RAMDEOBABA UNIVERSITY

SCHOOL
of
COMPUTER SCIENCE AND ENGINEERING

B.Tech Computer Science and Engineering

INFORMATION BOOKLET

Session 2025-26

RBU

RAMDEOBABA UNIVERSITY, NAGPUR

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

RAMDEOBABA UNIVERSITY

PART-1

PROGRAMME SCHEME & SYLLABUS

Session 2025-26

Department Vision

To continually improve the education environment, in order to develop graduates with strong academic and technical background needed to achieve distinction in the discipline. The excellence is expected in various domains like workforce, higher studies or lifelong learning.
To strengthen links between industry through partnership and collaborative development works.

Department Mission

To develop strong foundation of theory and practices of computer science amongst the students to enable them to develop into knowledgeable, responsible professionals, lifelong learners and implement the latest computing technologies for the betterment of the society.

Program Education Objectives

1. To prepare graduates to apply the broad set of techniques, tools, and skills from science, mathematics and engineering required to solve problems in Computer Science and Engineering
2. To prepare graduates to address practices in computer science and engineering using software development life cycle principles.
3. To provide adequate training & opportunities to work as teams in multidisciplinary projects.
4. To prepare the graduates to exhibit professionalism, communication skills, ethical attitude, and practice their profession with high regard to legal and ethical responsibilities.
5. To prepare graduates for engaging in life-long learning, such as post graduate study & certification courses.

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.

Programme Specific Outcomes (PSOs)

1. **Foundation of Computer System:** Ability to understand fundamental concepts of computer science & engineering, operating system, networking& data organization systems, hardware & software aspects of computing.

2. **Software development Ability:** Ability to understand the software development life cycle. Possess professional skills and knowledge of software design process. Familiarity and algorithmic competence with a broad range of programming languages and open-source platforms.

3. **Research Ability:** Ability to apply knowledge base to identify research gaps in various domains, model real world problems, solve computational tasks, to provide solution for betterment of society with innovative ideas.

B. Tech. Computer Science and Engineering [2025-26]
Teaching & Evaluation Scheme [B. Tech CSE]

RAMDEOBABA UNIVERSITY, NAGPUR-13														
Semester: I (B. Tech in Computer Science and Engineering)														
School	Computer Science and Engineering			Department		Computer Science and Engineering					Session		2025-26	
S. No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment			
							45		75		30			
							Theory	Lab	Theory	Lab	Theory	Lab		
1	ESC	25CS01TP0101	Fundamentals of Programming	3	2	4	30	15	50	25	20	10	150	3 hrs
2	PCC	25EE01TH0107	Computer Architecture and Organization	3	0	3	30		50		20		100	3 hrs
3	VSEC	25CS01PR0102	Computer Workshop–I Lab	0	2	1		15		25		10	50	
4	ESC	25CS01PR0103	Fundamentals of Linux OS	0	2	1		15		25		10	50	
5	VEC	25CS01TH0104	Cyber Laws & Ethics in IT	2	0	2	30		50		20		100	2 hrs
6	BSC	25HS03TH0102	Probability and Statistics	3	0	3	30		50		20		100	3 hrs
7	BSC	25HS05TP0101	Introduction to Quantum Computing	3	2	4	30	15	50	25	20	10	150	3 hrs
8	CCA	25HS04PR0101	Health-Fitness-Wellbeing	0	2	1		15		25		10	50	
9	IKC/ VEC	25HS02TH0103 + 25HS02TH0104	Humanities Elective-I	1	0	1	30				20		50	
10	BSC/ CCA	25HS02PR0102+ 25HS02PR0105-1 to 17	Humanities Elective-II	0	2	1	15		25		10		50	
Total Courses		**10**		**Total Credits**			**21**		**Total Marks**				**850**	

RAMDEOBABA UNIVERSITY, NAGPUR-13

Semester: II (B. Tech in Computer Science and Engineering)

School	Computer Science and Engineering	Department	Computer Science and Engineering	Session	2025-26

S. No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
							Mid Semester		End Semester		Teachers Assessment			
							45		**75**		30			
				L	P		Theory	Lab	**Theory**	**Lab**	Theory	Lab		
1	ESC	25CS01TP0201	Object Oriented Programming	3	2	4	30	15	50	25	20	10	150	3 hrs
2	PCC	25CS01TP0202	Data Structures	3	2	4	30	15	50	25	20	10	150	3 hrs
3	PCC	25CS01TP0203	Operating Systems	3	2	4	30	15	50	25	20	10	150	3 hrs
4	VSEC	25CS01PR0204	Computer Workshop–II Lab	0	2	1		15		25		10	50	
5	BSC	25HS03TP0212	Calculus and Linear Algebra	3	2	4	30	15	50	25	20	10	150	3 hrs
6	VEC	25HS01TP0201	Environmental Science	1	2	2	30	15		25	20	10	100	
7	IKC/ VEC	25HS02TH0203 + 25HS02TH0204	Humanities Elective-I	1	0	1	30				20		50	
8	BSC/ CCA	25HS02PR0202 + 25HS02PR0206-1 to 17	Humanities Elective-II	0	2	1		15		25		10	50	

Humanities Elective-I	25HS02TH0203	Foundational Course in Universal Human Values
	25HS02TH0204	Foundational Literature of Indian Civilization
Humanities Elective-II	25HS02PR0202	Professional Communication Lab
	25HS02PR0206-1 to 17	Liberal/Performing Art

Total Courses	**8**	**Total Credits**	**21**		**Total Marks**	**850**

Liberal/ Performing Art Bucket

Sr. No.	Course Code	Course Title	L	P	Credits	Continuous Evaluation	End Sem Exam/ Internal Evaluation	Total	ESE Duration
1	25HS02PR0105-1/ 25HS02PR0206-1	Fundamentals of Indian Classical Dance: Bharatnatayam	0	2	1	25	25	50	--
2	25HS02PR0105-2/ 25HS02PR0206-2	Fundamentals of Indian Classical Dance: Kathak	0	2	1	25	25	50	--
3	25HS02PR0105-3/ 25HS02PR0206-3	Introduction to Digital Photography	0	2	1	25	25	50	--
4	25HS02PR0105-4/ 25HS02PR0206-4	Introduction to Basic Japanese Language	0	2	1	25	25	50	--
5	25HS02PR0105-5/ 25HS02PR0206-5	Art of Theatre	0	2	1	25	25	50	--
6	25HS02PR0105-6/ 25HS02PR0206-6	Introduction to French Language	0	2	1	25	25	50	--
7	25HS02PR0105-7/ 25HS02PR0206-7	Introduction to Spanish Language	0	2	1	25	25	50	--
8	25HS02PR0105-8/ 25HS02PR0206-8	Art of Painting	0	2	1	25	25	50	--
9	25HS02PR0105-9/ 25HS02PR0206-9	Art of Drawing	0	2	1	25	25	50	--
10	25HS02PR0105-10/25HS02PR0206-10	Nature Camp	0	2	1	25	25	50	--
11	25HS02PR0105-11/25HS02PR0206-11	Developing Self-awareness	0	2	1	25	25	50	--
12	25HS02PR0105-12/25HS02PR0206-12	Art of Poetry	0	2	1	25	25	50	--
13	25HS02PR0105-13/25HS02PR0206-13	Creative and content writing	0	2	1	25	25	50	--
14	25HS02PR0105-14/25HS02PR0206-14	Science of life through Bhagwad Gita	0	2	1	25	25	50	--
15	25HS02PR0105-15/25HS02PR0206-15	Sanskrit Sambhashan Spoken Sanskrit	0	2	1	25	25	50	--
16	25HS02PR0105-16/25HS02PR0206-16	Kirtan Kala	0	2	1	25	25	50	--
17	25HS02PR0107-17/25HS02PR0206-17	Introduction to German Language	0	2	1	25	25	50	--
18	25HS04PR0102-1/25HS04PR0202-1	Adventure Sports	0	2	1	25	25	50	--
19	25HS04PR0102-2/25HS04PR0202-2	Introduction to Defense Forces & Obstacle Training	0	2	1	25	25	50	--
20	25HS04PR0102-3/25HS04PR0202-3	First Aid & Disaster Management	0	2	1	25	25	50	--
21	25HS04PR0102-4/25HS04PR0202-4	Basic Nutritional Course	0	2	1	25	25	50	--
22	25HS04PR0102-5/25HS04PR0202-5	Stress Management Through Yoga & Meditation	0	2	1	25	25	50	--

RAMDEOBABA UNIVERSITY, NAGPUR-13															
Semester: III (B. Tech in Computer Science and Engineering)															
School	Computer Science and Engineering			Department		Computer Science and Engineering						Session		2025-26	
S.No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks							Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment				
							45		75		30				
							Theory	Lab	Theory	Lab	Theory	Lab			
1	PCC	25CS01TH0301	Theory of Computation	3	0	3	30		50		20			100	3 hrs
2	PCC	25CS01TP0302	Design and Analysis of Algorithms	3	2	4	30	15	50	25	20	10		150	3 hrs
3	PCC	25CS01TP0303	Computer Networks	3	2	4	30	15	50	25	20	10		150	3 hrs
4	BSC	25HS03TH0301	Discrete Mathematics	3	0	3	30		50		20			100	3 hrs
5	VSEC	25CS01PR0304	Software Laboratory–I	0	4	2		15		25		10		50	
6	OE	25CSOEC01TH0305	Open Elective-I	2	0	2	30		50		20			100	2 hrs
7	MDM	25CS01TH0305	MDM-I	3	0	3	30		50		20			100	3 hrs
8			Self Defense [Audit Course]	-	-	-								0	
Total Courses		**8**		**Total Credits**		**21**			**Total Marks**					**750**	

RAMDEOBABA UNIVERSITY, NAGPUR-13

Semester: IV (B. Tech in Computer Science and Engineering)

School	Computer Science and Engineering	Department	Computer Science and Engineering	Session	2025-26

S. No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment			
							45		**75**		30			
							Theory	Lab	**Theory**	**Lab**	Theory	Lab		
1	PCC	25CS01TH0401	Compiler Design	3	0	3	30		50		20		100	3 hrs
2	PCC	25CS01TP0402	Database Management System	3	2	4	30	15	50	25	20	10	150	3 hrs
3	PCC	25CS01TP0403	Artificial Intelligence	3	2	4	30	15	50	25	20	10	150	3 hrs
4	PEC	25CS01PR0404*	Software Laboratory–II*	0	4	2		15		25		10	50	
5	OE	25CSOEC01TH0405	Open Elective-II	2	0	2	30		50		20		100	2 hrs
6	CEP	25CS01PR0405	Community Engagement Project	0	4	2		15		25		10	50	
7	VEC	25CS01PR0406	Creativity, Innovation & Design Thinking	2	0	2		30				20	50	
8	AEC	25CS01PR0407	Basic Competitive Coding	0	2	1		30				20	50	
9	MDM	25CS01TH0407	MDM-II	3	0	3	30		50		20		100	3 hrs
Total Courses		**9**		**Total Credits**		**23**			**Total Marks**				**800**	

RAMDEOBABA UNIVERSITY, NAGPUR-13

Semester: V (B. Tech in Computer Science and Engineering)

School	Computer Science and Engineering	Department	Computer Science and Engineering	Session	2025-26

S.No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment			
							45		**75**		30			
							Theory	Lab	**Theory**	**Lab**	Theory	Lab		
1	PCC	25CS01TP0501	Machine Learning	3	2	4	30	15	50	25	20	10	150	3 hrs
2	PCC	25CS01TP0502	Software Engineering	3	2	4	30	15	50	25	20	10	150	3 hrs
3	PCC	25CS01TP0503	Cloud Computing	3	2	4	30	15	50	25	20	10	150	3 hrs
4	PEC	25CS01PR0504*	Software Lab-III*	0	4	2		30				20	50	
5	EEM	25CS01PR0505	Idea Lab	0	2	1		15		25		10	50	
6	PEC	25CS01TH0506	Program Elective-I	3	0	3	30		50		20		100	3 hrs
7	OE	25CSOEC01TH0505	Open Elective-III	2	0	2	30		50		20		100	2 hrs
8	MDM	25CS01TH0507	MDM-III	3	0	3	30		50		20		100	3 hrs
Total Courses		**8**		**Total Credits**		**23**			**Total Marks**				**850**	

RAMDEOBABA UNIVERSITY, NAGPUR-13															
Semester: VI (B. Tech in Computer Science and Engineering)															
School	Computer Science and Engineering			Department		Computer Science and Engineering					Session		2025-26		
S.No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment			
							45		75		30			
							Theory	Lab	Theory	Lab	Theory	Lab		
1	PCC	25CS01TP0601	Deep Learning-I	3	2	4	30	15	50	25	20	10	150	3 hrs
2	PEC	25CS01TP0602	Program Elective –II	3	2	4	30	15	50	25	20	10	150	3 hrs
3	PEC	25CS01TH0603	Program Elective –III	3	0	3	30		50		20		100	3 hrs
4	PEC	25CS01TP0604	Program Elective –IV	3	2	4	30	15	50	25	20	10	150	3 hrs
5	AEC	25HS02TP0601	Business Communication	1	2	2	30	15		25	20	10	100	
6	VSEC	25CS01PR0605	Mini Project	0	4	2		15		25		10	50	
7	AEC	25CS01PR0606	Advanced Competitive Coding	0	2	1		30				20	50	
8	MDM	24CS01TH0607	MDM-IV	3	0	3	30		50		20		100	3 hrs
Total Courses		**8**		**Total Credits**		**23**			**Total Marks**				**850**	

RAMDEOBABA UNIVERSITY, NAGPUR-13

Semester: VII (B. Tech in Computer Science and Engineering)

School	Computer Science and Engineering	Department	Computer Science and Engineering	Session	2025-26

S. No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment			
							45		75		30			
							Theory	Lab	Theory	Lab	Theory	Lab		
1	PEC	25CS01TP0701	Program Elective-V	3	2	4	30	15	50	25	20	10	150	3 hrs
2	PEC	25CS01TP0702	Program Elective-VI	2	2	3	30	15	50	25	20	10	150	3 hrs
3	PEC	25CS01TH0703	Program Elective-VII	3	0	3	30		50		20		100	3 hrs
4	PEC	25CS01TH0704	Program Elective-VIII	3	0	3	30		50		20		100	3 hrs
5	PRJ	25CS01PR0705	Major Project-1	0	8	4		30		50		20	100	
6	AEC	25CS01PR0706	Participative Learning	0	2	1		30				20	50	
7	Internship	25CS01PR0707	Internship Evaluation [Min 6 Weeks]	-	-	-							0	
Total Courses		**7**		**Total Credits**		**18**			**Total Marks**				**650**	
OR														
1	Internship		Full Semester internship	0	0	12		120		250		80	450	
2			NPTEL			3							100	
3			NPTEL			3							100	
Total Courses		**3**		**Total Credits**		**18**			**Total Marks**				**650**	

RAMDEOBABA UNIVERSITY, NAGPUR-13														
Semester: VIII (B. Tech in Computer Science and Engineering)														
School	Computer Science and Engineering			Department		Computer Science and Engineering					Session		2025-26	
S.No	Course Type	Course Code	Course Name	Hours/Week		Credits	Maximum Marks						Total	ESE Duration (Hrs)
				L	P		Mid Semester		End Semester		Teachers Assessment			
							45		75		30			
							Theory	Lab	Theory	Lab	Theory	Lab		
1	PEC	25CS01TH0801	Program Elective-IX /NPTEL/ SWAYAM	3	0	3	30		50		20		100	3 hrs
2	PEC	25CS01TH0802	Program Elective-X /NPTEL/ SWAYAM	3	0	3	30		50		20		100	3 hrs
3	PRJ	25CS01PR0803	Major Project-2	0	12	6		30		50		20	100	
Total Courses		3		**Total Credits**		**12**			**Total Marks**				**300**	
OR														
1	Internship /OJT	25CS01PR0804	Industry Internship/Research Internship/TBI	0	24	12		90		150		60	300	
OR														
1	RM		Research Methodology	4	0	4		30		50		20	100	3 hrs
2	Internship		Research Internship	0	0	8		60		100		40	200	
Total Courses		**2**		**Total Credits**		**12**			**Total Marks**				**300**	

