implement, and evaluate supervised and unsupervised machine learning algorithms using real-world datasets and Python-based tools.
4. To explore ensemble methods and model optimization techniques to improve prediction accuracy and model generalization.

Syllabus

Unit I

Introduction to Machine Learning and Data Analytics: What is Machine Learning? Relation to AI and Data Science, Types of Learning: Supervised, Unsupervised, Reinforcement, Overview of Data Analytics: Descriptive, Predictive, Prescriptive, Steps in a Machine Learning Pipeline, Applications in various domains such as healthcare, finance, marketing.

Unit II

Data Preprocessing and Exploration: Need for Data Preprocessing, Data types, data quality, and data formats, Data Cleaning: Missing values, outliers, duplicate handling, Exploratory Data Analysis (EDA): Descriptive statistics, visualizations, Data Transformation: Normalization, Standardization, Encoding, Feature Engineering: Feature extraction and feature selection.

Unit III

Supervised Learning Algorithms: Regression Techniques: Linear Regression, Classification Techniques: Logistic Regression, K-Nearest Neighbors, Decision Trees and Random Forests, Support Vector Machines (SVM), ANN, Model Evaluation: Confusion Matrix, Accuracy, Precision, Recall, F1 Score, ROC-AUC.

Unit IV

Unsupervised Learning and Pattern Discovery:

Clustering Techniques: K-Means, Hierarchical Clustering, DBSCAN, Association Rule Mining: Apriori Algorithm, FP-Growth, Evaluation of clustering results.

Unit V

Ensemble Learning and Model Optimization:

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

Course Outcomes:

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

- Preprocess raw data using techniques such as data cleaning, feature engineering, and dimensionality reduction.
- Apply supervised learning algorithms such as regression, decision trees, and SVM to solve classification and prediction problems.
- Apply unsupervised learning techniques including clustering and association rule mining to discover hidden patterns in data.
- Analyze machine learning models using cross-validation, hyperparameter tuning, and ensemble methods.

Text Books:

Tom M. Mitchell – *Machine Learning*, McGraw Hill

Christopher M. Bishop – *Pattern Recognition and Machine Learning*, Springer

Sebastian Raschka & Vahid Mirjalili – *Python Machine Learning*, Packt

Reference Books:

Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press

Andreas Müller & Sarah Guido, Introduction to Machine Learning with Python, O'Reilly

Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

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

[Data Science & Analytics]

Course Code: 24CS04PR0403 **Course: Machine Learning for Data Analytics**
Lab L: 0 Hrs, T: 0 Hr, P: 2Hr, Per Week **Total Credits: 1**

Course Objectives

1. To introduce fundamental concepts and techniques of Machine Learning and their relevance in data-driven decision making and analytics.
2. To develop ability in preprocessing and transforming data, including data cleaning, feature selection, and dimensionality reduction, to enhance model performance.
3. To enable students to design, implement, and evaluate supervised and unsupervised machine learning algorithms using real-world datasets and Python-based tools.
4. To explore ensemble methods and model optimization techniques to improve prediction accuracy and model generalization.

Syllabus: Based on the syllabus of 24CS04TH0403

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

[Data Science & Analytics]

Course Code: 24CS04PR0404 **Course: Statistical Programming Lab**
L: 0 Hrs, T: 0 Hr, P: 4Hr, Per Week **Total Credits: 2**

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

Syllabus

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

- Introduction to different statistical tools and packages
- Reading and writing different types of datasets
- 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.
4. Create regression models.

Reference Books

1. An Introduction to Statistics with Python: With Applications in the Life Science by Thomas Haslwanter, Springer.
2. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce, Peter Gedeck, Reilly Media.

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

[Data Science & Analytics]

Course Code: 24CS04PR0405 **Course: Community Engagement Project**
L: 0 Hrs, T: 0 Hr, P: 4Hr, Per Week **Total Credits: 2**

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

[Data Science & Analytics]

Course Code: 24CS04TH0406 **Course: Creativity, Innovation & Design Thinking**
L: 2 Hrs, T: 0 Hr, P: 0Hr, Per Week **Total Credits: 2**

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 ofn most creative personalities.