Elective Basket

Semester	SEM IV	SEM V	SEM V	SEM VI	SEM VI	SEM VI	SEM VII	SEM VII	SEM VII	SEM VII	SEM VIII	SEM VIII
Specialization	**Software Lab-II**	**Software Lab -III**	**PE-I (T)**	**PE-II (TP)**	**PE-III (T)**	**PE-IV (TP)**	**PE-V (TP)**	**PE-VI (TP)**	**PE-VII (T)**	**PE-VIII (T)**	**PE-IX (T)**	**PE-X(T)**
Track 1 (Computer Science & Engineering)	**Elec-I** Advanced Linux	**Elec-I** Web Progra Ming	**Elec-I** Distributed Operating Systems	**Elec-I** Fundamentals of Public Cloud Platform	**Elec-I** Cryptography & Network Security	**Elec-I** Data Storage and Networks in cloud	**Elec-I** Cloud Administration	**Elec-I** AL & ML on Public Cloud Platform	**Elec-I** Cloud Migration	**Elec-I** Data Engineering on Cloud	**Elec-I** Cloud Security	**Elec-I** Architecting on Cloud
Track 2 (Computer Science & Engineering)			**Elec-II** Computer Graphics	**Elec-II** Generative AI	**Elec-II** Digital Image Processing	**Elec-II** Natural Language Processing	**Elec-II** Data Mining & Analytics	**Elec-II** Deep Learning-II	**Elec-II** Computer Vision	**Elec-II** Cryptography & Network Security	**Elec-II** Deep Learning for Computer Vision and NLP	**Elec-II** GenAI for Image and Video/ GenAI for NLP
Track 3 (Computer Science & Engineering)	**Elec-II** Web Programming	**Elec-II** Design Patterns Lab	**Elec-III** E Commerce & ERP		**Elec-III** Customer Relationship Management	**Elec-III** System Design			**Elec-III** Fog Computing/ Reinforcement Learning		**Elec-III** Bio-informatics	**Elec-III** Soft Computing
Track 4 (Artificial Intelligence and Machine Learning)	Open-Source Tools for AIML	Advanced Python Lab	Applied AI and Expert Systems	Computer Vision	Trustworthy and Explainable AI	Natural Language Processing	ML for Multimedia Content Analysis	MLOps and Federated Learning	Reinforcement Learning/ Generative AI	Social Network and Recommendation Systems	GPU Programming/ Generative Adversarial Network	Agentic AI
Track 5 (Artificial Intelligence and Data Science)	Data Exploration and Handling Lab	Web Technolog ies Lab	Data Analysis and Visualization	NoSQL databases	Data Privacy and Security	Natural Language Processing	Image Analysis and Computer Vision	Deep Learning-II	Large Scale Data Analytics	Time Series Analysis	Generative AI	Financial Engineering
Track 6 (Data Science and Analytics)	Data Exploration and Handling Lab	Web Technolog ies Lab	Data Analysis and Visualization	Natural Language Understanding and Analytics	Network Security & Cryptography	Business Intelligence and Analytics	Next Generation Databases	Big Data Analytics	Customer Relationship Management	Financial Analytics	Image and Video Analytics	Time Series Analysis
Track 7 (Cyber Security)	Open-Source Tools for Cyber Security	Basics of Ethical Hacking Lab	Basics of Ethical Hacking	Cryptography & Network Security	Application Security	Vulnerability Assessment and Penetration Testing	Auditing IT Infrastructure for Compliance Theory	Secure Coding	Incident Handling and Response	Digital Forensics	Executive Governance and Management in IT Security	Disaster Recovery & Business Continuity Management
Track 8 (Information System)	Advanced Linux	Web Programm ing	Product and Project Management	Mobile Apps Development	Wireless Communication	Internet of things	Customer Relationship Management	Context Aware Computing	Information Retrieval	Cryptography & Network Security	Software Defined Network	Cyber Physical Systems

Additional courses offered by School of CSE

Honors Programs

Honors in Web Technologies

Sr No	Sem	Course Code	Course Name	Hours/ Week			Maximum Marks			ESE Durations on
				L	P	Credits	Continuous Evaluation	End Sem Exam	Total	
1	III	25CS05HT0301	Blockchain and Web 3 Programming	3	0	3	100	-	100	-
2	IV	25CS05HT0401	Development of Progressive Web Application	3	0	3	100	-	100	-
3	V	25CS05HT0501	Cloud Native App Development	4	0	4	100	-	100	-
4	VI	25CS05HT0601	Introduction to Devops	4	0	4	100	-	100	-
5	VII	25CS05HP0701	Project	0	8	4	50	50	100	-

Honors in Full Stack Development

Sr No	Sem	Course Code	Course Name	Hours/ Week			Maximum Marks			ESE Durations on
				L	P	Credits	Continuous Evaluation	End Sem Exam	Total	
1	III	25CS01HT0301	Web Development	3	0	3	100	-	100	-
2	IV	25CS01HT0401	Full Stack-I	3	0	3	100	-	100	-
3	V	25CS01HT0501	Full Stack-II	4	0	4	100	-	100	-
4	VI	25CS01HT0601	Software Development Automation	4	0	4	100	-	100	-
5	VII	25CS01HP0701	Project	0	8	4	50	50	100	-

Honors in Cyber Security

Sr No	Sem	Course Code	Course Name	Hours/ Week			Maximum Marks			ESE Durations on
				L	P	Credits	Continuous Evaluation	End Sem Exam	Total	
1	III	25CS04HT0301	Information and Cyber Security	3	0	3	100	-	100	-
2	IV	25CS04HT0401	Cyber Security Auditing	3	0	3	100	-	100	-
3	V	25CS04HT0501	Cyber Forensics: Threats, Vulnerability, Malware	4	0	4	100	-	100	-
4	VI	25CS04HT0601	Security Strategies in Windows and Linux	4	0	4	100	-	100	-
5	VII	25CS04HP0701	Project	0	8	4	50	50	100	-

Honors in Data Science

Sr No	Sem	Course Code	Course Name	Hours/ Week			Maximum Marks			ESE Durations on
				L	P	Credits	Continuous Evaluation	End Sem Exam	Total	
1	III	25CS02HT0301	Data Science Essentials	3	0	3	100	-	100	-
2	IV	25CS02HT0401	Software Architecture Analysis	3	0	3	100	-	100	-
3	V	25CS02HT0501	Data Engineering	4	0	4	100	-	100	-
4	VI	25CS02HT0601	Business and Web Analytics	4	0	4	100	-	100	-
5	VII	25CS02HP0701	Project	0	8	4	50	50	100	-

Honors in AIML

Sr No	Sem	Course Code	Course Name	Hours/ Week			Maximum Marks			ESE Durations on
				L	P	Credits	Continuous Evaluation	End Sem Exam	Total	
1	III	25CS03HT0301	Computational Statistics for Data Science	3	0	3	100	-	100	-
2	IV	25CS03HT0401	Distributed Computing Frameworks	3	0	3	100	-	100	-
3	V	25CS03HT0501	AIML Techniques for Vision and Navigation	4	0	4	100	-	100	-
4	VI	25CS03HT0601	Generative Adversarial Networks	4	0	4	100	-	100	-
5	VII	25CS03HP0701	Project	0	8	4	50	50	100	-

Honors With Research

Sr No	Sem	Course Code	Course Name	Hours/ Week			Maximum Marks			ESE Durations on
				L	P	Credits	Continuous Evaluation	End Sem Exam	Total	
1	VII	25CS01HT0701	Research Methodology/ NPTEL	4	0	4	50	50	100	-
2	VII	25CS01HP0702	Project -I	0	8	4	100	100	200	-
3	VIII	25CS01HP0801	Project -II	0	20	10	200	200	400	-

Minor Program

Semester	Course Name	Course Code
III	Programming for Problem Solving	25CS01MT0301
IV	Tools & Techniques of Artificial Intelligence	25CS01MT0401
V	Exploratory Data Analysis	25CS01MT0501
VI	Fundamentals of Machine Learning	25CS01MT0601
VII	Project	25CS01MP0701

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

MDM Course Name [CSE]	Semester	MDM	Course Code
Introduction to Web Development	III	MDM-I	25CS01TH0305
Front End Development	IV	MDM-II	25CS01TH0407
Backend Technologies	V	MDM-III	25CS01TH0507
Cloud Technologies	VI	MDM-IV	25CS01TH0605

Exit Programs Options

First Year [Certificate Course in Basic Programming Skills]

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

Second Year [Diploma in respective discipline]

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

Third Year [Bachelor of Vocation in respective discipline]

i. Project

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

Course Code: 25CS01TP0101 **Course: Fundamentals of Programming**
L: 3Hrs, P: 2Hr, Per Week **Total Credits: 4**

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

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

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

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

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

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

Course Outcomes

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

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

Text Books:

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

Reference Books

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

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

Course Code: 25EE01TH0107 Course: Computer Architecture and Organization

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

UNIT I: Fundamentals of Computer Architecture:

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

UNIT II: Instruction Set Architecture and Arithmetic Operations:

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

UNIT III: Memory Hierarchy and Management:

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

UNIT IV: Input/output Organization:

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

UNIT V: Advanced Computer Architectures and Parallel Processing:

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

Course Outcomes:

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

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

Text Books

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

Reference Books

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

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

Course Code : 25CS01PR0102 **Course : Computer Workshop-I Lab**

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

MS Excel

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

HTML

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

HTML-5

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

CSS & Bootstrap

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

Course Outcomes

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

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

Text Books

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

Reference Books

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

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

Course Code: 25CS01PR0103 **Course: Fundamentals of Linux OS**

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

Course Objectives:

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

Linux Operating System:

- 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

Course Outcomes

Upon completion of the course, students will be able to

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

Text Book

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

Reference Books

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

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

Course Code: 25CS01TH0104 **Course: Cyber Laws & Ethics in IT**

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

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

Course Outcomes

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

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

Text Books:

1. George Reynolds, “Ethics in information Technology”,5th edition, Cengage Learning

2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001.

Reference Books:

1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.

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

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

Course Code: 25HS03TH0102 **Course: Probability and Statistics**

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

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.

Module 1: (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.

Module 2: (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.

Module 3: (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.

Module 4: (8 Lectures)

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

Module 5: (7 Lectures):

Testing of Hypothesis for difference of mean and proportion, Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes, maximum likelihood estimation

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

1. Identify and differentiate between discrete and continuous random variables, and interpret probabilities obtained from standard probability distributions.
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. Explain the fundamental concepts of hypothesis testing, including significance levels, p-values, and the underlying logic of hypothesis testing.

5. To apply MLE to various statistical models, such as linear regression, exponential distribution, etc.

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 II, B. Tech. Computer Science & Engineering

Course Code:25HS05TP0101 **Course: Introduction to Quantum Computing**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives

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

Module 1: Basic Quantum Theory

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

Module 2: Complex Vector Spaces and Linear Algebra in Quantum Computing

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

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

Module 3: Classical and Quantum Systems

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

Module 4: Quantum representation of systems

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

Module 5: Architecture and Algorithms

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

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

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

Course Outcomes

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

1. Use the basic quantum theory relating to the probabilistic behaviour of an electron in an atom.

2. Apply complex vector space to eigenvalues and eigenfunctions, inner products, tensor products in the domain of quantum theory
3. Classify deterministic and probabilistic systems and analyse quantum observations and quantum measurements.
4. Build the foundational concepts of quantum states, quantum measurements as applicable to the qubit spin systems using mathematical and conceptual frameworks.
5. Use quantum gates in building architecture and quantum algorithms.
6. Utilize Mathematica software for graph plotting and for least squares fitting of the experimental data.

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 II, B. Tech. Computer Science & Engineering

Course Code:25HS04PR0101 **Course: Health-Fitness-Wellbeing**

L: 0 Hr, P: 2Hrs, 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 theoretical knowledge.

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 the concept of health and wellness through audio visual aids and evaluate their basic understanding of the concept of Health.
3. To make Overall growth & development with team spirit, social values and leadership qualities among students through discussions and interactive sessions.
4. To create Environment conducive to enhanced interaction and recreation among students as neutralizer for stress demonstrated through numerous everyday scenarios.

Unit 1:

- Health & Wellness: Meaning, Definition and Importance, Dimensions, Influencing Factors & Enhancing Factors.
- Concept of Health-related Fitness & Body Types.
- Importance and Assessment of BMI & Pulse Rate.
- Healthy Dietary Habits and prevention from Sedentary Lifestyle.
- Yoga: Suryanamaskar, Types of Asana, Pranayama & Meditation
- Causes of Stress & Stress relief through Exercise and Yoga

Unit 2:

- Current Trends in Sports Science through audio-visual learning.
- Competitions & Tournament records.
- Sports Current Affairs.
- Importance of Warm up & Cool Down.
- Safety Measures in Sports and Essential Equipment required for Football, Volleyball, Basketball, Table Tennis & Chess.
- Recreational Activities: Types, Importance and benefits.

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. To have a theoretical knowledge of the principles of implementing general and specific conditioning of physical exercises and yoga.
3. Develop Health-related fitness and Body-mind co-ordination through a better understanding of the subject.
4. To understand Healthy & active living with reducing Sedentary Lifestyle.

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 I/II, B. TECH Computer Science & Engineering

Course Code :25HS02TH0103 25HS02TH0203

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

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.

Course outcome:

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

1. Develop a holistic perspective of life
2. Better understanding of inter-personal relationships and relationship with society and nature.
3. An ability to strengthen self-reflection

Reference Material

The primary resource material for teaching this course consists of

1. Text book: R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2
2. Reference books:
   a) B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
   b) PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
   c) Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
   d) Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
   e) Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
   f) Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
   g) A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.

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

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

Course Code: 25HS02TH0104 25HS02TH0204	**Course: Foundational Literature of Indian Civilization**
L: 1 Hrs, P: 0 Hrs, Per Week	**Total Credits: 1**

Unit 1: Overview of Indian Knowledge System:

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

Unit 2: The Vedic corpus:

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

Unit 3: Indian Philosophical systems:

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

Unit 4: Vedic Maths -1

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

Unit -5: Vedic Maths – 2

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

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

Reference material

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

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

Course Code : 25HS02PR0102 25HS02PR0202 | **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

List of practicals

Professional Communication-1

Practical 1:Speaking Skills

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

Practical 2: Listening Skills

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

Practical 3: Reading

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

Professional Communication-2

Practical 4: Presentation Skills: Orientation & Mock Session

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

Practical 5: **Presentation Skills: Practice**

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

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

Practical 7: Group Discussions and Personal Interview: Practice

Professional Communication-3

Practical 8: Writing Practices

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

Practical 9: Writing Practices

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

Practical 10:Writing Practices:

This practical will cover the following topics: Academic Correspondence

<u>Course Outcomes</u>

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

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-1 Course: Fundamentals of Indian Classical Dance:
25HS02PR0206-1 Bharatnatayam
L: 00 Hrs, 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.

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

Course Outcomes

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

CO1: Understand the importance of dance and Bharatnataym 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* (1st level formal exam of Bharatnatayam).

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-2 25HS02PR0206-2 **Course: Fundamentals of Indian Classical Dance: Kathak**

L: 00 Hrs, 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.

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

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).

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-3 **Course: Introduction to Digital Photography**
25HS02PR0206-3
L: 00 Hrs, 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.

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

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

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 I/II, B. TECH Computer Science & Engineering

Course Code:25HS02PR0105-4 **Course: Introduction to Basic Japanese**
25HS02PR0206-4 **Language**
L: 00 Hrs, 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.

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

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

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-5 **Course: Art of Theatre**
25HS02PR0206-5
L: 00 Hrs, 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.

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

Course Outcomes:

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

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.

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-6 **Course: Introduction to French**
25HS02PR0206-6
L: 00 Hrs, 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.

List of Practicals

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

Course outcomes:

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

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

Recommended reading

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

Syllabus for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-7
254HS02PR0206-7
Course: Introduction to Spanish Language
L: 00 Hrs, 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.

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

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

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-8 **Course: Art of Painting**
25HS02PR0206-8
L: 00 Hrs, 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.

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

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

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-9
25HS02PR0206-9
Course: Art of Drawing

L: 00 Hrs, 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.

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

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

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-10 Course: Nature Camp
25HS02PR0206-10
L: 00 Hrs, 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 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

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.

Syllabus for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-11 **Course: Developing Self-awareness**
25HS02PR0206-11
L: 00 Hrs, 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

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

Course Outcomes:

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

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 for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-12 **Course: Art of Poetry**
25HS02PR0206-12
L: 00 Hrs, P: 2 Hrs, Per Week **Total Credits: 01**

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

Course Outcomes:

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

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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-13 **Course: Creative and content writing**
25HS02PR0206-13
L: 00 Hrs, 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.

Creative Writing

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

Content Writing

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

Content Creation

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

Course outcomes:

On completion of the course, student will be able to achieve the following:
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 for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-14 **Course: Science of life through Bhagwad Gita**
25HS02PR0206-14
L: 00 Hrs, 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

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

Course Outcome

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 for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-15 Course: Sanskrit Sambhashan- Spoken Sanskrit
25HS02PR0206-15
L: 00 Hrs, 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

संस्कृतसम्भाषणशिबिरस्य पाठ्यक्रमः

प्रथमं दिनम्

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

द्वितीयं दिनम्

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

तृतीयं दिनम्

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

चतुर्थं दिनम्

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

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

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।
- ऐक्यमन्त्रः।

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।
- ऐक्यमन्त्रः।

सप्तमं दिनम्

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

- गीतम्।
- आरोग्यसम्बन्धिशब्दा: – वैद्यरोगिसम्भाषणम्।
- प्रश्नोत्तरस्पर्धा।
- ऋषीणां नामानि।
- कथा - शिक्षक: एकां कथां वदति। अनन्तरं छात्रेषु एकैक: तस्या: कथाया: एकैकं वाक्यम् उक्त्वा कथां सम्पूर्णां करोति।
- सङ्ख्या - दीर्घसङ्ख्यापाठनम्।
- प्रश्नोत्तरम्।
- क्रीडा - (गणद्वये नामस्मरणक्रीडा)
- कथा।
- पुस्तकानां परिचय:।
- सप्त वाक्यानि।
- सूचना।
- ऐक्यमन्त्र:।

अष्टमं दिनम्

- गीतम्।
- पुन:स्मारणम्।
- वारम्।
- अत: - यत: परिवर्तनाभ्यास:।
- यद्यपि – तथापि।
- यत्र – तत्र।
- कति - कियत् - एतयो: भेदज्ञापनम्।
- यावत् – तावत्।
- यत् – तत्।
- य: - स:।
- या – सा।
- गीतम्।
- अस्माकम्।
- चर्चा।
- सङ्ख्या - 'शतायु: - गतायु:' क्रीडा।
- विनोदकणिकाकथनम्।
- कथा।
- अष्ट वाक्यानि।
- समाजनिधिविषये सूचना।
- ऐक्यमन्त्र:।

नवमं दिनम्

- गीतम्।
- पुन:स्मारणम्।
- चित्।
- ....द्वयम्।
- सङ्ख्यासु लिङ्गभेद:।
  एक: - एका - एकम्
  द्वयम् - द्वयम् - द्वयम्
  त्रय: - तिस्र: - त्रीणि
  चत्वार: - चतस्र: - चत्वारि
- शिश्रक: - अहं वैद्य: - मम नाम सुरेश:
  (छात्रा: तमुद्दिश्य प्रश्नान् पृच्छेयु:।)
- .... अर्थम् (समाजार्थम्, संस्कृतकार्यार्थम्...)।
- गीतम्।
- तव्यत् – अनीयर्।
- अनन्त्यकथारचना।
- सङ्ख्यान्वेषणम् (क्रीडा)।
- छात्रै: सह प्रश्नोत्तरम्।
- समाजनिधिविषये पुन:स्मारणम्।
- ऐक्यमन्त्र:।