Unit II

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

Unit III

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

Unit IV

Innovation: Meaning and Importance — Difference with Creativity, Invention and Discovery Process, Nine lessons for Innovation, Design Thinking: Understanding the design thinking approach, Human centered design, Case Studies on Innovation business ideas like Amazon, Swiggy, Red bus, Flip fart, Ola, Big Basket, methods and techniques — organizational Aspects, Economic Aspects like venture capital, angel investors, Evaluation of Effectiveness of Innovation

Unit V

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

Course Outcomes:

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

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

Text Books 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. DSA (Data Science and Analytics)

Course Code: 24CS04TH0501 **Course: Data Warehousing and Mining**

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

Objectives

1. Understand and implement techniques for preprocessing of classical data models and algorithms in data warehouses and data mining
2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
3. Master data mining techniques in various applications like social, scientific and environmental context

Syllabus

Unit I

Introduction to Data Warehouse, Data Warehouse basic Concepts, Architecture of Data Warehouse, Dimensional modelling: dimensions and facts, Star and Snowflake schema, pros & cons of the Star / Snowflake schema, Types of dimension and facts. and OLAP OLTP integration– comparison of OLAP with OLTP systems, ROLAP, MOLAP and HOLAP, Multidimensional modelling, Data Cube, Data Cube Computation methods, Advanced SQL support for OLAP

Unit II

Basics of data preprocessing, concepts of data integration and data transformation, data reduction, data summarization, introduction to data quality, data profiling concepts and applications. Extraction, Transformation, and Load. Data Cleaning methods, Descriptive Data Summarization, Data Reduction, Data Discretization, Data partitions, and Concept hierarchy generation

Unit III

Space Management in Data warehouse. Schemas for storing data in warehouse using different storage structures, B-tree index, hash index, clusters, Bitmap index functional index, domain index.

Unit IV

Introduction: - What is Data mining? Data Mining on what kind of data, Data mining Functionalities, Classification of Data Mining Systems, Major Issues on Data mining, KDD Process, Market Basket Analysis, Classification and Prediction: - Classification by Back propagation, A Multilayer Feed-Forward Neural Network, Support Vector Machines, Genetic Algorithms, Techniques to Improve Classification Accuracy.

Unit V

Clustering: Measuring Data Similarity and Dissimilarity Partition based Clustering, k-Means, k-Medoids, Hierarchical based clustering, BIRCH, Chameleon, Density based clustering, OPTICS, DENCLUE, Grid-Based Clustering, STING, CLIQUE, Outlier Detection.

Course Outcomes:

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

1. Use the fundamental theories and concepts of data warehousing in real life application.
2. Apply multi-dimensional modeling techniques in designing data warehouses and learn the process of data cleaning and pre-processing for mining applications.
3. Use the principles of data mining for designing data mining applications and apply different methods and techniques involved in data mining.
4. Distinguish problems related to classification and clustering and evaluate accuracy of various classification and clustering algorithms.

Textbooks

1. Jaiwei Han and Micheline Kamber; Data Mining Concepts and Techniques; 2 edition; Morgan Kaufmann Publishers, 2006.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

Reference Books

1. Tang and MacLennan, Data Mining with SQL Server 2005, Wiley Publishing, 2005
2. Data Warehousing and Fundamentals by Paulraj Ponniah, A Wiley-Interscience Publication
3. Margaret H Dunham, “Data Mining Introductory and advanced topics”, 6th Edition, Pearson Education, 2009.
4. Arun KPujari, “Data Mining Techniques”,1st Edition, University Press, 2005

Syllabus for Semester V, B. Tech. DSA (Data Science and Analytics)

Course Code: 24CS04PR0501 Course: Data Warehousing and Mining Lab

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

Course Objectives

1. Understand and implement techniques for preprocessing of classical data models and algorithms in data warehouses and data mining
2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
3. Master data mining techniques in various applications like social, scientific and environmental context

Syllabus

Practical's based on 24CS04TH0501

Course Outcomes:

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

1. Use the fundamental theories and concepts of data warehousing in real life application.
2. Apply multi-dimensional modeling techniques in designing data warehouses and learn the process of data cleaning and pre-processing for mining applications.
3. Use the principles of data mining for designing data mining applications and apply different methods and techniques involved in data mining.
4. Distinguish problems related to classification and clustering and evaluate accuracy of various classification and clustering algorithms.

Textbooks

1. Jaiwei Han and Micheline Kamber; Data Mining Concepts and Techniques; 2 edition; Morgan Kaufmann Publishers, 2006.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.

Reference Books

1. Tang and MacLennan, Data Mining with SQL Server 2005, Wiley Publishing, 2005
2. Data Warehousing and Fundamentals by Paulraj Ponniah, A Wiley-Interscience Publication
3. Margaret H Dunham, "Data Mining Introductory and advanced topics", 6th Edition, Pearson Education, 2009.
4. Arun KPujari, "Data Mining Techniques",1st Edition, University Press, 2005

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Data Science and Analytics)

Course Code: 24CS04TH0502 **Course: Software Engineering and Project Management**

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 structured and object-oriented 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 evaluate and design project execution strategies to ensure successful and sustainable software delivery.

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 - Software Quality Framework, Quality Attributes; Software Effort Estimation - Albrecht Function Point Analysis, Cost Estimation - COCOMO Model; CMMI Maturity Levels, ISO 9001
Product Metrics - Metrics for Analysis & Design Models, Metrics for Source Code, Defect Metrics; Process & Project Metrics, Software Measurement.

Unit – IV:

Agile Project Management Methods; People & Team Management: Team Structures, Responsibility Assignment Matrix (RAM), Conflict Resolution, Motivation & Leadership; Stakeholder Management: Stakeholder Identification & Analysis, Communication Plans,

Reporting & Escalation; Project Procurement & Outsourcing: Make-or-Buy Decision, Vendor Selection, Contract Types, Service Level Agreement (SLA) Management; Project Management Tools; Project Governance & Closure; Software Project Economics.

Unit -V:

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; Software Quality Assurance (SQA), Software Configuration Management (SCM); Risk Management, Risk Strategies; Software Reengineering Process, Reverse Engineering, 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. Rajib Mall; Fundamentals of Software Engineering; 5th Edition, PHI Learning, 2018.
3. Ian Somerville; Software Engineering; Seventh Edition; Pearson Education. 2008.

Reference Books

1. Rajib Mall; Software Project Management, 5th Edition, McGrawHill
2. Pankaj Jalote; An Integrated Approach to Software Engineering; Third Edition, Springer, 2005.
3. David Gustafsan; Software Engineering; Schaum's Series, Tata McGraw Hill,2002.

Syllabus for Semester V, B. Tech. Computer Science & Engineering
(Data Science and Analytics)

Course Code: 24CS04PR0502 **Course: Software Engineering and Project Management Lab**

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

Course Objectives

- To construct software requirement and design models using CASE tools for given problem statements.
- To apply effort estimation and cost modelling techniques and construct project schedules
- To simulate software project lifecycle stages using an Agile framework.
- To configure and use project management for task tracking, issue management, stakeholder communication plans, and SCM workflows
- To design project economics and assess software maintenance and reengineering strategies for legacy systems.

Syllabus

Practicals based on syllabus of 24CS04TH0502

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. Rajib Mall; Fundamentals of Software Engineering; 5th Edition, PHI Learning, 2018.
3. Ian Somerville; Software Engineering; Seventh Edition; Pearson Education. 2008.

Reference Books

1. Rajib Mall; Software Project Management, 5th Edition, McGrawHill
2. Pankaj Jalote; An Integrated Approach to Software Engineering; Third Edition, Springer, 2005.
3. David Gustafsan; Software Engineering; Schaum's Series, Tata McGraw Hill,2002

Syllabus for Semester V, B. Tech. DSA (Data Science and Analytics)

Course Code: 24CS04TH0503 **Course:** Cloud Technologies for Data Analytics

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

Course Objectives:

1. Understand virtualization and containerization technologies used in cloud environments.
2. Explain and apply cloud architecture principles and service models.
3. Design and configure secure cloud networking and infrastructure.
4. Use AWS services for deploying applications and managing data.
5. Develop and evaluate scalable cloud-based application solutions.
6. Build strong foundations in cloud-based data analytics using AWS

Course Outcomes:

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

1. Explain virtualization and container technologies in cloud computing.
2. Explain cloud computing concepts, AWS architecture, and data analytics lifecycle.
3. Implement cloud networking and security configurations.
4. Analyze and select appropriate data storage solutions (data lakes, warehouses, and databases) on AWS.
5. Deploy and manage applications using AWS cloud platform

Syllabus:

UNIT 1: Virtualization & Containerization

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

UNIT II: Foundations of Cloud & Analytics

Introduction to cloud computing. Cloud service models: IaaS, PaaS, and SaaS. Deployment models: public, private, hybrid, and community cloud. Cloud architecture principles: scalability, high availability, fault tolerance, and elasticity. AWS global infrastructure: regions, availability zones, and edge locations. Basics of data analytics: types and lifecycle. Data analytics architecture on AWS. Cloud migration. Shared responsibility model.