दशमं दिनम्

- गीतम्।
- पुन:स्मारणम्।
- पत्रलेखनम्।
- दूरवाणीसम्भाषणम्।
- मार्गनिर्देश: – कुत्र गन्तव्यम् इत्यादि।
- तव्यत् अभ्यासार्थम् – अद्य किं किं करणीयम् ?
- सान्दर्भिकभाषणम् –
  1. प्रवासात् प्रतिनिवर्तनस्य।
  2. आपणिकस्य इत्यादि।
- क्रीडा – सङ्ख्यायोजनम् (गणद्वये)।
- शुभाशया:।
- असत्यकथनम् / कल्पनाकथनम्।
- समारोप: (सर्वै: शिक्षार्थिभि: भारतमातु: पूजां कृत्वा निधिसमर्पणं करणीयम्।)
- पत्राचारप्रगतशिक्षणादिविषये सूचना।
- ऐक्यमन्त्र:।

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 for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-16 **Course: Kirtan Kala**
25HS02PR0206-16
L: 00 Hrs, P: 2 Hrs, Per Week **Total Credits: 01**

Course objectives:

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

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

Course outcome

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

Syllabus for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS02PR0105-17 25HS02PR0206-17 **Course: Introduction to German Language**

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

Course objective:

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

List of Practicals

Practical-1: Orientation about Germany, the language, and culture
Practical-2: Vocabulary building for everyday conversations
Practical -3: Numbers, days and time
Practical-4: Introducing Oneself & Others
Practical-5: Reading Skills: Reading simple text in German language
Practical-6: Basic Verbs & Sentence Construction
Practical-7: Food & Dining, Giving Directions & Transportation
Practical-8: Writing Skills: Write basic German and practice

Course outcomes:

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

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

Recommended reading

1. German Made Easy by Diego A. Agundez
2. Teach Yourself Complete German: Learn to Read, write, Speak and Understand A new Language by Paul Coggle, Heiner Schenke
3. Netzwerk A1 by Helen Smitz, Stefanie Dengler and Paul Rusch
4. Deutsche Welle (DW) – www.dw.com/learngerman
5. BBC Languages – German – www.bbc.co.uk/languages/german
6. Goethe-Institut – www.goethe.de

Syllabus for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS04PR0102-1
25HS04PR0202-1

Course Name: Adventure Sports

L: 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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS04PR0102-2 25HS04PR0202-2

Course Name: Introduction to Defense Forces & Obstacle Training

L: 0 Hrs. P: 2Hrs. 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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS04PR0102-3 25HS04PR0202-3 **Course Name: First Aid & Disaster Management**

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

Course Objective:

- Understand Disaster Types and Characteristics
- Learn Risk Assessment and Management
- Master Emergency Preparedness and Response
- Explore Recovery and Reconstruction
- Develop Skills in Communication and Coordination
- Understand Legal and Ethical Considerations

Syllabus:

- Basic First Aid
- Transportation of Casualty
- Injury Prevention & Cure
- Various Types of Knots & Hitches
- Various team building activities
- Fire emergencies & use of extinguishers (Optional)
- Snake Bite & Environmental emergencies.

Course Outcome:

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

1. Identify and Categorize Disasters
2. Conduct Risk Assessments
3. Develop Emergency Plans
4. Implement Response Strategies

Syllabus for Semester I/II, B. TECH Computer Science & Engineering

Course Code: 25HS04PR0102-4 25HS04PR0202-4 **Course Name: Basic Nutritional Course**

L: 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 I/II, B. TECH Computer Science & Engineering

Course Code: 25HS04PR0102-5 Course Name: Stress Management through Yoga
25HS04PR0202-5 & Meditation
L: 0 Hrs. P: 2 Hrs. Per Week Total Credits: 01

Course Objective:

Mental health is one of the most important facets of human life. Academic learning has emerged as a major source of stress among young students worldwide. Promoting mental well-being among students in India is a crucial step toward achieving Sustainable Development Goal 3 (Good Health and Well-being). Stress management involves using various techniques and strategies to control stress levels, improve how you react to stressful situations. Yoga combines physical movement with deep breathing and meditation, providing a holistic approach to stress relief.

Unit-1

Introduction to Stress: The Meaning of Stress, types of stress: distress, eustress
Stress Management Techniques I:
Treatment 1- (Asanas): Tadasana, Trikonasana, Vrikshasana, Garudasana,, Ardha-Padamasana, Padamasana, Vajarasana, Ushtrasana, Gomukhasna,, Paschimottanasan, ,Ardha Halasana, ,Setu-Bandhanasa,Naukasana, Bhujangasana, and Dhanurasana; along with relaxing asanas

Unit-2

Spiritual approach to stress management.
Stress Management Techniques II
Treatment 2 – (Prananyam) Deep breathing, Yoga, Mindfulness meditation
Rechak, Purak, Kumbhak, Nadi Suddhi and Bhramari Pranayama.
Measuring Academic stress- It can be measure using questionnaire: Academic stress Scale (Sun .et al 2011**).**

Course Outcome:

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

1. Understand the basics of stress management.
2. Analyze stress triggers and to manage them.
3. Evaluate the responses to stressful situations.
4. Apply the techniques of Yog & Meditation for stress management in day-to-day life.

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

Course Code: 25CS01TP0201 **Course: Object Oriented Programming**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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.

Unit I:

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

Unit II:

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

Unit III:

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

Unit IV:

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

Unit V:

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

Course Outcomes:

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

1. Apply object-oriented principles such as abstraction, encapsulation, inheritance, and polymorphism to develop efficient Java programs.
2. Illustrate various Java constructs, including constructors, methods, arrays, wrapper classes, packages, and lambda expressions, for effective program development.
3. Implement exception handling mechanisms and Java streams for robust and error-free programming.

4. Utilize generics and collections to develop scalable and maintainable software solutions.
5. Analyze the characteristics, significance, and application of design patterns in the software development process

Text Books

1. Herbert Schildt; JAVA The Complete Reference; Ninth Edition, Tata McGraw- Hill Publishing Company Limited.

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
3. Design Patterns By Erich Gamma, Pearson Education

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

Course Code: 25CS01TP0202 **Course: Data Structures**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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.

UNIT-I: Data Structures and Algorithm Basics

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

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

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

UNIT-II: Stacks and Queues

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

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

UNIT-III: Linked Lists

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

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

UNIT-IV: Trees and Graphs

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

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

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

UNIT-V: Sorting and Searching

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

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

Course Outcomes:

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

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

Textbooks

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

References

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

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

Course Code : 25CS01TP0203	**Course: Operating Systems**
L: 3Hrs, P: 2Hrs, Per Week	**Total Credits: 4**

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.

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

Course Code: 25CS01PR0204 **Course: Computer Workshop-II Lab**

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

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

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

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

Course Outcomes

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

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

Text Books

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

Reference Books

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

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

Course Code: 25HS03TP0212 **Course: Calculus & Linear Algebra**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objective

The objective of this course is to build a strong foundation in Calculus for prospective Computer Science engineers by integrating analytical methods with computational tools. The course emphasizes core concepts such as continuity, differentiability, vector calculus, linear algebra, and infinite series, while also exposing students to software-based approaches for solving, visualizing, and analyzing mathematical problems. By combining theoretical understanding with computational techniques, this course prepares students to apply mathematical reasoning effectively in fields such as data science, computer graphics, optimization, algorithms, and machine learning.

Module 1 : (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.

Module 2: (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,

Module 3: (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.

Module 4: (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.

Module 5: (6 Lectures)

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

Course Outcomes

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

1. Apply the concepts of continuity and differentiability to derive Taylor’s and Maclaurin series, and use mathematical software to visualize function approximations.
2. Compute and analyze partial derivatives, Jacobians, and determine extreme values of functions of two variables; validate optimization results using software-based visualization techniques.
3. Interpret vector fields by evaluating gradient, divergence, and curl, and use computational tools to plot and explore these vector functions in 2D and 3D.

4. Solve systems of linear equations and perform eigenvalue and eigenvector analysis to diagonalize matrices and reduce quadratic forms, demonstrating select applications using computational methods.
5. Evaluate convergence of sequences and series using standard tests, and implement recurrence relations in computational settings to solve problems in mathematics and algorithms.

Lab Syllabus

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

Textbooks/References

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

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

Course Code: 25HS01TP0201 **Course: Environmental Science**

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

Unit 1: Sustainability Engineering

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

Unit 2: E-Waste and Green Computing

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

Text Books:

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

Reference Books:

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

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

Course Code: 25CS01TH0301 **Course: Theory of Computation**

L: 3 Hrs, 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.

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

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

Course Code: 25CS01T10302 **Course: Design and Analysis of Algorithms**

L: 3 Hrs, T: 2Hrs, P: 0 Hr, Per Week **Total Credits: 4**

Course Objectives

The objective of this course is

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

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 III, B. Tech. Computer Science & Engineering

Course Code: 25CS01TP0303 **Course: Computer Networks**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives

1. To Introduce the fundamental concepts of each layer in the OSI and TCP/IP models.
2. To implement, and troubleshoot local area networks (LAN), wide area networks (WAN), and hybrid networks.
3. To Examine the transport layer protocols and their role in ensuring reliable data transfer.
4. To Investigate modern applications and technologies used in computer networks.

UNIT - I

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

UNIT – II

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

UNIT – III

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

UNIT - IV

Transport Layer: Elements of Transport protocols: Addressing, Connection establishment, Connection release, Crash recovery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP). TCP congestion control.

UNIT - V

Application Layer: Domain Name Space (DNS), DDNS, File Transfer Protocol (FTP), WWW, HTTP, Bluetooth, Firewalls, SDN Network.

Course Outcomes:

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

1. Design basic computer network by choosing appropriate devices, protocols, and topologies to meet specific requirements as per OSI and TCP/IP layer functionality.
2. Apply the concepts of data link layer protocols (Ethernet) and error detection and correction mechanisms.
3. Implement and evaluate network routing algorithms such as RIP, OSPF, and BGP.
4. Implement transport layer protocols like TCP, UDP and analyze their role in data transfer and network technologies.

Text Books

1. "Computer Networks" by Andrew S. Tanenbaum, David J. Wetherall (5th Edition), Pearson Education

2. "Data and Computer Communications" by William Stallings (10th Edition), Pearson Education
3. Data Communication and networking by Behrouz Forouzan (4th Edition) Mic Graw Hill Publication.

Reference Books

1. "Computer Networking: A Top-Down Approach" by James F. Kurose, Keith W. Ross (7th Edition), Pearson Education.
2. "Network Security Essentials" by William Stallings (5th Edition), Pearson Education.
3. "Software-Defined Networking: Design and Deployment" by Patricia A. Morreale, Daniele Ceccarelli, Wiley.

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

Course Code: 25HS03TH0301 **Course: Discrete Mathematics**

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

Course Objective:

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

Syllabus

Module 1: (9 Lectures)

Combinatorics: Addition and multiplication rule in combinatorics, Linear and Circular permutation, Combination, Binomial Identities, Inclusion and Exclusion Principle, distribution Principle, recurrence relations, generating function, examples using ordinary power series and exponential generating functions.

Module 2: (8 Lectures)

Modular Arithmetic: Modular Arithmetic, Euclid's Algorithm, primes, Fermat's theorem, Euler's theorem, Diophantine equations, Linear congruences, Chinese Remainder theorem, application to Cryptography.

Module 3: (7 Lectures)

Mathematical Logic: Statement and notations, connectives, Negation, conjunction, disjunction, conditional & bi-conditional statement. Tautologies, equivalence of formulas, Duality law, Tautological implications, Theory of inference for statement calculus.

Module 4: (9 Lectures)

Groups and Fields: Group definitions and examples, cyclic group, permutation groups, subgroups and homomorphism, co-sets, Lagrange's theorem and Normal subgroup, Error correcting codes, Hamming codes. Finite field, Galois field.

Module 5: (7 Lectures)

Lattice theory: Lattices as partially ordered set, Properties of Lattice, Lattices as algebraic system, sub lattices, direct product, homomorphism, some special Lattices.

Course Outcomes

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

1. Formulate problems and solve recurrence relations
2. Apply techniques of number theory to solve problems from linear congruences, coding theory etc. in cryptography.
3. Internalize logical notations to define and reason about fundamental mathematical concepts and use it derive logical inference.
4. Apply groups and fields in coding theory.
5. Understand the Lattice as algebraic structure and use it for pattern recognition and in cryptography.

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science: J. P. Tremblay and R. Manohar , Tata McGraw-hill.
2. Discrete Mathematics: Babu Ram, Pearson Publication.
3. Combinatorial Mathematics: C. L. Liu & D. P. Mohapatra, 3rd edition, Tata McGraw-hill.
4. David M Burton, ‘Elementary Number Theory’ , McGraw Hill, Seventh edition 2014.

Reference Books:

1. Foundations of Discrete Mathematics: K. D. Joshi, New age international Publication.
2. Discrete Mathematics: Kolman, Busby & Ross, Pearson Publication

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

Course Code: 25CS01PR0304 **Course: Software Laboratory – I**

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

Course Objectives

1. Introduce core Python concepts, including syntax, data types, control structures, and functions.
2. Explore Python's built-in data structures and their real-world applications in problem-solving.
3. To develop practical and efficient solutions for complex real-life challenges.

Practicals based on the following syllabus:

• Python Execution model and Basic building blocks of Python Programs/Scripts/Modules
• Various keywords, Operators , control and loop constructs used in Python
• User defined Function generation in Python
• Dealing with Python files, Modules and Packages SciPy, an Open Source Python- based library, which is used in mathematics, scientific computing, Engineering, and technical computing.
• Developing small mathematical applications using packages like Numpy, Matplotlib etc.
• Introduction of with Web scraping and its need
• Application development to scrape the web with the help of standard libraries like Requests and bs4(Beautiful Soup).

Course Outcomes:

On successful completion of the course, students will be able to:
1. Design Python programs using different data and control structures.
2. Use Python Files, Modules and Packages to handle complex python programs
3. Develop mathematical and scientific applications in python using numpy, scipy libraries
4. Create small applications for web scraping using standard libraries

Text Books

1. Learning Python: Powerful object oriented programming, Mark Lutz, O'REILLY publications; 5th edition.
2. Introduction to Computing & Problem Solving with Python Jeeva Jose and P Sojan Lal Ascher, Khanna Book Publishing; First Edition (1 January 2019)
3. Problem Solving with Algorithms and Data Structures using Python by By Brad Miller andDavid Ranum, 2nd addition

Reference Books

1. Learning with Python, Allen Downey ,Jeffrey Elkner ,Chris Meyers,Dreamtech Press; First Edition (1 January 2015)
2. The Python 3 Standard Library - Example (Developer's Library) by Doug Hellmann, second edition

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

Course Code: Audit | **Course Name: Self Defense**
L: 0 Hr, P: 0Hr. Per Week | **Total Credits: Audit Course**

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

Syllabus:

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

Pattern of Classes: Training/Classes at Campus

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

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

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

Course Code: 25CS01TH0401 **Course: Compiler Design**

L: 3 Hrs, 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.

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

Course Code: 25CS01TP0402 **Course: Database Management System**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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.

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 IV, B. Tech. Computer Science & Engineering

Course Code: 25CS01TP0403 **Course: Artificial Intelligence**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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.

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 IV, B. Tech. Computer Science & Engineering

Course Code: 25CS01PR0405	**Course: Community Engagement Project**
L: 0 Hrs, 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

Course Code: 25CS01PR0406 Course: Creativity, Innovation & Design Thinking

L: 2 Hrs, 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.

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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 VI

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 IV, B. Tech. Computer Science & Engineering

Course Code: 25CS01PR0407 Course: Basic Competitive Coding

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

The course will cover exercises based on following topics

- Arrays – Matrices – Strings – Time and Space Complexity – TLE – MLE
- Hash Map – Hash Set – Tree Map – Tree Set
- Stacks – Queues – Problems – Heap – Priority Queue – Problems
- Linked Lists – Traversal based Problems
- Trees – Types – Traversals

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

Course Code: 25CS01TP0501 **Course: Machine Learning**

L: 3 Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:

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

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

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

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

UNIT - IV
Probabilistic Machine Learning: Maximum Likelihood Estimation, MAP, Bayes Classifiers Naïve Bayes, Bayes optimal classifiers, Minimum description length principle.
Bayesian Networks, Inference in Bayesian Networks.

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

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

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

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

Reference Books

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

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

Course Code: 25CS01TP0502 | **Course: Software Engineering**

L: 3 Hrs, P: 2Hrs, Per Week | **Total Credits: 4**

Course Objectives

1. To familiarize students with the fundamentals of software engineering principles and practices.
2. To aid students in designing software systems using structured and object-oriented approaches.
3. To apprise students with different software testing and debugging strategies in building a quality software.
4. To introduce students to the practice of software project management.

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; Requirements Engineering.

Unit-II

Requirements Analysis, 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

Basic concepts of Testing, Software Testing Life Cycle (STLC), Verification and Validation, Unit Testing, Integration Testing, Validation Testing, System Testing,

Art of Debugging. White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing, Equivalence Partitioning, Boundary Value Analysis, Web Testing, Test case design, Building, Execution, Automated Testing.

Unit-IV

Software Project management- Plans, Methods and Methodology; Project Success and Failure, Project Evaluation, Cost-benefit evaluation technique, Project Planning & Scheduling.

Software Effort Estimation- Albrecht Function Point Analysis, COSMIC Function Point, Cost Estimation, COCOMO Model, Project Scheduling. Software Quality.

A Framework for Product Metrics, Metrics for Analysis & Design Models, Metrics for Source Code, Metrics for Testing & Maintenance. Metrics for process & project - Software measurement.