UNIT III: Cloud Networking, Security & Costing

IP addressing concepts. Cloud networking: Virtual Private Cloud (VPC), subnets, and CIDR. Internet Gateway and NAT Gateway. Cloud security: Identity and Access Management (IAM), security groups, and network ACLs. Data security basics. Costing: pay-as-you-go pricing, total

cost of ownership (TCO), and cost optimization basics.

UNIT IV: Core Cloud Services

Compute services: AWS EC2 and Azure Virtual Machines. Virtual machine configuration for Windows and Linux. Remote access: SSH and RDP. Storage services: AWS S3, EBS, EFS, and S3 for data lake. Database services: AWS RDS, DynamoDB, and Redshift for data warehouse. Data types: structured, semi-structured, and unstructured. Data lakes and data warehouses. Data modeling fundamentals.

UNIT V: Cloud Application Deployment, Data Processing & ETL Pipelines

Application deployment in cloud. Hosting web applications on virtual machines. Platform services: Elastic Beanstalk. Load balancing and auto scaling. Infrastructure as Code: CloudFormation and ARM Templates. ETL and ELT concepts. ETL pipeline using AWS Glue. Batch processing and stream processing. AWS Lambda for serverless processing. Data integration and transformation. AWS Step Functions for workflow orchestration.

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.
5. "Data Analytics on AWS" – AWS Training & Certification
6. "Cloud Computing for Data Science" – V. K. Jain

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. "AWS Certified Data Analytics Study Guide" – Richard Maarek
6. "Fundamentals of Data Engineering" – Joe Reis & Matt Housley

Syllabus for Semester V, B. Tech. DSA (Data Science and Analytics)

Course Code: 24CS04PR0503 **Course:** Cloud Technologies for Data Analytics Lab

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

Course Objectives

1. Create and manage virtual machines and container-based environments.
2. Configure cloud networking components (VPC, subnets, gateways).
3. Deploy storage and database services on cloud platforms.
4. Host and manage applications on AWS.
5. Implement serverless and scalable cloud solutions.
6. Build real-world data pipelines

Syllabus

Practical's based on 24CS0TH0503

Course Outcomes

On successful completion of the course, the student will be able to:
1. Configure and manage AWS resources (IAM, EC2, S3) for analytics applications.
2. Design and implement virtual networks in cloud environments, including subnets, IP addressing, and connectivity mechanisms.
3. Deploy and manage applications using AWS cloud platform by utilizing compute, storage, and database services.
4. Implement data storage solutions including data lakes, data warehouses, and databases on AWS.
5. Develop and automate ETL pipelines using AWS Glue, Lambda, and Step Functions.

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

Course Code: 24CS04PR0504 **Course: Data Science Tools Lab**

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

Course Objectives

- Introduce students to advanced data handling tools such as Microsoft Excel, Microsoft Power BI, and Tableau for managing and analysing structured datasets
- Enable students to perform data cleaning, transformation, and manipulation for effective analysis
- Familiarize students with data visualization techniques and dashboard development to derive insights
- Expose students to real-world data science tools and practices for interactive reporting and data-driven decision-making

Syllabus

- Advanced features of Microsoft Excel
- Data visualization and dashboarding using Tableau
- Business intelligence and data modelling using Microsoft Power BI
- Exposure to additional data science tools (not limited to the above)

Course Outcomes

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

1. Understand advanced features of Microsoft Excel for data cleaning, transformation, and automation.
2. Analyze and model data using Microsoft Power BI to generate meaningful insights and reports.
3. Design interactive visualizations and dashboards using Tableau for data-driven decision-making.
4. Apply additional data analytics tools and techniques beyond the core platforms to solve real-world problems.

Text Books

1. Andy Kriebel, “Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software”, Wiley, 2014.
2. Dejan Sarka, “Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics”, Apress, 2020.

Reference Books

1. Cole Nussbaumer Knaflic, “Storytelling with Data: A Data Visualization Guide for Business Professionals”, Wiley, 2015.