Unit-V

Risk management - Risk strategies, Software risks, Risk identification, Risk refinement, RMMM Risk Response development & Risk Response Control, Risk Analysis.

Change Management- Software Configuration Management, SCM Repository, SCM Process, Estimation, Reengineering- Software reengineering, Reverse 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. Demonstrate White Box Testing and Black Box Testing for building bug-free quality software.
4. Integrate software project management practices in software product development.

Text Books

1. Roger S. Pressman and Bruce R. Maxim; Software Engineering – A Practitioner's Approach; Eighth Edition, McGraw Hill; 2015.
2. Ian Somerville; Software Engineering; Seventh Edition; Pearson Education. 2008.

Reference Books

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

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

Course Code: 25CS01TP0503	**Course: Cloud Computing**
L: 3 Hrs, P: 2Hrs, Per Week	**Total Credits: 4**

Course Objectives

The objective of this course is to impart necessary and practical knowledge of components of Cloud computing and develop skills required to design real-life cloud-based projects by:

1. Learning basics of cloud and challenges in implementation.
2. Identifying areas where cloud computing can be applied.
3. Understanding the cloud environment and its security issues.
4. Understanding the various cloud programming and software environments.

UNIT I:

Introduction: Evolution of Cloud Computing –Underlying Principles of Parallel Distributed Computing, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning, Applications, deployment models - Public, Private and Hybrid Clouds, and service models- Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage. Software as a Service (SaaS) - Anything as a service (XaaS).

UNITII:

Virtualization: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, introduction to Various Hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

UNIT III:

Resource Management and Load Balancing: Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management, Resource Optimization, Resource dynamic reconfiguration, Scheduling Techniques for Advance Reservation, Capacity Management to meet SLA Requirements, and Load Balancing, various load balancing techniques.

UNIT IV:

Interoperability, Migration and Fault Tolerance: Issues with interoperability, Vendor lock-in, Interoperability approaches, Broad Aspects of Migration into Cloud, Migration of virtual Machines and techniques. Fault Tolerance Mechanisms. Security: Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues.

UNIT V:

Cloud Programming and Applications: Health care Analytics and Predictive Modelling Financial Data Analysis and Fraud Detection E-commerce Analytics for Customer Insights Smart City Solutions with Cloud (case Studies), Deployment of Web Services from Inside and Outside a Cloud Architecture.

Course Outcomes:

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

1. Understand the architecture, models, and characteristics of cloud computing
2. Apply virtualization and resource management techniques in cloud environments.
3. Analyze security, interoperability, and deployment issues in cloud-based systems.
4. Implement cloud solutions for real-world applications using appropriate tools and platforms.

Text Books

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, ―Distributed and cloud computing from Parallel Processing to the Internet of Things‖, Morgan Kaufmann, Elsevier –2012

2.Cloud Computing Principles and Paradigms‖, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley Publishers.2011

Reference Books

1Barrie Sosinsky, ― Cloud Computing Bible‖ John Wiley & Sons, 2010

2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, ―Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance‖, O'Reilly 2009

3. Cloud Computing: A Practical Approach, Toby Velte, Anthony T Velte, Robert Elsenpeter, McGraw Hill,2009

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

Course Code: 25CS01PR0505 | **Course: Idea Lab**

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

Course Outcomes

On successful completion, of course student will able to:

1. Identify problems across various domains and effectively frame them that facilitates creative solution generation.
2. Understand business models, pricing strategies, and ethical considerations in innovations.
3. Apply for patents/copyrights under IPR activities.
4. Design prototypes or proof-of-concepts to test and validate their ideas.
5. Enhance their presentation and communication skills as they pitch ideas, articulate concepts, and engage with stakeholders.

Syllabus:

1. Introduction of idea generation techniques and methodologies based on case studies of successful innovations.
2. Conducting market research, such as surveys, interviews, focus groups, and observational studies.
3. Brainstorming exercises and group discussions on problem framing and the solutions.
4. Hands-on activities for developing prototypes and refining ideas through user feedback.
5. Technical report writing and research proposals that match technology readiness levels (TRLs).
6. Practice sessions for pitching ideas and receiving constructive feedback.
7. Discussion on concepts such as business models, value proposition, pricing strategies and ethical implications for scalable innovations.

Text Books

1. Jacob Goldenberg and David Mazursky, Creativity in Product Innovation, Cambridge University Press, 2022.
2. Jessica Livingston, Founders at Work: Stories of Startups' Early Days", Fourth Edition, Apress, 2008.
3. Bill McGowan, Pitch Perfect: How to Say It Right the First Time, Every Time, Reprint Edition, Harper Business, 2016.

Reference Books

1. Bjarki Hallgrimsson, Prototyping and Modelmaking for Product Design, Laurence King Publishing Ltd, 2012.
2. David Bornstein and Susan Davis, Social Entrepreneurship: What Everyone Needs to Know, Oxford University Press, 2010

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

Course Code: 25CS01TP0601	**Course: Deep Learning-I**
L: 3 Hrs, P: 2Hrs, Per Week	**Total Credits: 4**

Course Objectives

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

UNIT I:

Basics of Deep Learning History of Deep Learning, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons,, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons.

UNIT II:

Training of Feedforward Neural Networks Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Training of Feedforward Neural Networks, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam

UNIT III:

Optimization Algorithm Activation Function and Initialization Methods: Sigmoid, Tanh, ReLU, Xavier and He Initialization, Regularization: Bias and Variance, Overfitting, Hyperparameters Tuning, L1 and L2 Regularization, Data Augmentation and Early Stopping, Parameter Sharing and Tying.

UNIT IV:

Convolutional Neural Network (CNN) Convolutional Neural Networks, 1D and 2D Convolution, Visualizing Convolutional Neural Networks, Guided Backpropagation.

UNIT V:

Recurrent Neural Network (RNN) Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Long Short-Term Memory (LSTM) Cells, Gated Recurrent Units (GRUs). **Variants of CNN and RNN** Encoder-Decoder Models, Attention Mechanism, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet

Course Outcomes:

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

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

Text Books

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

Reference Books:

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

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

Course Code: 25HS02TP0601 **Course: Business Communication**

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

Course Objective

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.

UNIT 1: 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 2: 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 3: 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 4: Report

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

UNIT 5: 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

Course Code: 25CS01PR0601	**Course: Mini Project**
L: 0 Hr, P: 4Hrs, Per Week	**Total Credits: 2**

Course Objectives

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

Course Outcomes:

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

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.

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

Course Code: 25CS01PR0407 **Course: Advanced Competitive Coding**

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

The course will cover exercises based on following topics

- Trees – BST – Insertion – Views: Top, Left, Right, Bottom
- Trees – Path Based Problems
- Greedy – Divide and Conquer – Back Tracking
- Sliding Window – Sub Arrays – 2 Pointer Technique
- Dynamic Programming – Memoization vs Tabulation
- One Dimensional and 2 Dimensional DP
- Graphs – Traversals – MST – Dijkstra – Bellman Ford Algorithms

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

Course Code: 25CS01PR0705	**Course: Major Project-1**
L: 0 Hr, P: 8 Hrs, Per Week	**Total Credits: 4**

Course Objectives

The objective of project is to let the students apply theoretical knowledge and practical skills acquired in the previous semesters to solve a real-world problem by developing an innovative, and efficient solution while enhancing problem-solving, teamwork, and research capabilities.

Course Outcomes:

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

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.

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

Course Code: 25CS01PR0707 **Course: Internship Evaluation**

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

Course Objectives

1. To enable students to explore opportunities for alternative career development.
2. To assess interests and abilities in the respective field of study and to integrate theory and practice.
3. To learn workplace habits and develop attitudes and skills necessary for job success.

Scope

Students are expected to complete the internship before the start of the VII semester. The industry internship evaluation will be carried out during the VII Semester.

Mode of Conduction

Each student will be evaluated through Seminar-cum-Presentations on the following parameters

- Technology
- Domain Understanding
- Outcomes.

Course Outcomes

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

1. Apply fundamental science and engineering principles to identify and evaluate real-world challenges.
2. Use modern tools and demonstrate a continuous learning approach.
3. Communicate technical information employing written reports and presentations.

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

Course Code: 25CS01PR0803	**Course: Major Project-2**
L: 0 Hr, P: 12 Hrs, Per Week	**Total Credits: 6**

Course Objectives

The objective of project is to let the students apply theoretical knowledge and practical skills acquired in the previous semesters to solve a real-world problem by developing an innovative, and efficient solution while enhancing problem-solving, teamwork, and research capabilities.

Course Outcomes:

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

1. Identify and finalize the problem statement by investigating various domains and society needs.
2. Perform requirement analysis and design methodology for solving the identified problem.
3. Apply programming techniques and modern tools for the development of the solution.
4. Apply ethical principles, project management skills and demonstrate the ability to work in teams for project development within the confines of a deadline.
5. Communicate technical information employing written reports and presentations.

Track 1:
Computer Science and Engineering

Syllabus for Semester IV, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01PR0404-01 Course: Elect-1 Software Lab-II Advanced Linux
L: 0Hrs, P: 4Hrs, Per Week Total Credits: 2

Course Objectives:
The primary objective of this course is to provide students with in-depth knowledge and hands-on experience in advanced Linux system administration, shell scripting, and kernel-level programming.

Unit I: Linux Fundamentals and Host Administration
Linux installation, basic command-line usage, vi editor operations, software package management, user and group management, file permissions, bootloader (GRUB) configuration, hard disk partitioning and mounting, process monitoring and control, core system services, and kernel compilation.

Unit II: Shell Scripting and Linux Programming
Shell scripting basics, loops, conditionals, functions, system automation using scripts, introduction to Linux system programming, use of libipq, libnet, and libpcap libraries, packet handling, network control, and packet capture.

Unit III: Intranet Services Configuration
Linux networking fundamentals, DHCP server configuration, NFS server setup, Samba server setup, NIS server configuration, LDAP server installation and integration.

Unit IV: Internet Services and Security
FTP server configuration, SSH server setup, DNS configuration using BIND, web server deployment using Apache and Nginx, Squid proxy server setup, mail server configuration using Postfix and Dovecot, firewall configuration using iptables, VPN server deployment.

Unit V: Advanced Linux Kernel Programming
Kernel architecture, system call implementation, process management using task_struct, CPU scheduling, context switching, interrupt handling with softirqs and tasklets, synchronization using spinlocks and semaphores, timer management, page table and memory allocation, VFS internals, block layer, NVMe storage, TCP/IP networking stack.

Course Outcomes
On successful completion of the course, student shall be able to
1. Demonstrate proficiency in installing, configuring, and managing Linux systems, users, and core services.2.
2. Develop automated solutions using shell scripts and apply basic Linux programming with system libraries.3
3. Configure and manage intranet services such as DHCP, NFS, Samba, NIS, and LDAP.
4. Deploy and secure internet services including FTP, SSH, DNS, Web, Proxy, Mail, Firewall, and VPN servers.
5. Analyze and implement advanced Linux kernel functionalities including system calls, memory, scheduling, and networking.

Text Books:

1. Linux Administration: A Beginner's Guide", Wale Soyinka, McGraw-Hill Education
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder, Trent Hein, Ben Whaley, Dan Mackin, Pearson Education
3. Linux Kernel Development, Robert Love, Addison-Wesley

Reference Books

1. Understanding the Linux Kernel, Daniel P. Bovet, Marco Cesati, O'Reilly Media
2. Linux Command Line and Shell Scripting Bible, Richard Blum, Christine Bresnahan, Wiley

Syllabus for Semester IV, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01PR0404-02 Course: Elec-II Software Lab-II Web Programming
L: 0Hrs, P: 4Hrs, Per Week Total Credits: 2

Course Objectives:
1. To comprehend the fundamentals of React with JavaScript and JSX for creating templates with React components and their importance in building reusable UI elements.
2. To familiarize the students with essential skills for modern front-end web applications by the use of ReactJS features.
3. To learn to implement client-side routing using React Router for Single Page Applications (SPAs).

Introduction to React: ReactJS Introduction, Advantages of React JS, Introduction to JSX,
Difference between JS and JSX, Templating using JSX, Working with React, createElement, Expressions, logical operators, specifying attributes, children and Fragments.

React Components overview: Types of components, Controlled, Split Up, Composable, Reusable, Component Declarations and Styling Components, Conditional Rendering, List Rendering.

Props and State: State and its significance, Read state and setState, Passing data to components using props, Validating props using prop Types, Supplying default values to props using default Props.

Event Handling: Lifecycle Methods, Handling events in React Components, React Forms, Controlled Components, Uncontrolled components.

Routing with React Router: Need of react Router, React Router Installation, Components in React Router, Adding Navigation using Link component.

Course Outcomes
On successful completion of the course, student shall be able to
1. Understand the fundamentals of React with JavaScript and JSX.
2. Build and reuse functional and class-based React components effectively.
3. Utilize props and state effectively to manage data flow and UI interactions in React applications
4. Handle user events and implement conditional rendering based on user interaction.
5. Demonstrate dynamic routing and navigation in a React application.

Text Books:
1. React Up & Running: Building Web Applications - Stoyan Stefanov, O'Reilly Media, Second Edition, 2021.
2. Learning React: Modern Patterns for Developing React Apps - Alex Banks & Eve Porcello, O'Reilly Media, Second Edition, 2020.

3. React in Action 1st Edition - Mark Tielens Thomas, Manning Pubns Co, First Edition, 2018.

Reference Books

1. Pure React- a step-by-step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch

Syllabus for Semester V, Track 1 B. Tech. Computer Science & Engineering

Course Code: 25CS01PR0504 **Course: Software Lab-III Design Patterns Lab**

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

Course Objectives:

- To implement and validate commonly used design patterns using an object-oriented programming language.
- To build small-scale applications that demonstrate the usage of individual design patterns.
- To analyze the impact of design patterns on code reusability, scalability, and maintainability.
- To identify anti-patterns and refactor code for better design

UNIT-I:

Elements of Design Pattern, Describing Design Pattern, Design Pattern Classification, Role of design patterns in software design, Example implementation of design pattern using UML.

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 implementations 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 implementations 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, Comparative study of Behavioral patterns, and implementations based on real life applications.

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 implementations based on real life applications.

Course Outcomes

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

1. Apply various design patterns in practical coding problems.
2. Build modular and maintainable systems using object-oriented principles.
3. Refactor existing code using design patterns to improve design quality.
4. Develop mini-projects showcasing real-life applications of multiple design patterns.

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, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0506-01 Course: Distributed Operating System
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives
This course introduces principles, design and implementation of distributed system. The course focus primarily on the principles and design of distributed systems and cover communication, distributed storage, naming, synchronization, scheduling, fault tolerance and recovery.

Unit I
Introduction to Distributed systems: Examples of distributed systems, challenges, architectural models, issues in distributed operating systems, communication primitives, Theoretical Foundations - inherent limitations of a distributed system, Lamports logical clocks, vector clocks, casual ordering of messages, global state, cuts of a distributed computation, termination detection.
Unit II
Distributed Mutual Exclusion: Introduction, classification of mutual exclusion and associated algorithms (token based and non-token based approach), a comparative performance analysis.
Unit III
Distributed Deadlock Detection: Introduction, deadlock handling strategies in distributed systems, issues in deadlock detection and resolution, control organizations for distributed deadlock detection, centralized and distributed deadlock detection algorithms, hierarchical deadlock detection algorithms. Agreement protocols: introduction, the system model, a classification of agreement problems, solutions to the Byzantine agreement problem
Unit IV
Distributed File system: Introduction to DFS , design issues , File service architecture , Distributed shared memory: design issues, Architecture, algorithms for implementing DSM, memory coherence and protocols
Unit V
Distributed Scheduling: Introduction, issues in load distributing, components of a load distributing algorithm, load distributing algorithms, performance comparison, selecting a suitable load sharing algorithm, requirements for load distributing, task migration and associated issues.
Unit VI
Failure Recovery: introduction, basic concepts, classification of failures recovery in concurrent systems, consistent set of check points, synchronous and asynchronous check pointing and recovery. Fault Tolerance: Introduction, Atomic Actions and committing, Commit protocols, Voting Protocols

Course Outcomes:
On successful completion of the course, students will be able to:
1. Apply knowledge of basic distributed system techniques and concepts.
2. Comprehend issues in mutual exclusion, deadlock detection, and agreement protocols in the context of distributed systems.
3. Realize design issues for distributed file system, distributed shared memory and distributed scheduling.
4. Recognize the importance of fault tolerance and failure recovery in a distributed environment.

Text Books

1. Advanced concepts in Operating Systems – Singhal and Shivratri; McGraw Hill Coulouris, Dollimore, Kindleberg;
2. Distributed Systems Concepts and Design, Fourth Edition, Pearson education, 2009.
3. Distributed Systems An Algorithmic Approach, Second Edition, Sukumar Ghosh, CRC Press.

Reference Books

1. Andrew S. Tanenbaum; Distributed Operating System; Pearson education; 2003.
2. Pradeep K. Sinha, "Distributed Operating System-Concepts and Design", PHI, 2003

Syllabus for Semester VI, Track 1 B. Tech. Computer Science & Engineering

Course Code: 25CS01TP0602-01 **Course: Fundamentals of Public Cloud Platform**

L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Unit 1: Introduction to Cloud Computing & Public Cloud Models
- Basics of Cloud Computing – Characteristics & Benefits
- Cloud Deployment Models: Public, Private, Hybrid
- Cloud Service Models: IaaS, PaaS, SaaS
- Introduction to Public Cloud Providers: AWS, Azure, GCP
- Cloud Terminologies & Use Cases
- Overview of Global Infrastructure (Regions, Zones)

Unit 2: AWS Core Services and Architecture
- AWS Management Console and CLI
- EC2, S3, RDS, Lambda, IAM, VPC, CloudWatch
- Elastic Load Balancing and Auto Scaling
- Hands-on: Launch EC2 instance, attach EBS, store data in S3
- AWS Shared Responsibility Model
- Basics of Billing and AWS Free Tier

Unit 3: Microsoft Azure Fundamentals
- Azure Portal, Azure CLI, Azure Resource Manager (ARM)
- Core Azure Services: Virtual Machines, Blob Storage, Azure SQL, Azure Functions
- Azure Networking: VNets, NSG, Load Balancer
- Role-Based Access Control (RBAC)
- Hands-on: Deploy VM and Web App using Azure Portal
- Azure Pricing Calculator and TCO Estimator

Unit 4: Google Cloud Platform (GCP) Essentials
- GCP Console, Cloud Shell, and gcloud CLI
- Core GCP Services: Compute Engine, Cloud Storage, BigQuery, Cloud Functions
- Identity and Access Management (IAM) in GCP
- Virtual Private Cloud (VPC) in GCP
- Hands-on: Create VM and Cloud Bucket in GCP
- Overview of GCP billing and quotas

Unit 5: Multi-Cloud Strategies & Industry Applications
- Cloud Migration Basics
- Multi-Cloud Architecture & Vendor Lock-in Issues
- Monitoring, Security, and Compliance in the Cloud
- Real-world Case Studies: Multi-cloud in E-Commerce, Banking, EdTech
- Cloud Cost Optimization Techniques
- Industry-recognized certifications: AWS Cloud Practitioner, Azure Fundamentals (AZ-900), GCP ACE

Suggested Lab Activities
- Setting up cloud accounts (AWS, Azure, GCP)
- VM creation, object storage, networking on all three platforms
- Role management and permissions demo
- Cost estimation tasks using pricing calculators
- Simple serverless app deployment (Lambda/Azure Functions/Cloud Functions)

Course Outcomes

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

1. Explain the essential characteristics of cloud computing and different service models (IaaS, PaaS, SaaS).
2. Identify and utilize core cloud services like compute, storage, networking, and databases on AWS, Azure, and GCP.
3. Compare cloud platform offerings and deployment strategies from AWS, Azure, and GCP
4. Apply basic cloud deployment and management skills using CLI, portals, and SDKs.

Textbooks

1. Cloud Computing: Concepts, Technology & Architecture – Thomas Erl, Zaigham Mahmood, Ricardo Puttini
2. AWS Certified Cloud Practitioner Study Guide – Ben Piper, David Clinton
3. Exam Ref AZ-900 Microsoft Azure Fundamentals – Jim Cheshire
4. Google Cloud Certified Associate Cloud Engineer Study Guide – Dan Sullivan

Reference Books

1. Architecting the Cloud – Michael J. Kavis
2. Cloud Computing: A Hands-On Approach – Arshdeep Bahga, Vijay Madisetti
3. Cloud Computing Bible – Barrie Sosinsky
4. Learning Google Cloud Platform – Marko Sluga
5. Azure for Architects – Ritesh Modi

Syllabus for Semester VI, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0603-01 Course: Cryptography and Network Security
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives

1. To build strong fundamentals of cryptographic techniques and algorithms to realize Security Goals.
2. Understand authentication, access control, intrusion detection, and prevention.
3. Identify and mitigate software security vulnerabilities in existing systems.

UNIT I:

Introduction to Security Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Non repudiation, Classical Cryptographic Techniques.

UNIT II:

Symmetry key Cryptography Algebraic Structures, Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard. Key distribution, Attacks.

UNIT III:

Public key Cryptography Mathematical background, Number Theory. Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem. RSA Algorithm, , Elliptic Curve Cryptography.

UNIT IV:

Message Authentication, Integrity and Key Management Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures, Key Management, Diffie- Hellman Key Exchange Kerberos, X.509

UNIT V:

Network Security Practices and Wireless Security Electronic Mail Security – PGP, – IP security – Web Security – The Secure Sockets Layer (SSL),Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things.

Course Outcomes:

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

1. Analyse the Network Security Threats.
2. Apply cryptographic techniques and algorithms to build security-related applications.
3. Solve problems related to key generation and key exchange algorithms.
4. Implement necessary Security mechanisms to secure the Computer Network.
5. Understand the security concepts in Wireless network

Text Books

1. William Stallings; Cryptography & Networks Security Principles and Practice; 6th Edition
2. Pearson Education, 2013.
3. Atul Kahate; Cryptography and Network Security; 1st Edition; Tata McGraw Hill, 2008.
4. Behrouz A. Forouzan, Cryptography and network security MC Graw Hill 3rd Edition
5. C. Kaufman, R. Perlman, M. Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2nd edition, 2002.

Reference Books

1. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i",

Pearson Education, 2004.
3. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
4. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

Syllabus for Semester VI, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0604-01 **Course: Data Storage and Network in cloud**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Unit I: Introduction to Cloud Storage

Concepts in Cloud Storage, Types of Storage: Object Storage, Block Storage, File Storage, Differences among the different types of storage.

Unit II: Storage Services in AWS
Simple Storage Service (S3), Elastic Block Store (EBS), Elastic File Store (EFS), FSX, FSX Lustre, AWS Snowball, Snowmobile etc., Features of different storage services in AWS, perform various operations through the different storage services in AWS.

Unit III: Storage Services in Ms Azure
Binary Large Objects (Blobs), Block Blob, Page Blob, Append Blob; Azure Disks, Azure File Share etc., Features of different storage services in Azure, perform various operations through the different storage services in Azure.

Unit IV: Introduction to Networks in Cloud

Designing the Networks in On Premises environment, Concept of CIDR blocks, Subnet Masks etc. Designing the Networks in Cloud environment, Designing a custom Virtual Private Cloud (VPC) in AWS, Designing a custom Virtual Network in Ms Azure.

Unit V: Virtual Private Cloud (VPC) in AWS and Virtual Networks in Ms Azure

Introduction to VPC, Features of default and custom VPC, Subnets, Creating a VPC along with multiple Subnets, Route Tables, Internet Gateway, NAT Gateway, NAT Instances etc., Concept on Public and Private subnets, VPC Peering. Introduction to VNET, Features of default and custom VNETs, Subnets, Creating a VNET along with multiple Subnets, VNET Peering, VPN Gateway.

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

1. Differentiate between the different storage types
2. Understand and analyze storage services in AWS and Azure.
3. Analyze and deploy storage services on AWS and Azure platform.
4. Design and create the networks in cloud.
5. Understand and analyze the networking services in AWS and Azure.
6. Analyze and deploy networking services on AWS and Azure platform.

Text Books:

1. Practical AWS Networking, By Mitesh Soni, Packt Publication.
2. Azure Networking Cookbook, Second Edition - Second Edition, By Mustafa Toroman, Packt Publication.
3. AWS Storage Services: A complete guide to understanding storage services, IP Specialist - Companion Guide: First Edition – 2022
4. Microsoft Azure Storage: The Definitive Guide, Avinash Valiramani, Microsoft.
5. learn.microsoft.com

Syllabus for Semester VII, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0701-01 Course: Cloud Administration
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Unit 1: Azure Administration Essentials
- Introduction to Azure architecture and services
- Azure portal, CLI, PowerShell, and Cloud Shell
- Azure regions, availability zones, and resource groups
- Manage Azure subscriptions and billing
- Implement Role-Based Access Control (RBAC)
- Introduction to Azure Resource Manager (ARM) templates

Unit 2: Identity and Governance in Azure
- Azure Active Directory (AAD) overview
- Users, groups, and roles management
- Configure multi-factor authentication (MFA)
- Implement Conditional Access and Privileged Identity Management (PIM)
- Governance: Policies, Blueprints, and Locks
- Hands-on: Creating users, assigning roles, configuring RBAC

Unit 3: Azure Compute, Storage and Networking
- Create and manage virtual machines (Linux & Windows)
- Configure availability sets and scale sets
- Configure Azure Storage (Blob, File, Queue, Table)
- Implement Azure Disks and snapshots
- Create Virtual Networks (VNets), Subnets, NSGs, and route tables
- Deploy Load Balancers and Application Gateways
- Hands-on: Deploy VM with VNet and secure it using NSGs

Unit 4: Monitoring, Backup and Disaster Recovery
- Azure Monitor, Metrics, Logs, and Alerts
- Configure Diagnostic settings and Log Analytics
- Implement Azure Backup and Site Recovery (ASR)
- Configure and use Azure Recovery Services vault
- Hands-on: Set up backup for a VM and configure monitoring with alerts

Unit 5: Automation, Optimization, and Exam Preparation
- Automate tasks using Azure Automation (Runbooks)
- Use PowerShell and CLI scripts for VM and storage tasks
- Cost management: Budgets, alerts, recommendations
- Performance tuning and rightsizing
- AZ-104 exam structure, domains, and sample questions
- Final project: Deploy and administer a secure and monitored Azure infrastructure

Suggested Lab Exercises
- Create resource groups, VMs, and storage accounts
- Configure RBAC and test access restrictions
- Setup backup and disaster recovery for critical resources
- Automate patch management using Azure Automation
- Monitor VMs and trigger alerts on threshold breaches

Course Outcomes (COs)

1. Explain and manage core Azure services and subscriptions.
2. Implement identity and access control using Azure Active Directory.
3. Configure virtual machines, storage accounts, and networking in Azure.
4. Monitor Azure resources and implement backup, security, and disaster recovery.
5. Automate and optimize operations using CLI, PowerShell, and Azure tools.

Textbooks

1. **Exam Ref AZ-104 Microsoft Azure Administrator** – Harshul Patel (Microsoft Press)
2. **Microsoft Azure Infrastructure Services for Architects** – John Savill
3. **Hands-On Azure for Administrators** – Mustafa Toroman

Reference Books

1. **Microsoft Learn: AZ-104 Learning Path** – learn.microsoft.com
2. **Cloud Computing: Concepts, Technology & Architecture** – Thomas Erl
3. **Azure for Architects** – Ritesh Modi
4. **The Azure Cloud Native Architecture Mapbook** – Stephane Eyskens
5. **Azure Well-Architected Framework** – Microsoft Documentation

Syllabus for Semester VII, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0702-01 Course: AL & ML for Public Cloud Platform
L: 2Hrs, P: 2Hrs, Per Week Total Credits: 3

Unit 1: Introduction to Artificial Intelligence and Azure AI Services
- Overview of Artificial Intelligence and Machine Learning
- AI in daily life and industry applications
- Introduction to Microsoft Azure
- Azure Cognitive Services overview
- Use cases of Azure AI services (vision, speech, language, decision-making)

Unit 2: Machine Learning on Azure
- What is machine learning? Types of ML: supervised, unsupervised, reinforcement
- Azure Machine Learning basics
- Create and run ML models using Azure ML Studio
- Data preprocessing, training, and deployment
- Hands-on: Build a basic regression/classification model using Azure ML

Unit 3: Computer Vision and Image Analysis
- Introduction to Computer Vision APIs
- Image classification, object detection, facial recognition
- OCR and form recognizer
- Hands-on: Use Azure Cognitive Services for image analysis

Unit 4: Natural Language Processing (NLP) and Conversational AI
- Text analytics: sentiment analysis, key phrase extraction
- Translator and language detection services
- Azure Bot Service and QnA Maker
- Hands-on: Build a chatbot using Azure Bot Framework and Language Studio

Unit 5: Responsible AI and AI-900 Exam Preparation
- Principles of responsible AI: fairness, reliability, privacy, security
- Challenges in deploying ethical AI solutions
- Cost management and monitoring in Azure AI
- AI-900 certification preparation and mock tests
- Final capstone project: Build and deploy a complete AI solution using Azure

Suggested Lab Exercises
- Create an ML model with Azure ML Studio
- Perform sentiment analysis on a dataset
- Build a facial recognition system with Computer Vision API
- Develop a multilingual chatbot using Azure Bot Services
- Apply content moderation and text translation APIs

Course Outcomes (COs):
1. Understand basic AI/ML concepts and real-world applications.
2. Explore Azure AI services including Computer Vision, NLP, and Conversational AI.
3. Apply machine learning concepts using Azure Machine Learning Studio.
4. Demonstrate use of responsible AI principles on Azure.
5. Prepare and qualify for the AI-900 certification with hands-on labs.

Text Books

1. **Microsoft Certified Azure AI Fundamentals Study Guide (Exam AI-900)** – Julian Sharp (Microsoft Press)
2. **Hands-On Azure for Developers** – Mustafa Toroman
3. **Artificial Intelligence: A Guide for Thinking Humans** – Melanie Mitchell

Reference Books and Resources

- Microsoft Learn AI-900 Learning Paths – https://learn.microsoft.com
- **Practical Artificial Intelligence with Azure** – Rabeb Othmani
- **Azure AI Fundamentals (AI-900) Exam Ref** – Jim Cheshire
- AI School by Microsoft – https://aischool.microsoft.com

Syllabus for Semester VII, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0703-01   Course: Cloud Migration
L: 3Hrs, P: 0Hrs, Per Week   Total Credits: 3

Unit 1: Introduction to Cloud Migration
- Basics of cloud computing and benefits of migration
- Types of cloud environments: IaaS, PaaS, SaaS
- Business drivers and challenges of cloud migration
- Migration phases: Assess, Mobilize, Migrate, Optimize
- Cloud adoption frameworks (AWS CAF, Azure CAF, GCP CAF)

Unit 2: Migration Planning and Assessment
- Workload discovery and dependency mapping
- Readiness assessments and application inventory
- Cost estimation and ROI analysis
- Choosing a migration strategy: 6 R's (Rehost, Replatform, Refactor, Repurchase, Retire, Retain)
- Hands-on: Using Azure Migrate/AWS Migration Evaluator for workload assessment

Unit 3: Migration Tools and Platforms
- **AWS Tools:** Migration Hub, Server Migration Service (SMS), Application Migration Service, Database Migration Service (DMS)
- **Azure Tools:** Azure Migrate, Database Migration Service, Site Recovery
- **GCP Tools:** Migrate for Compute Engine, Velostrata, GCP Transfer Appliances
- Hybrid migration options and multi-cloud considerations
- Hands-on: Migrate a sample on-prem VM to cloud (Azure/AWS)

Unit 4: Data Migration, Testing and Validation
- Storage migration (NAS to object storage, etc.)
- Database migration and schema conversion tools
- Application testing post-migration
- Performance tuning and rollback planning
- Hands-on: Use AWS DMS or Azure DMS to migrate a sample database

Unit 5: Post-Migration Optimization and Governance
- Monitoring and troubleshooting migrated workloads
- Cost optimization using cloud-native tools
- Security compliance and access management post-migration
- Backup, DR, and business continuity planning
- Final Project: Complete migration of a small IT workload with documentation

Suggested Lab Exercises
- Use Azure Migrate to assess and migrate a virtual machine
- Migrate MySQL database to Amazon RDS using AWS DMS
- Perform data migration using GCP Migrate for Compute Engine
- Create a rollback plan and simulate a failed migration
- Monitor a migrated workload and optimize cost/security settings

Course Outcomes (COs)
1. Explain the need for cloud migration and various migration strategies.
2. Plan and assess an on-premise workload migration to cloud platforms.
3. Perform workload migration using tools such as AWS Migration Hub and Azure Migrate.

4. Address security, compliance, and cost optimization during migration.
5. Design and implement a migration plan with rollback, monitoring, and validation.

Text Books

1. **Cloud Migration Handbook: Use Cases, Guidance, and Best Practices** – José Antonio Hernández
2. **Architecting Cloud Computing Solutions –** Kevin L. Jackson, Scott Goessling
3. **Microsoft Azure Migration Handbook** – Steve Miles

Reference Books & Online Resources

1. **AWS Migration Whitepapers and Tools** – aws.amazon.com/migration
2. **Microsoft Learn – Azure Migrate Path** – learn.microsoft.com
3. **Google Cloud Migration Center** – cloud.google.com/migrate
4. **Cloud Adoption Frameworks (AWS, Azure, GCP)**
5. **Cloud Migration Patterns** – O'Reilly Media

Syllabus for Semester VII, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0704-01 Course: Data Engineering and Cloud
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Unit 1: Introduction to Cloud Data Engineering
- Data engineering fundamentals and roles
- Overview of cloud data platforms: AWS, Azure, GCP
- Data pipeline concepts: Batch vs Streaming
- Cloud-based data architecture: lake house, warehouse, data lake
- Case studies and use cases from various industries

Unit 2: Data Ingestion and Storage
- Batch ingestion using Azure Data Factory, AWS Glue, GCP Dataflow
- Streaming ingestion using Kafka, Azure Event Hubs, Amazon Kinesis, Pub/Sub
- Cloud Storage Solutions: S3, Azure Blob, GCS, HDFS
- Structured, semi-structured, and unstructured data handling
- Hands-on: Ingest and store data in AWS S3 / Azure Data Lake / GCS

Unit 3: Data Transformation and Processing
- ETL/ELT design patterns
- Processing with Spark (Databricks, EMR, Synapse Spark Pools)
- SQL-based transformation tools: Big Query, Redshift, Azure Synapse
- Handling schema evolution, partitioning, and clustering
- Hands-on: Build a Spark pipeline to transform CSV/JSON data on cloud

Unit 4: Data Orchestration and Workflow Automation
- Scheduling and orchestration: AWS Step Functions, Azure Data Factory Pipelines, GCP Composer (Airflow)
- Error handling and retries, notifications
- Workflow monitoring and logging
- Hands-on: Build a multi-stage data pipeline using orchestration tools

Unit 5: Real-Time Data Processing and Analytics
- Introduction to real-time analytics and Lambda architecture
- Real-time data pipelines using Kinesis / Azure Stream Analytics / Dataflow
- Data quality, governance, lineage, and compliance
- Visualization and reporting: Power BI, Quick Sight, Looker Studio
- Capstone Project: Design and implement a data pipeline from ingestion to visualization

Suggested Lab Exercises
- Load IoT/CSV data to cloud storage and run Spark job
- Real-time data stream ingestion using Kafka or Kinesis
- Use Azure Synapse or Big Query to run complex queries
- Build ETL pipelines with AWS Glue or ADF
- Monitor and orchestrate workflows with Airflow or Step Functions

Course Outcome
1. Understand data engineering lifecycle and its importance in modern data ecosystems.
2. Design and implement ETL/ELT pipelines using cloud-native tools.
3. Utilize managed services for big data storage, processing, and orchestration.
4. Work with real-time data processing using streaming technologies.
5. Evaluate and optimize cloud-based data workflows for performance and cost.