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

Course Code: 24CS04PR0505 **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
(Data Science & Analytics)

Course Code: 24CS04TH0506 -1 **Course: Computer Vision**

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

Course Objectives

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

Syallbus

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

Feature extraction: HOG, SIFT, Dimensionality Reduction: PCA, LDA, CNN fundamentals, transfer learning, object detection (YOLO – overview)

Course Outcomes

On successful completion of the course, the student 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 V, B. Tech. Computer Science & Engineering
(Data Science & Analytics)

Course Code: 24CS04TH0506-2 **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
(Data Science & Analytics)

Course Code: 24CS04TH0506 -3 **Course: Mobile Application Development**

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

Course Objectives

- To design and develop Android mobile applications with a focus on user experience, data handling, and background processing.
- To understand and implement core Android components such as Intents, Fragments, and UI elements including ListView and various control widgets.
- To build real-world applications by integrating native hardware features, location-based services, graphics, and multimedia.
- To apply software testing techniques and perform app signing, packaging, and distribution for deployment.

Syllabus

Unit-I

Getting Started with Mobility: Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, setting up the mobile app development environment along with an emulator, a case study on Mobile app development, Building blocks of mobile apps: App user interface designing –mobile UI resources (Layout, UI elements, Drawable, Menu)

Unit -II

Activity-state and life cycle, interaction amongst activities. App functionality beyond user interface – Threads, Async task, Services – States and life cycle, Notification, Broadcast receivers, Telephony and SMS APIs

Unit -III

Working with View Groups, Building data with the AdapterView Class, Designing AutoText Complete View, Implementing Screen Orientation, Designing the views programmatically, Handling UI events, Creating Menus, Intents: Explicit Intents, Implicit intents, Fragments, Web view, List View, Spinner, Alert Dialog, Rating Bar, Seek Bar, Progress Bar

Unit – IV

Sprucing up mobile apps: Graphics and animation – custom views, canvas, animation APIs,

multimedia – audio/video playback and record, location awareness and native hardware access (sensors such as accelerometer and gyroscope), Native data handling: On-device file I/O, shared preferences, Mobile databases such as SQLite, and enterprise data access

Unit -V

Testing of Mobile App: Different levels of testing, different types of testing, Static Testing types, Dynamic Testing types, Debugging mobile apps, Test automation of mobile apps, Taking apps to market, Versioning, signing, and packaging mobile apps, distributing apps on mobile market place, Localization, Prework for publishing app

Course Outcomes

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

1. Design and develop mobile apps using Android as a development platform with a key focus on user experience design, native data handling, and background tasks and notifications
2. Apply the concept of Intent, Fragment, ListView, Progress bar, Seek bar and Rating bar
3. Apply the concepts of native hardware, location awareness, graphics, and multimedia in building real-world applications
4. Apply techniques of software testing and review
5. Perform testing signing, packaging, and distribution of mobile apps

Text Books

1. Android Application Development all in one for Dummies - Barry Burd, 1st Edition, John Wiley and Sons
2. Teach Yourself Android Application Development 24 Hours- Lauren Darcy, 1st Edition, Pearson

Reference Books

1. Mobile Apps Development:Anubhav Pradhan,Anil .Deshpande,1stEdition,WileyIndia
2. Foundations of Software Testing: Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black, 2nd Revised Edition, Cengage Learning

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

Course Code: 24CS04TH0601 **Course: NoSQL 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 VI, B. Tech. Computer Science & Engineering
(Data Science & Analytics)

Course Code: 24CS04PR0601 **Course: NoSQL Databases Lab**

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

Course Objectives

- To explore different NoSQL data models including key-value, document, column-family, and graph models for handling diverse data types.
- 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

Practical's based on syllabus of 24CS04TH0601

Course Outcomes

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

1. Implement key-value and document-oriented database operations for efficient data storage and retrieval.
2. Develop real-time applications using appropriate NoSQL data models.
3. Examine and evaluate column-family database architecture and columnar storage techniques for performance optimization.
4. Design and implement graph-based data models for 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 VI, B. Tech. Computer Science & Engineering
(Data Science & Analytics)

Course Code: 24CS04TH0602 **Course: Deep Learning-I**

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. A. 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
(Data Science & Analytics)

Course Code: 24CS04PR0601 **Course: Deep Learning-I Lab**

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

Course Objectives:

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

Syllabus

Experiments based on **24CS04TH0601**

Course Outcomes:

On completion of the course the student will be able to

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

Text Books:

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

Reference Books:

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

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

Course Code: 24CS04TH0603-1 **Course: Computer Network**

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

Course Objectives

- To Introduce the fundamental concepts of layers in the OSI and TCP/IP models.
- To understand and solve design issues in the different layers of the network.
- To troubleshoot problems in network topologies and examine network and transport layer protocol working.
- To apply applications of AI in computer networks.