Text Books

1. **Data Engineering with Python** – Paul Crickard
2. **Designing Data-Intensive Applications** – Martin Kleppmann
3. **Fundamentals of Data Engineering** – Joe Reis and Matt Housley

Reference Books & Resources

1. **Google Cloud Certified Professional Data Engineer Study Guide** – Dan Sullivan
2. **Azure Data Engineer Associate Certification Guide (DP-203)** – David E. Rendon
3. **AWS Certified Data Analytics Study Guide** – Asif Abbasi
4. **Cloud Academy, A Cloud Guru, and Microsoft Learn modules**
5. **Official Cloud Documentation:**
    - https://cloud.google.com/data-engineering
    - https://learn.microsoft.com
    - https://docs.aws.amazon.com

Syllabus for Semester VIII, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0801-01 Course: Cloud Security
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Unit 1: Cloud Security Fundamentals
- Shared Responsibility Model (AWS vs Azure)
- Zero Trust Security Architecture
- Cloud Compliance & Regulatory Requirements (ISO, HIPAA, PCI-DSS, GDPR)
- Security posture management tools
- AWS: AWS Organizations, Trusted Advisor
- Azure: Microsoft Defender for Cloud, Compliance Manager

Unit 2: Identity and Access Management (IAM)
- AWS IAM: Users, Groups, Roles, Policies
- Azure Active Directory (AAD), RBAC, Conditional Access
- Identity Federation and SSO
- MFA and Privileged Access Management (PAM)
- Hands-on: Configuring IAM Policies in AWS & Conditional Access in Azure

Unit 3: Infrastructure and Network Security
- VPC and Subnet design (AWS), VNet and NSG (Azure)
- Security Groups, Network ACLs
- Firewalls: AWS WAF, Azure Firewall
- DDoS Protection: AWS Shield, Azure DDoS Protection
- Bastion Hosts and Just-in-Time Access
- Hands-on: Implement secure VPC/VNet with Firewall rules

Unit 4: Data Protection and Key Management
- Encryption at rest and in transit
- Key Management Service (AWS KMS, Azure Key Vault)
- S3 Bucket Policies, Blob Storage Security
- Tokenization and Data Masking
- Hands-on: Store and retrieve secrets using Key Vault & KMS

Unit 5: Monitoring, Compliance, and Incident Response
- AWS CloudTrail, CloudWatch, AWS Config
- Azure Monitor, Log Analytics, Azure Policy
- SIEM Integration: Azure Sentinel, AWS Security Hub
- Incident response automation: Lambda functions / Azure Automation
- Hands-on: Create threat alerts in Security Hub and Azure Sentinel

Suggested Labs / Hands-on Exercises
- Identity & Access setup in both AWS and Azure
- VPC/VNet with secure routing and firewall rules
- Encryption and decryption with KMS and Key Vault
- Configure DDoS and WAF protection for web apps
- Monitor and audit logs using AWS CloudTrail and Azure Log Analytics

Course Outcomes (COs):

1. Understand cloud security fundamentals and shared responsibility models.
2. Configure IAM, identity federation, and access control in AWS and Azure.
3. Secure networks using VPC/Subnet rules, NSGs, WAFs, and Firewalls.
4. Protect data at rest and in transit using encryption and key management tools.
5. Monitor, audit, and automate threat detection and response.

Textbooks

1. **Exam Ref AZ-500 Microsoft Azure Security Technologies**
   Yuri Diogenes & Orin Thomas, Microsoft Press
2. **AWS Certified Security Specialty Exam Guide**
   Stuart Scott, Packt Publishing
3. **Cloud Security and Privacy**
   Tim Mather, Subra Kumaraswamy, Shahed Latif – O'Reilly

Reference Books & Resources

- **AWS Security Best Practices Whitepaper**
  https://docs.aws.amazon.com/whitepapers/
- **Microsoft Learn – Security Engineer Learning Path**
  https://learn.microsoft.com/en-us/training/
- **Practical Cloud Security: A Guide for Secure Design and Deployment**
  Chris Dotson – O'Reilly
- **Azure Security Documentation**
  https://learn.microsoft.com/en-us/security/azure-security

Syllabus for Semester VIII, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0802-01   Course: Architecting on Cloud
L: 3Hrs, P: 0Hrs, Per Week   Total Credits: 3

Unit 1: AWS Cloud Architecture Fundamentals
•AWS Global Infrastructure
•AWS Well-Architected Framework
•Design principles for high availability, scalability, and disaster recovery
•Overview of Compute, Storage, Database, Networking, and Security services

Unit 2: Identity, Access Management, and Security
•AWS Identity and Access Management (IAM)
•Policies, Roles, and Permission Boundaries
•AWS Organizations and SCPs
•Key Management Service (KMS), Secrets Manager, and AWS Shield/WAF

Unit 3: Compute, Storage, and Networking Architecture
•EC2 instance types, Load Balancers (ALB/NLB), Auto Scaling Groups
•Amazon S3, EBS, EFS, S3 Glacier, Storage Gateway
•VPC, Subnets, Route Tables, NAT Gateway, Transit Gateway
•Hands-on: Deploy a VPC-based multi-tier web app with Auto Scaling

Unit 4: Designing for Resilience, Monitoring, and DR
•High Availability using Multi-AZ and Multi-Region
•Amazon Route 53, Elastic Load Balancer
•Amazon CloudWatch, AWS CloudTrail, AWS Config
•Backup strategies: AWS Backup, Cross-Region Replication
•Disaster Recovery strategies: Pilot Light, Warm Standby, Multi-Site

Unit 5: Cost Optimization, Automation, and DevOps Practices
•AWS Pricing Calculator, Cost Explorer, Budgets, Trusted Advisor
•Infrastructure as Code using AWS CloudFormation, Terraform (optional)
•CI/CD pipelines with CodePipeline, CodeDeploy, and GitHub
•Final Project: Design, Document, and Deploy a Full Architecture Solution on AWS

Lab Activities
•Configure IAM roles and permissions for secure access
•Deploy EC2 with Auto Scaling and Elastic Load Balancer
•Set up VPC with public/private subnets, NAT Gateway, and security groups
•Monitor resources using CloudWatch alarms and dashboards
•Use CloudFormation templates to automate infrastructure deployment

Course Outcomes (COs):
1. Explain AWS architectural principles and services used for building robust solutions.
2. Design scalable, resilient, and fault-tolerant architectures using AWS components.
3. Implement security, compliance, and identity strategies on AWS.

4. Apply cost optimization and performance tuning using AWS tools.
5. Create infrastructure using Infrastructure as Code and DevOps best practices.

Text Books

1.AWS Certified Solutions Architect Official Study Guide Authors: Ben Piper, David Clinton Publisher: Wiley
2.Amazon Web Services in Action Authors: Michael Wittig, Andreas Wittig Publisher: Manning Publications

Reference Books and Online Resources

1.AWS Well-Architected Framework Whitepaper – https://aws.amazon.com/architecture/well-architected/
2.AWS Skill Builder (Learning Path) – https://skillbuilder.aws/
3.Designing Distributed Systems – Brendan Burns
4.AWS Documentation and Labs – https://docs.aws.amazon.com/
5.AWS Solutions Library – https://aws.amazon.com/solutions/

Track 2:
Computer Science and Engineering

Syllabus for Semester IV, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01PR0404-01 Course: Software Lab-II Advanced Linux Programming
L: 0Hrs, P: 4Hrs, Per Week Total Credits: 2

Course Objectives:
The primary objective of this course is to provide students with in-depth knowledge and hands-on experience in advanced Linux system administration, shell scripting, and kernel-level programming.

Unit I: Linux Fundamentals and Host Administration
Linux installation, basic command-line usage, vi editor operations, software package management, user and group management, file permissions, bootloader (GRUB) configuration, hard disk partitioning and mounting, process monitoring and control, core system services, and kernel compilation.

Unit II: Shell Scripting and Linux Programming
Shell scripting basics, loops, conditionals, functions, system automation using scripts, introduction to Linux system programming, use of libipq, libnet, and libpcap libraries, packet handling, network control, and packet capture.

Unit III: Intranet Services Configuration
Linux networking fundamentals, DHCP server configuration, NFS server setup, Samba server setup, NIS server configuration, LDAP server installation and integration.

Unit IV: Internet Services and Security
FTP server configuration, SSH server setup, DNS configuration using BIND, web server deployment using Apache and Nginx, Squid proxy server setup, mail server configuration using Postfix and Dovecot, firewall configuration using iptables, VPN server deployment.

Unit V: Advanced Linux Kernel Programming
Kernel architecture, system call implementation, process management using task_struct, CPU scheduling, context switching, interrupt handling with softirqs and tasklets, synchronization using spinlocks and semaphores, timer management, page table and memory allocation, VFS internals, block layer, NVMe storage, TCP/IP networking stack.

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

1. Demonstrate proficiency in installing, configuring, and managing Linux systems, users, and core services.
2. Develop automated solutions using shell scripts and apply basic Linux programming with system libraries.
3. Configure and manage intranet services such as DHCP, NFS, Samba, NIS, and LDAP.
4. Deploy and secure internet services including FTP, SSH, DNS, Web, Proxy, Mail, Firewall, and VPN servers.

5. Analyze and implement advanced Linux kernel functionalities including system calls, memory, scheduling, and networking.

Text Books:

1. Linux Administration: A Beginner’s Guide", Wale Soyinka, McGraw-Hill Education
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder, Trent Hein, Ben Whaley, Dan Mackin, Pearson Education
3. Linux Kernel Development, Robert Love, Addison-Wesley

Reference Books

1. Understanding the Linux Kernel, Daniel P. Bovet, Marco Cesati, O’Reilly Media
2. Linux Command Line and Shell Scripting Bible, Richard Blum, Christine Bresnahan, Wiley

Syllabus for Semester IV, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01PR0404-02 Course: Software Lab-II Web Programming
L: 0Hrs, P: 4Hrs, Per Week Total Credits: 2

Course Objectives:

1. To comprehend the fundamentals of React with JavaScript and JSX for creating templates with React components and their importance in building reusable UI elements.
2. To familiarize the students with essential skills for modern front-end web applications by the use of ReactJS features.
3. To learn to implement client-side routing using React Router for Single Page Applications (SPAs).

Introduction to React: ReactJS Introduction, Advantages of React JS, Introduction to JSX,
Difference between JS and JSX, Templating using JSX, Working with React, createElement, Expressions, logical operators, specifying attributes, children and Fragments.

React Components overview: Types of components, Controlled, Split Up, Composable, Reusable, Component Declarations and Styling Components, Conditional Rendering, List Rendering.

Props and State: State and its significance, Read state and setState, Passing data to components using props, Validating props using prop Types, Supplying default values to props using default Props.

Event Handling: Lifecycle Methods, Handling events in React Components, React Forms, Controlled Components, Uncontrolled components.

Routing with React Router: Need of react Router, React Router Installation, Components in React Router, Adding Navigation using Link component.

Course Outcomes

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

1. Understand the fundamentals of React with JavaScript and JSX.
2. Build and reuse functional and class-based React components effectively.
3. Utilize props and state effectively to manage data flow and UI interactions in React applications
4. Handle user events and implement conditional rendering based on user interaction.
5. Demonstrate dynamic routing and navigation in a React application.

Text Books:

1. React Up & Running: Building Web Applications - Stoyan Stefanov, O'Reilly Media, Second Edition, 2021.
2. Learning React: Modern Patterns for Developing React Apps - Alex Banks & Eve Porcello, O'Reilly Media, Second Edition, 2020.
3. React in Action 1st Edition - Mark Tielens Thomas, Manning Pubns Co, First Edition, 2018.

Reference Books

1. Pure React- a step-by-step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch

Syllabus for Semester V, Track 2 B. Tech. Computer Science & Engineering

Course Code: 25CS01PR0504 **Course: Software Lab-III Design Patterns Lab**

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

Course Objectives:

- To implement and validate commonly used design patterns using an object-oriented programming language.
- To build small-scale applications that demonstrate the usage of individual design patterns.
- To analyze the impact of design patterns on code reusability, scalability, and maintainability.
- To identify anti-patterns and refactor code for better design

UNIT-I:

Elements of Design Pattern, Describing Design Pattern, Design Pattern Classification, Role of design patterns in software design, Example implementation of design pattern using UML.

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 implementations 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 implementations 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, Comparative study of Behavioral patterns, and implementations based on real life applications.

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 implementations based on real life applications.

Course Outcomes

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

1. Apply various design patterns in practical coding problems.
2. Build modular and maintainable systems using object-oriented principles.
3. Refactor existing code using design patterns to improve design quality.
4. Develop mini-projects showcasing real-life applications of multiple design patterns.

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, Track 2 B. Tech. Computer Science & Engineering

Course Code: 25CS01TH0506-02 **Course: Computer Graphics**

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

Course Objectives

1. Understanding and applying advanced graphics algorithms, including clipping, filling, and curve generation for effective image construction.
2. Introducing the fundamentals of 3D graphics, focusing on basic transformations, projections, and simple object representations.

UNIT - I

Introduction to Graphics: Importance of Computer Graphics, Graphics Hardware, Application of Computer Graphics, Raster and Vector Graphics, Raster scan display system, Raster graphics Algorithm.

UNIT - II

Polygon filling methods: Scan Conversion Algorithms: Simple Ordered edge list, Edge Fill, Fence Fill and Edge Flag Algorithm, Seed Fill Algorithms: Simple and Scan Line Seed Fill Algorithm

UNIT - III

2D Clipping algorithms for regular and irregular windows: Sutherland Cohen Out code, Sutherland Cohen Subdivision, Mid-Point subdivision, Cyrus Beck, Liang–Barsky Algorithm, Polygon Clipping Algorithms.

UNIT - IV

2D Transformations, Normalized Device Coordinates, Viewing Transformations, 3D System Basics and 3D Transformations and Projections.

UNIT - V

Hidden line & hidden surface removal algorithms, Painter's algorithm, Z-buffer, Warnock’s algorithm, and Back face detection. Rendering, Shading, Ray tracing techniques, Illumination methods, Color models.

Course Outcomes:

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

1. Implement various raster graphics algorithms and solid area scan conversion techniques.
2. Apply windowing, various line and polygon clipping algorithms.
3. Process geometric data using transformations and projection techniques.
4. Apply the concepts of color models, lighting and shading models, hidden surface elimination, and rendering models to enhance the image quality.

Text Books

1. Rogers; Procedural Elements of Computer Graphics; 3rd Edition; McGraw Hill, 2001.
2. Newman and Sproull; Principles of Interactive Computer Graphics; McGraw Hill, 1989.
3. Hearn and Baker; Computer Graphics; 2nd Edition; PHI, India, 1994.
4. Ivan Harringhton; Computer Graphics - A Programming Approach; McGraw Hill Publications, 1987.
5. Computer Graphics Using OPENGL- 2nd edition, F.S. Hill Jr. Pearson Education, 2003

Reference Books

1. James D. Foley, Andries Van Dam, Feiner Steven K. and Hughes John F. – Computer Graphics: Principles & Practise, Adddison Wesley Publishing House

Syllabus for Semester VI, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0602-02 Course: Generative AI
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Course Objectives:

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

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

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

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

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

Unit 5: Explainable and Responsible Generative AI
Explainable AI basics, XAI techniques: SHAP, LIME, Integrated Gradients, attention visualization, Explainability in LLMs and GANs.
Responsible AI: principles, bias and fairness in generative models, Regulatory frameworks and ethical guidelines (EU AI Act, OECD AI Principles, NIST AI Risk Framework)

Course Outcomes:

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

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

TEXT BOOKS:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition,2022.
2. The Art of Prompt Engineering with ChatGPT: A Hands-On Guide - Learn AI Tools the Fun Way, Shroff/Hunter; First Edition,2023.
3. Interpretable Machine Learning,: A Guide for Making Black Box Models Explainable, Christoph Molnar ,Shroff/Molnar, Second Edition,2020.
4. Responsible AI: Best Practices for Creating Trustworthy AI Systems, Qinghua Lu, Liming Zhu, et al, Pearson publisher, Ist Edition, 2024.

REFERENCE BOOKS:

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

Syllabus for Semester VI, Track 1 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0603-02 Course: Digital Image Processing
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:

- To understand fundamentals of digital image representation and processing.
- To explore techniques for image enhancement, restoration, segmentation, and compression.
- To apply algorithms for object recognition and real-world image processing problems.

Unit I:
Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system, Image sensing and acquisition, sampling and quantization of an Image, Basic relationship between pixels, Image representation, types of images (binary, grayscale, color, indexed), and Mathematical operations.

Unit II:
Image Enhancement: Spatial Domain methods- Intensity transformations, Histogram Processing;
Image smoothing and sharpening (linear and nonlinear filters) ;
Frequency Domain methods- Basics of filtering in frequency domain, The Fourier transform- 2D Discrete Fourier Transform and its inverse, Low-pass and high-pass filtering; Homomorphic filtering, selective filtering.

Unit III:
Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit or Miss Transformation, Boundary Extraction, Hole Filing.
Image Segmentation: Point, Line, edge detection; Edge detectors: Sobel, Prewitt, Canny; boundary detection; Thresholding techniques: global, local, Otsu's method; region-based segmentation.

Unit IV:
Image Compression: Image compression fundamentals, coding Redundancy. Compression models-Huffmann coding, run length coding, Bit Plane coding, and JPEG standards
Image restoration: Image degradation and restoration model, Types of Noise (Eg: Gaussian, salt & pepper, etc.); Noise removal methods – Mean filter, Median, Min, Max, Midpoint, Inverse filter, Wiener filter, Adaptive filters etc.

Unit V:
Feature Extraction and Object Recognition: Image representation: boundary descriptors, region descriptors, Texture analysis; Feature extraction: shape, color, texture features; Object recognition using template matching and statistical classifiers; Basics of machine learning and CNNs in image classification.

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

1. Describe basic methods of image processing, video processing and their applications.
2. Performing image processing by application of various techniques like image enhancement, morphological processing, image Segmentation, compression, etc.

3. Interpret image and video processing algorithms.
4. Select, apply and use various algorithms in image and video processing applications.

Text Books:

1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Pearson Education, 3rd ed.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India. 2nd edition 2004
3. John Willam, K. Pratt, Digital Image Processing. Willey & Sons (3rd Edition).
4. S. Jayaraman, Digital Image Processing, McGraw Hill, 2012.
5. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach. Prentice Hall, 2011.

Reference Books:

1. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson, 2009.
2. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
3. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
4. Richard Szeliski, Computer Vision: Algorithms and Applications. Springer, 2010.

Syllabus for Semester VI, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0604-02 Course: Natural Language Processing
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

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.

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.

UNIT II

Lexical Analysis, Part-of-Speech (POS) Tagging, Approaches for POS Tagging, Rule-Based, Stochastic, Hybrid Approach, Taggers Evaluations, Applications of Tagging.
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, 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.
4. Dipanjan Sarkar, Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition, Apress Media, LLC, California, 2019, ISBN: 978-1484243534.

Reference Books

1. Natural Language Processing with Python: From Basics to Advanced Projects, Second Edition, 2024, Cuantum Technologies LLC. Plano, ISBN: 979-8894968483.
2. Jyotika Singh, Natural Language Processing in the Real World: Text Processing, Analytics, and Classification, First edition, 2023, CRC Press is an imprint of Taylor & Francis Group, LLC, ISBN: 978-1003264774.
3. Gerhard Paaß and Sven Giesselbach, Foundation Models for Natural Language Processing: Pre-trained Language Models Integrating Media, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer Nature Switzerland Pte Ltd. 2022, ISBN: 978-3031231896.
4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, Inc., USA, Revised First edition, May 2022, ISBN: 978-1098136796.

Syllabus for Semester VII, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0701-01 **Course: Data Mining and Analytics**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:

1. Understand foundational concepts of data mining and knowledge discovery.
2. Apply various data mining techniques like classification, clustering, and association rules.
3. Gain practical skills in data analysis and visualization using modern tools.
4. Analyze and interpret data for real-world applications and decision-making.
5. Understand privacy implications of data analytics.

Unit I: Data Mining Introduction
Introduction to Data Mining and Knowledge Discovery Process, Types of Data: Structured, Semi-structured, Unstructured, Data Preprocessing: Cleaning, Integration, Transformation, Reduction, Challenges in Data Mining, Applications in various domains like Healthcare, E-commerce, Finance

Unit II: **Association and Classification Techniques**
Association Rule Mining: Apriori Algorithm, FP-Growth Algorithm, Measures of Rule Interestingness Classification Techniques: Decision Trees (ID3, C4.5, CART), Naive Bayes Classifier, k-Nearest Neighbors (KNN), Evaluation Metrics: Confusion Matrix, Accuracy, Precision, Recall, F1-score

Unit III: **Clustering and Outlier Detection**
Clustering Techniques: K-Means Clustering, Hierarchical Clustering (Agglomerative/Divisive), DBSCAN, Cluster Evaluation Techniques, Outlier Detection Methods: Distance-based, Density-based

Unit IV: **Data Analytics and Visualization**
Data Analytics Lifecycle, Descriptive, Predictive, and Prescriptive Analytics, Exploratory Data Analysis (EDA), Data Visualization using:, Python Libraries: Matplotlib, Seaborn. Tools: Tableau / Power BI / Orange, Basic Time Series Analysis Concepts

Unit V: **Applications, Tools, and Real-life Use Cases**
Applications of Data Mining in Real-World Scenarios, Case Studies: Market Basket Analysis, Customer Segmentation, Fraud Detection, Tools and Platforms Overview: WEKA, RapidMiner, Privacy in Data Mining

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

1. **Understand** basic concepts of data mining, knowledge discovery, and data preprocessing techniques.
2. **Apply** classification and association rule mining techniques on datasets and evaluate their performance.
3. **Implement** clustering and outlier detection algorithms to uncover patterns in data.
4. **Perform** exploratory data analysis and create insightful visualizations and analyze real-word problems

Text Books:

1. Jiawei Han, Micheline Kamber, Jian Pei – Data Mining: Concepts and Techniques, 4th Edition, Morgan Kaufmann
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne Introduction to Data Mining 2nd Edition, Pearson Education

Reference Books

1. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Springer

Syllabus for Semester VII, Track 2 B. Tech. Computer Science & Engineering

Course Code: 25CS01TP0702-02 **Course: Deep Learning-II**

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

Course Objectives:

1. Understanding the fundamentals of deep learning and its applications in generative models.
2. Learning to train and evaluate generative models on different types of data such as images, text, and audio.
3. Developing practical skills in implementing and fine-tuning generative models using popular deep learning frameworks.

Unit I :

Directed Graphical Models**:** Probability Theory, Joint Distributions, representations of joint distribution, graphical representation of joint distribution, reasoning in a Bayesian network, Causal Reasoning, Evidential Reasoning, Independencies encoded by a Bayesian network (Case 1: Node and its parents), Independencies encoded by a Bayesian network (Case 2: Node and its non-parents), Independencies encoded by a Bayesian network (Case 3: Node and its descendants)

Unit II :

Markov Networks: Motivation, Factors in Markov Network, Local Independencies in a Markov Network, Using joint distributions for classification and sampling, concept of a latent variable.

Unit III :

Restricted Boltzmann Machines: Introduction to Restricted Boltzmann Machines, RBMs as Stochastic Neural Networks, Unsupervised Learning with RBMs, Computing the gradient of the log likelihood, Motivation for Sampling.

Unit IV :

Markov Chains: Introduction to Markov Chains, Need of Markov Chains, Setting up a Markov Chain for RBMs, Training RBMs using Gibbs Sampling, Training RBMs using Contrastive Divergence.

Unit V :

Variational Autoencoders: Revisiting Autoencoders, Variational Autoencoders: The Neural Network Perspective, Variational autoencoders: (The graphical model perspective), Neural Autoregressive Density Estimator, Masked Autoencoder Density Estimator.

Course Outcomes:

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

1. Use probability concepts to build directed graphical models and markov networks.
2. Solve problems using Restricted Boltzmann Machines and markov chains.
3. Apply autoencoder model to find solution of a given problem.

Text Books:

1. Ian Good fellow and Yoshua Bengio and Aaron Courville. *Deep Learning*. An MIT Press book. 2016.
2. Charu C. Aggarwal. *Neural Networks and Deep Learning: A Textbook*. Springer. 2019.

3. Christopher Bishop. *Pattern Recognition and Machine Learning*. Springer Verlag, 2006.

Reference Books:

1. *Deep Learning from Scratch: Building with Python from First Principles* by Seth Weidman published by O`Reilley.
2. *Grokking Deep Learning* by Andrew W. Trask published by Manning Publications.

Syllabus for Semester VII, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0703-02 Course: Computer Vision
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives

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

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

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

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

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

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

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

1. Use the fundamental concepts of computer vision to solve different problems.
2. Apply feature detection, image alignment, motion analysis, and object tracking techniques to solve real-world problems.

3. Analyze the different object detection and recognition techniques to determine their effectiveness in different real-world scenarios.
4. Apply machine learning based techniques to perform pattern analysis and dimensionality reduction.

Text Books

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

Reference Books

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

Syllabus for Semester VII, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0704-02 Course: Cryptography and Network Security
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives
1. To build strong fundamentals of cryptographic techniques and algorithms to realize Security Goals.
2. Understand authentication, access control, intrusion detection, and prevention.
3. Identify and mitigate software security vulnerabilities in existing systems.

UNIT I:
Introduction to Security Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Non repudiation, Classical Cryptographic Techniques.
UNIT II:
Symmetry key Cryptography Algebraic Structures, Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard. Key distribution, Attacks.
UNIT III:
Public key Cryptography Mathematical background, Number Theory. Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem. RSA Algorithm, , Elliptic Curve Cryptography.
UNIT IV:
Message Authentication, Integrity and Key Management Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures, Key Management, Diffie- Hellman Key Exchange Kerberos, X.509
UNIT V:
Network Security Practices and Wireless Security Electronic Mail Security – PGP, – IP security – Web Security – The Secure Sockets Layer (SSL),Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things.

Course Outcomes:
On successful completion of the course, students will be able to:
1. Analyse the Network Security Threats.
2. Apply cryptographic techniques and algorithms to build security-related applications.
3. Solve problems related to key generation and key exchange algorithms.
4. Implement necessary Security mechanisms to secure the Computer Network.
5. Understand the security concepts in Wireless network

Text Books
1. William Stallings; Cryptography & Networks Security Principles and Practice; 6th Edition
2. Pearson Education, 2013.
3. Atul Kahate; Cryptography and Network Security; 1st Edition; Tata McGraw Hill, 2008.
4. Behrouz A. Forouzan, Cryptography and network security MC Graw Hill 3rd Edition
5. C. Kaufman, R. Perlman, M. Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2nd edition, 2002.

Reference Books
1. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i",

Pearson Education, 2004.
3. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
4. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

Syllabus for Semester VIII, Track 2 B. Tech. Computer Science & Engineering

Course Code: 25CS01TH0801-02 **Course: Deep Learning for Computer Vision and NLP**

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

Course Objectives:

- To introduce deep learning foundations and neural architectures.
- To apply deep learning to solve vision tasks like classification, detection, segmentation.
- To implement NLP tasks using embeddings, RNNs, transformers, and attention mechanisms.

Unit I: Introduction to Deep Learning

Introduction to perceptrons and multilayer networks, Activation functions, loss functions, Backpropagation and gradient descent, Overfitting, underfitting, regularization, dropout, Batch normalization, optimization techniques (Adam, SGD)

Unit II: **Convolutional Neural Networks (CNNs) for Vision**

Convolution, pooling, padding, CNN architecture: LeNet, AlexNet, VGG, ResNet, Image classification pipelines, Transfer learning, fine-tuning pretrained models, Image augmentation and regularization.

Unit III: **Advanced Computer Vision Tasks**

Object detection: R-CNN, Fast R-CNN, YOLO, SSD; Semantic and instance segmentation: U-Net, Mask R-CNN; Feature maps and visualization; Image captioning; Use of frameworks: TensorFlow / PyTorch for vision

Unit IV: **Deep Learning for NLP**

LSTMs and GRUs for sequence modeling; Transformers in NLP- Self-attention and Multi-head Attention, Transformer architecture, Positional Encoding and its variants; Pretrained Language Models- BERT, RoBERTa, T5 / BART.

Unit V: Multimodal Transformers and Foundation Models

Vision Transformer (ViT), Vision and Language alignment: CLIP (Contrastive Language-Image Pretraining), Image captioning, models for text-to-image generation; Applications: Text classification, Question Answering, Sentiment Analysis.

Course Outcomes:

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

1. Describe the theoretical foundations of deep learning, including neural architectures, training strategies, and optimization techniques.
2. Apply convolutional neural networks and transfer learning approaches to perform computer vision tasks.
3. Develop deep learning models for natural language processing using recurrent and transformer-based architectures.
4. Evaluate multimodal foundation models for tasks involving vision and language learning.

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016.
2. Francois Chollet, Deep Learning with Python, 2nd Edition, Manning Publications, 2021.
3. Delip Rao and Brian McMahan, “Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning”, O’Reilly Media, 2019.
4. Vishwesh Ravi Shrimali, Computer Vision with PyTorch, Packt Publishing, 2020.

Reference Books:

1. Rajalingappaa Shanmugamani, Deep Learning for Computer Vision, Packt Publishing, 2018
2. Denis Rothman, Transformers for Natural Language Processing, Packt Publishing, 2021
3. Vaswani et al., "Attention is All You Need", NeurIPS 2017

Syllabus for Semester VIII, Track 2 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0802-02 Course: GenAI for Image and Video
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:

- To introduce fundamental generative models such as GANs, VAEs, and diffusion models for image and video synthesis.
- To explore vision-language models and multimodal generative techniques for applications such as text-to-image generation and image captioning.

Unit I: Foundations of Generative Models for Visual Data
Generative modeling in vision: use cases and challenges; Review of CNNs and image representation; Introduction to Variational Autoencoders (VAEs); Generative Adversarial Networks (GANs): architecture, loss functions; Types of GANs: DCGAN, Conditional GAN, CycleGAN.

Unit II: **Image Generation Techniques**
StyleGAN, BigGAN, and latent space manipulation; Image inpainting, denoising, and super-resolution; Text-to-image generation using CLIP, DALL·E, Imagen; Prompt-based visual synthesis using diffusion models (e.g., Stable Diffusion); Image editing using GenAI (e.g., Photoshop's generative fill, DreamBooth)

Unit III: **Diffusion Models and Visual Transformers**
Basics of denoising diffusion probabilistic models (DDPMs); Training and sampling in diffusion models; Vision Transformers (ViT): image classification to generation; Latent diffusion and its applications in controllable image generation; Tools and libraries: Diffusers.

Unit IV: **Generative AI for Video Processing**
Video representation: frames, temporal modeling; Video GANs and video-to-video synthesis; Video super-resolution and frame interpolation; Text-to-video generation (overview of Sora), Lip sync, video dubbing, and avatar generation.

Unit V: **Evaluation Metrics and Applications**
Evaluation metrics: FID, IS, PSNR, SSIM; Dataset biases and limitations of generative models; Deepfakes: detection, risks, and countermeasures; Copyright, consent, and misinformation concerns; Real-world applications: film post-production, AR/VR, advertising, healthcare

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

1. Describe the architecture and principles behind generative models for image and video generation.
2. Apply state-of-the-art generative AI techniques to perform tasks like image super-resolution, inpainting, style transfer, and video generation.
3. Integrate vision-language models and multimodal frameworks for text-to-image and text-to-video generation.
4. Analyze the performance of generative AI applications in visual media.

Text Books:

1. Ian Goodfellow et al., Deep Learning, MIT Press, 2016
2. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play (2nd Ed.), O'Reilly, 2022
3. Jakub M. Tomczak, Deep Generative Models, Springer, 2023

Reference Books:

1. Salman Khan et al., Transformers for Vision, Springer, 2022
2. Elucidating the Design Space of Diffusion-Based Generative Models" by Karras et al. (2022)

Track 3:
Computer Science and Engineering

Syllabus for Semester IV, Track 3 B. Tech. Computer Science & Engineering

Course Code: 25CS01PR0404-01 **Course: Software Lab-II Advanced Linux Programming**

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

Course Objectives:

The primary objective of this course is to provide students with in-depth knowledge and hands-on experience in advanced Linux system administration, shell scripting, and kernel-level programming.

Unit I: Linux Fundamentals and Host Administration

Linux installation, basic command-line usage, vi editor operations, software package management, user and group management, file permissions, bootloader (GRUB) configuration, hard disk partitioning and mounting, process monitoring and control, core system services, and kernel compilation.

Unit II: Shell Scripting and Linux Programming

Shell scripting basics, loops, conditionals, functions, system automation using scripts, introduction to Linux system programming, use of libipq, libnet, and libpcap libraries, packet handling, network control, and packet capture.

Unit III: Intranet Services Configuration

Linux networking fundamentals, DHCP server configuration, NFS server setup, Samba server setup, NIS server configuration, LDAP server installation and integration.

Unit IV: Internet Services and Security

FTP server configuration, SSH server setup, DNS configuration using BIND, web server deployment using Apache and Nginx, Squid proxy server setup, mail server configuration using Postfix and Dovecot, firewall configuration using iptables, VPN server deployment.

Unit V: Advanced Linux Kernel Programming

Kernel architecture, system call implementation, process management using task_struct, CPU scheduling, context switching, interrupt handling with softirqs and tasklets, synchronization using spinlocks and semaphores, timer management, page table and memory allocation, VFS internals, block layer, NVMe storage, TCP/IP networking stack.

Course Outcomes

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

1. Demonstrate proficiency in installing, configuring, and managing Linux systems, users, and core services.2.
2. Develop automated solutions using shell scripts and apply basic Linux programming with system libraries.3
3. Configure and manage intranet services such as DHCP, NFS, Samba, NIS, and LDAP.
4. Deploy and secure internet services including FTP, SSH, DNS, Web, Proxy, Mail, Firewall, and VPN servers.

5. Analyze and implement advanced Linux kernel functionalities including system calls, memory, scheduling, and networking.

Text Books:

1. Linux Administration: A Beginner's Guide", Wale Soyinka, McGraw-Hill Education
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder, Trent Hein, Ben Whaley, Dan Mackin, Pearson Education
3. Linux Kernel Development, Robert Love, Addison-Wesley

Reference Books

1. Understanding the Linux Kernel, Daniel P. Bovet, Marco Cesati, O'Reilly Media
2. Linux Command Line and Shell Scripting Bible, Richard Blum, Christine Bresnahan, Wiley

Syllabus for Semester IV, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01PR0404-02 Course: Software Lab-II Web Programming
L: 0Hrs, P: 4Hrs, Per Week Total Credits: 2

Course Objectives:

1. To comprehend the fundamentals of React with JavaScript and JSX for creating templates with React components and their importance in building reusable UI elements.
2. To familiarize the students with essential skills for modern front-end web applications by the use of ReactJS features.
3. To learn to implement client-side routing using React Router for Single Page Applications (SPAs).

Introduction to React: ReactJS Introduction, Advantages of React JS, Introduction to JSX,
Difference between JS and JSX, Templating using JSX, Working with React, createElement, Expressions, logical operators, specifying attributes, children and Fragments.

React Components overview: Types of components, Controlled, Split Up, Composable, Reusable, Component Declarations and Styling Components, Conditional Rendering, List Rendering.