Syllabus:

Unit I
Introduction: Network hardware, Network software, Protocol hierarchies, Design issues for layers. The ISO-OSI reference model, TCP/IP model. Physical Layer: Issues, Transmission Impairments, Data Rate Limits, Performance. Bandwidth Utilization: Multiplexing, Transmission Media: Guided and Unguided.

Unit II
Data Link Layer - Design issues, Services, Error Detection and Correction, Data Link Control, Elementary Data Link Layer protocols. Medium Access Sub Layer: Multiple Access Protocols, IEEE standards: Ethernet (802.3), Wireless LAN (802.11).

Unit III
Network Layer: IPv4 Addressing, Datagram forwarding in IP4, Subnetting, CIDR Notation. Address Translation (ARP), Host Configuration (DHCP), Routing algorithms, Introduction to IPv6.

Unit IV
Transport Layer: Elements of Transport protocols: Addressing, Connection establishment, Connection release, User Datagram Protocol (UDP), Transmission Control Protocol (TCP). TCP congestion control. Traffic shaping Leaky Bucket and token bucket algorithm.

Unit V
Application Layer: Domain Name Space (DNS), File Transfer Protocol (FTP), Cryptographic techniques (symmetric/asymmetric encryption), SSL/TLS protocols, Load Balancing Optimization using AI/ML, AI-based Threat Hunting in Network Security.

Course Outcomes:

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

1. Demonstrate the knowledge of layered architecture for networking.
2. Understand the design issues at different layers in network architecture.
3. Exhibit knowledge of IP addressing and standard network services.

4. Analyze TCP protocol related to traffic shaping and routing algorithms.
5. Understand protocols at the application layer and implement network security mechanisms to protect data and infrastructure.

Text Books

1. Computer Networks: Andrew Tanenbaum, PHI.
2. Data Communication and Networking: Behrouz Forouzan, TMH.

Reference Books

1. Introduction to Data Communications and Networking: Wayne Tomasi, Pearson Education.
2. Computer Networks: A systems approach: Larry. L. Peterson, Bruce. S. Davie, 3rd Edition, Morgan Kaufmann publishers.
3. Computer Networks and Internet: Douglas Comer, PHI.

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

Course Code: 24CS04TH0603-2 **Course: Business and Web Analytics**

L: 3 Hrs, T: 0 Hrs, P: 2 Hrs Per Week **Total Credits: 03**

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 modeling to solve business problems such as churn, segmentation, and forecasting.
3. Implement web analytics frameworks to track user behavior, 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.

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.

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 Book:

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
(Data Science & Analytics)

Course Code: 24CS04TH0603-3 **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
(Data Science & Analytics)

Course Code: 24CS04TH0604-1 **Course: Natural Language Processing**

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

Course Objectives

1. To familiarize the concepts and techniques of natural language processing.
2. To learn computational techniques that enable machines to process, understand, and generate human language efficiently.
3. To apply the statistical learning methods and cutting-edge research models to solve natural language processing problems.
4. To integrate natural language processing into real-world systems to develop, evaluate, and enhance applications.

Syllabus:

UNIT I

Introduction to NLP, Definition and Scope, A Brief History, Importance, Challenges, Tasks, Significance, NLP Pipeline and Applications, Morphological Analysis and Generation using Finite State Automata, Finite State Transducer, Hidden Markov model, Viterbi Algorithm, Applications of Tagging.

UNIT II

Lexical Analysis, Part-of-Speech (POS) Tagging, Approaches for POS Tagging, Rule-Based, Stochastic, Hybrid Approach, Taggers Evaluations, Tokenization with NLTK. **Syntax and Parsing**, Types of Constituents in Sentences, Context-Free Grammar (CFG), CFG Parsing, Top-Down Parser, Bottom-Up Parser, Shallow Parsing and Chunking, Thematic Roles, Conditional Random Fields, Maximum Likelihood Estimation, Lexical and Probabilistic Parsing, Probabilistic Context Free Grammars, The Probability of a String, Inside-Outside Algorithm, CKY Parsing.

UNIT III

Semantic Analysis, Lexical Vs Compositional Semantic Analysis, Word Senses and Relations, Types of Lexical Semantics, Word Sense Disambiguation, WordNet and Online Thesauri, Word Similarity and Thesaurus Methods, Text Representation, Word Embedding, TF-IDF, Bag of Words, Word2Vec, Skip-gram.

Pragmatic Analysis and Discourse, Discourse Phenomena, Coherence and Coreference, Importance of Coreference Relations, Discourse Segmentation, Algorithms for Coreference Resolution.

UNIT IV

N-Gram Language Model, Language Modeling and Chain Rule, Markov Chain in N-Gram Model, Shannon's Method in N-Gram Model, Smoothing Techniques, Extrinsic Evaluation Scheme, Zero Counts Problems, Smoothing Techniques, Laplace (Add-One) Smoothing, Add-k Smoothing, Backoff and Interpolation Smoothing, Good Turing Smoothing, The Transformer, Large Language Models, Language Model Evaluation, Entropy, Perplexity, ROUGE, BLEU.

UNIT V

Major NLP Applications, Information Retrieval Systems, Social Network Analysis, Sentiment Analysis, Information Extraction, Named Entity Recognition, Text Classification, Text Summarization Systems, Machine Translation, Word Alignment, Content Recommendation System, Answering Questions, Applications in Finance, E-Commerce, Travel and Hospitality, Marketing, Insurance, Healthcare, Law, Supply Chain, Telecommunication, Education and Research.

Course Outcomes

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

1. Understand core NLP concepts and techniques.
2. Apply various POS tagging approaches and parsing techniques to analyze sentence structure and utilize probabilistic models for syntactic analysis.
3. Analyze various semantic and pragmatic analysis techniques and discourse phenomena to enhance text representation and understanding.
4. Implement N-Gram language models and Transformer-based models for effective language modeling and text generation.
5. Design and develop innovative NLP solutions to address real-world challenges across industries like finance, healthcare, e-commerce, education and research.

Textbooks

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models, Third Edition, 2025, https://web.stanford.edu/~jurafsky/slp3.
2. Raymond ST. Lee, Natural Language Processing: A Textbook with Python Implementation, Springer Nature Singapore Pte Ltd. 2024, ISBN: 978-9819919987.
3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana, Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, O'Reilly Media, Inc., USA, First edition, 2020, ISBN: 978-1492054054.

Reference Books

1. Natural Language Processing with Python: From Basics to Advanced Projects, Second Edition, 2024, Cuantum Technologies LLC. Plano, ISBN: 979-8894968483.

2. Jyotika Singh, Natural Language Processing in the Real World: Text Processing, Analytics, and Classification, First edition, 2023, CRC Press is an imprint of Taylor & Francis Group, LLC, ISBN: 978-1003264774.
3. Gerhard Paaß and Sven Giesselbach, Foundation Models for Natural Language Processing: Pre-trained Language Models Integrating Media, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer Nature Switzerland Pte Ltd. 2022, ISBN: 978-3031231896.
4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, Inc., USA, Revised First edition, May 2022, ISBN: 978-1098136796.

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

Course Code: 24CS04TH0604-2 **Course: Introduction to DevOps**

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

Course Objectives:

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

Syllabus:

UNIT 1: 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 2: 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 → Build → Test → Deploy), Comparison: Jenkins vs AWS-native CI/CD

UNIT 3: 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 (Minikube or Cloud)

UNIT 4: Infrastructure as Code (IaC) & Cloud DevOps

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

UNIT 5: Monitoring, Logging, Security & DevSecOps

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

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

Course Outcomes:

On successful completion of the course, the student 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
(Data Science & Analytics)

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: EXAMPLES AND BASIC CONCEPTS:

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
((Data Science & Analytics)

Course Code: 24CS04PR0605 **Course:** Comprehensive Viva

L: 0 Hrs, T: 0 Hrs, P: 2 Hrs Per Week **Total 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 VI, B. Tech. Computer Science & Engineering ((Data Science & Analytics)

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

L: 1 Hrs, T: 0 Hrs, P: 0 Hrs Per Week **Total 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 ((Data Science & Analytics)

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

L: 0 Hrs, T: 0 Hrs, P: 2 Hrs Per Week **Total 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
(Data Science & Analytics)

Course Code: 24CS04PR0606 **Course: Mini project**

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

Course Objectives

The objective of the Mini Project is to let the students map and utilize the theoretical knowledge and technical knowledge acquired in the previous semesters to solve a real-world problem through team effort.

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
(Data Science & Analytics)

Course Code: 24CS04PR0607 **Course: Advanced Competitive Coding**

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

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