Props and State: State and its significance, Read state and setState, Passing data to components using props, Validating props using prop Types, Supplying default values to props using default Props.

Event Handling: Lifecycle Methods, Handling events in React Components, React Forms, Controlled Components, Uncontrolled components.

Routing with React Router: Need of react Router, React Router Installation, Components in React Router, Adding Navigation using Link component.

Course Outcomes

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

1. Understand the fundamentals of React with JavaScript and JSX.
2. Build and reuse functional and class-based React components effectively.
3. Utilize props and state effectively to manage data flow and UI interactions in React applications
4. Handle user events and implement conditional rendering based on user interaction.
5. Demonstrate dynamic routing and navigation in a React application.

Text Books:

1. React Up & Running: Building Web Applications - Stoyan Stefanov, O'Reilly Media, Second Edition, 2021.
2. Learning React: Modern Patterns for Developing React Apps - Alex Banks & Eve Porcello, O'Reilly Media, Second Edition, 2020.
3. React in Action 1st Edition - Mark Tielens Thomas, Manning Pubns Co, First Edition, 2018.

Reference Books

1. Pure React- a step-by-step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch

Syllabus for Semester V, Track 3 B. Tech. Computer Science & Engineering

Course Code: 25CS01PR0504 **Course: Software Lab-III Design Patterns Lab**

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

Course Objectives:

- To implement and validate commonly used design patterns using an object-oriented programming language.
- To build small-scale applications that demonstrate the usage of individual design patterns.
- To analyze the impact of design patterns on code reusability, scalability, and maintainability.
- To identify anti-patterns and refactor code for better design

UNIT-I:

Elements of Design Pattern, Describing Design Pattern, Design Pattern Classification, Role of design patterns in software design, Example implementation of design pattern using UML.

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 implementations 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 implementations 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, Comparative study of Behavioral patterns, and implementations based on real life applications.

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 implementations based on real life applications.

Course Outcomes

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

1. Apply various design patterns in practical coding problems.
2. Build modular and maintainable systems using object-oriented principles.
3. Refactor existing code using design patterns to improve design quality.
4. Develop mini-projects showcasing real-life applications of multiple design patterns.

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, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0506-01 Course: E Commerce & ERP
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:
The objective of this course is to:
- Understand the fundamentals and frameworks of E-Commerce and ERP.
- Explore business models and technologies in E-Commerce.
- Study the architecture, components, and implementation of ERP systems.
- Analyse the integration of business processes through ERP solutions.
- Evaluate case studies to understand real-world applications of E-Commerce and ERP.

Unit I: Introduction to E-Commerce
Definition, Evolution, and Impact of E-Commerce. E-Commerce Framework, Business Models: B2B, B2C, C2C, G2C. Benefits and limitations. E-Commerce Infrastructure: Internet, Intranet, Extranet, World Wide Web.

Unit II: **Electronic Payment Systems & Security**
Types of Electronic Payment Systems: Credit Cards, Debit Cards, E-Cash, E-Wallets, Smart Cards. Electronic data interchange, Risk and security issues: Encryption, Firewalls, SSL, Secure Electronic Transaction (SET), Digital Signatures and Certificates.

Unit III: **ERP Fundamentals**
ERP Introduction: Overview, Evolution, Need, Characteristics, Benefits. ERP Architecture: Technical and Functional Modules. Business Process Reengineering and ERP. ERP and Related Technologies: SCM, CRM, Data Warehousing.

Unit IV: **ERP Implementation and Lifecycle**
ERP Implementation Lifecycle: Planning, Selection, Implementation, Training, Maintenance. Critical Success Factors and Challenges. Role of Consultants, Vendors, and Users. Post-Implementation Review and Support.

Unit V: **Case Studies and Trends**
Case Studies of E-Commerce platforms (e.g., Amazon, Flipkart). ERP Case Studies (SAP, Oracle, Microsoft Dynamics). Emerging Trends: M-Commerce, Social Commerce, Cloud ERP, Open Source ERP.

Course Outcomes
On successful completion of the course, student shall be able to
1. Understand the structure and components of E-Commerce systems.
2. Analyse electronic payment methods and secure transaction techniques.
3. Describe ERP architecture and business process integration.
4. Plan and evaluate ERP implementation phases.
5. Interpret and analyse real-world case studies of E-Commerce and ERP solutions.

Text Books:
1. **E-Commerce: Fundamentals and Applications** – Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Chang, Wiley India
2. **ERP Demystified** – Alexis Leon, Tata McGraw-Hill Education

3. J. Joseph – E-Commerce: an Indian perspective – PHI
4. Vinod Kumar Garg and Venkitakrishnan N K – Enterprise Resource Planning Concepts and Practice – PHI

Reference Books

1. **Electronic Commerce: A Managerial Perspective** – Efraim Turban, David King, Pearson Education
2. **Enterprise Resource Planning** – C. S. V. Murthy, Himalaya Publishing
3. **Introduction to E-Commerce** – Jeffrey F. Rayport and Bernard J. Jaworski, Tata McGraw-Hill

Syllabus for Semester VI, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0602-01 Course: Fundamentals of Public Cloud Platform
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Unit 1: Introduction to Cloud Computing & Public Cloud Models
- Basics of Cloud Computing – Characteristics & Benefits
- Cloud Deployment Models: Public, Private, Hybrid
- Cloud Service Models: IaaS, PaaS, SaaS
- Introduction to Public Cloud Providers: AWS, Azure, GCP
- Cloud Terminologies & Use Cases
- Overview of Global Infrastructure (Regions, Zones)

Unit 2: AWS Core Services and Architecture
- AWS Management Console and CLI
- EC2, S3, RDS, Lambda, IAM, VPC, CloudWatch
- Elastic Load Balancing and Auto Scaling
- Hands-on: Launch EC2 instance, attach EBS, store data in S3
- AWS Shared Responsibility Model
- Basics of Billing and AWS Free Tier

Unit 3: Microsoft Azure Fundamentals
- Azure Portal, Azure CLI, Azure Resource Manager (ARM)
- Core Azure Services: Virtual Machines, Blob Storage, Azure SQL, Azure Functions
- Azure Networking: VNets, NSG, Load Balancer
- Role-Based Access Control (RBAC)
- Hands-on: Deploy VM and Web App using Azure Portal
- Azure Pricing Calculator and TCO Estimator

Unit 4: Google Cloud Platform (GCP) Essentials
- GCP Console, Cloud Shell, and gcloud CLI
- Core GCP Services: Compute Engine, Cloud Storage, BigQuery, Cloud Functions
- Identity and Access Management (IAM) in GCP
- Virtual Private Cloud (VPC) in GCP
- Hands-on: Create VM and Cloud Bucket in GCP
- Overview of GCP billing and quotas

Unit 5: Multi-Cloud Strategies & Industry Applications
- Cloud Migration Basics
- Multi-Cloud Architecture & Vendor Lock-in Issues
- Monitoring, Security, and Compliance in the Cloud
- Real-world Case Studies: Multi-cloud in E-Commerce, Banking, EdTech
- Cloud Cost Optimization Techniques
- Industry-recognized certifications: AWS Cloud Practitioner, Azure Fundamentals (AZ-900), GCP ACE

Suggested Lab Activities
- Setting up cloud accounts (AWS, Azure, GCP)
- VM creation, object storage, networking on all three platforms
- Role management and permissions demo
- Cost estimation tasks using pricing calculators
- Simple serverless app deployment (Lambda/Azure Functions/Cloud Functions)

Course Outcomes

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

1. Explain the essential characteristics of cloud computing and different service models (IaaS, PaaS, SaaS).
2. Identify and utilize core cloud services like compute, storage, networking, and databases on AWS, Azure, and GCP.
3. Compare cloud platform offerings and deployment strategies from AWS, Azure, and GCP
4. Apply basic cloud deployment and management skills using CLI, portals, and SDKs.

Textbooks

1. Cloud Computing: Concepts, Technology & Architecture – Thomas Erl, Zaigham Mahmood, Ricardo Puttini
2. AWS Certified Cloud Practitioner Study Guide – Ben Piper, David Clinton
3. Exam Ref AZ-900 Microsoft Azure Fundamentals – Jim Cheshire
4. Google Cloud Certified Associate Cloud Engineer Study Guide – Dan Sullivan

Reference Books

1. Architecting the Cloud – Michael J. Kavis
2. Cloud Computing: A Hands-On Approach – Arshdeep Bahga, Vijay Madisetti
3. Cloud Computing Bible – Barrie Sosinsky
4. Learning Google Cloud Platform – Marko Sluga
5. Azure for Architects – Ritesh Modi

Syllabus for Semester VI, Track 3 B. Tech. Computer Science & Engineering

Course Code: 25CS01TH0603-03 Course: Customer Relationship Management

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

Course Objectives

1. To make the students understand the organizational need, benefits and process of creating long-term value for individual customers.
2. To disseminate knowledge regarding the concept of Salesforce and Salesforce technologies.
3. To enable the students understand the technological and human issues relating to implementation of Customer Relationship Management in the organizations.

UNIT I :

Introduction to CRM and Salesforce : Definition and importance of CRM, Key CRM concepts, Benefits of CRM for businesses, Introduction to Salesforce, Salesforce's role in business processes, Salesforce Cloud offerings , Overview of Salesforce architecture, Multi-tenant cloud architecture, Salesforce Data Model (Objects, Records, Fields), Understanding Tabs, Apps, and Objects

UNIT II :

Salesforce Administration Basics : Understanding Salesforce Setup menu, Creating and managing users, Profiles, Roles, and Permission Sets, Organizing security settings (Organization-Wide Defaults, Sharing Rules), Data Validation Rules, Creating and customizing Objects, Object Relationships, Creating and managing Fields, Workflow Rules, Process Builder, and Flow.

UNIT III:

Introduction to Apex Programming : Apex basics (Syntax, Variables, Methods), Apex classes and triggers, Working with SOQL and SOSL (Salesforce Object Query Language, Handling exceptions in Apex, Apex Triggers, Writing Apex triggers to handle database events, Trigger context variables and best practices, Governor limits and optimization techniques.

Unit IV:

Advanced Salesforce Development – Lightning Web Components (LWC) : Overview of Lightning Web Components (LWC), LWC architecture and lifecycle, Creating and deploying LWC components, Handling events in LWC, Working with Apex from LWC, LWC Integration with Salesforce Data, Displaying Salesforce data in LWC, Handling record pages and lightning layouts, Best practices for LWC development.

UNIT V :

Salesforce Integration and Deployment, Salesforce Reports: Overview of integration in Salesforce, Integration tools: REST API, SOAP API, and Bulk API, Salesforce Connect, Introduction to Mulesoft for Salesforce integration, Introduction to Salesforce DX, Source-driven development and version control, Continuous Integration and Continuous Delivery (CI/CD) in Salesforce., Introduction to reports, types of reports, report builder, formatting reports, dashboard introduction, dashboard generation, charts in dashboards, limitations of Salesforce reports.

Course Outcomes:

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

1. Understand the fundamentals of Salesforce and its role in CRM.
2. Gain practical skills in configuring and managing Salesforce environments.
3. Apply the basics of Salesforce development using Apex to customize the platform.
4. Develop modern web applications on the Salesforce platform using Lightning Web

Components.
5. Integrate Salesforce with external systems and deploy applications in a production environment.

Text Books

1. Jason Ouellette; Development with the Force.com Platform, Second Edn, Addison Wesley, 2011. 2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018.
2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018
3. Judith W .Kincaid , Customer Relationship Management Getting it Right, Pearson Education
4. Customer Centricity –Focus on right customer for strategic advantage, by Peter Fader, Wharton Digital Press, 2012

Reference Books

1. Learning Salesforce Development with Apex – Paul Battisson
2. Salesforce for Beginners – Sharif Shaalan

Syllabus for Semester VI, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0604-03 **Course: System Design**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:
1. To introduce reliable software systems.
2. The objective of this course is to equip students with the knowledge and skills required to design scalable, reliable, and maintainable software systems.
3. Illustrate the benefits and drive the adoption of solutions for industry based real world problems.

Unit I: Introduction to System Design, System Design fundamentals, System Design Life Cycle, components of System Design, Scalability in System Design and System design patterns.

Unit II: Databases in Designing Systems: Relational databases, Non-relational databases, How to choose a database, Database sharding and partitioning, Database indexing.

Unit III: Distributed system basics: Distributed system fundamentals, Distributed system failures, MapReduce Stateless and stateful systems, Distributed system design patterns

Unit IV: High level Design (HLD) and LLD (Low Level Design)

Unit V: Event management, message passing, log file , Scalable web applications, DNS and load balancing, N-tier applications, HTTP and REST, Stream processing, Caching, Machine learning and System Design, Containerization and System Design, The cloud and System Design

Course Outcomes

On successful completion of the course, student shall be able to
1. Understand the fundamental principles of system design including scalability, reliability, maintainability and performance.
2. Perform exceptional scenarios building using appropriate databases and Distributed system fundamentals.
3. Ability to Perform High level Low Level Design.
4. Ability to do Event management, message passing and load balancing.

Text Books:
1. System Design Interview Volume 1 and 2 by Alex Xu.
2. Designing Data-Intensive Applications, Martin Kleppmann.
3. Patterns of Enterprise Application Architecture 1st Edition by Martin Fowler.

Reference Books
1. Clean Architecture: A Craftsman’s Guide to Software Structure and Design, Robert C. Martin , Pearson.
2. Systems Analysis and Design, Scott Tilley, Cengage Learning.
3. System Analysis and Design, Alan Dennis, Barbara Wixom, Roberta M. Roth, Wiley.

Syllabus for Semester VII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0701-01 Course: Cloud Administration
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Unit 1: Azure Administration Essentials

- Introduction to Azure architecture and services
- Azure portal, CLI, PowerShell, and Cloud Shell
- Azure regions, availability zones, and resource groups
- Manage Azure subscriptions and billing
- Implement Role-Based Access Control (RBAC)
- Introduction to Azure Resource Manager (ARM) templates

Unit 2: Identity and Governance in Azure

- Azure Active Directory (AAD) overview
- Users, groups, and roles management
- Configure multi-factor authentication (MFA)
- Implement Conditional Access and Privileged Identity Management (PIM)
- Governance: Policies, Blueprints, and Locks
- Hands-on: Creating users, assigning roles, configuring RBAC

Unit 3: Azure Compute, Storage and Networking

- Create and manage virtual machines (Linux & Windows)
- Configure availability sets and scale sets
- Configure Azure Storage (Blob, File, Queue, Table)
- Implement Azure Disks and snapshots
- Create Virtual Networks (VNets), Subnets, NSGs, and route tables
- Deploy Load Balancers and Application Gateways
- Hands-on: Deploy VM with VNet and secure it using NSGs

Unit 4: Monitoring, Backup and Disaster Recovery

- Azure Monitor, Metrics, Logs, and Alerts
- Configure Diagnostic settings and Log Analytics
- Implement Azure Backup and Site Recovery (ASR)
- Configure and use Azure Recovery Services vault
- Hands-on: Set up backup for a VM and configure monitoring with alerts

Unit 5: Automation, Optimization, and Exam Preparation

- Automate tasks using Azure Automation (Runbooks)
- Use PowerShell and CLI scripts for VM and storage tasks
- Cost management: Budgets, alerts, recommendations
- Performance tuning and rightsizing
- AZ-104 exam structure, domains, and sample questions
- Final project: Deploy and administer a secure and monitored Azure infrastructure

Suggested Lab Exercises

- Create resource groups, VMs, and storage accounts
- Configure RBAC and test access restrictions
- Setup backup and disaster recovery for critical resources
- Automate patch management using Azure Automation
- Monitor VMs and trigger alerts on threshold breaches

Course Outcomes (COs)

1. Explain and manage core Azure services and subscriptions.
2. Implement identity and access control using Azure Active Directory.
3. Configure virtual machines, storage accounts, and networking in Azure.
4. Monitor Azure resources and implement backup, security, and disaster recovery.
5. Automate and optimize operations using CLI, PowerShell, and Azure tools.

Textbooks

1. **Exam Ref AZ-104 Microsoft Azure Administrator** – Harshul Patel (Microsoft Press)
2. **Microsoft Azure Infrastructure Services for Architects** – John Savill
3. **Hands-On Azure for Administrators** – Mustafa Toroman

Reference Books

1. **Microsoft Learn: AZ-104 Learning Path** – learn.microsoft.com
2. **Cloud Computing: Concepts, Technology & Architecture** – Thomas Erl
3. **Azure for Architects** – Ritesh Modi
4. **The Azure Cloud Native Architecture Mapbook** – Stephane Eyskens
5. **Azure Well-Architected Framework** – Microsoft Documentation

Syllabus for Semester VII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TP0702-01 **Course: AL & ML for Public Cloud Platform**
L: 2Hrs, P: 2Hrs, Per Week **Total Credits: 3**

Unit 1: Introduction to Artificial Intelligence and Azure AI Services
- Overview of Artificial Intelligence and Machine Learning
- AI in daily life and industry applications
- Introduction to Microsoft Azure
- Azure Cognitive Services overview
- Use cases of Azure AI services (vision, speech, language, decision-making)

Unit 2: Machine Learning on Azure
- What is machine learning? Types of ML: supervised, unsupervised, reinforcement
- Azure Machine Learning basics
- Create and run ML models using Azure ML Studio
- Data preprocessing, training, and deployment
- Hands-on: Build a basic regression/classification model using Azure ML

Unit 3: Computer Vision and Image Analysis
- Introduction to Computer Vision APIs
- Image classification, object detection, facial recognition
- OCR and form recognizer
- Hands-on: Use Azure Cognitive Services for image analysis

Unit 4: Natural Language Processing (NLP) and Conversational AI
- Text analytics: sentiment analysis, key phrase extraction
- Translator and language detection services
- Azure Bot Service and QnA Maker
- Hands-on: Build a chatbot using Azure Bot Framework and Language Studio

Unit 5: Responsible AI and AI-900 Exam Preparation
- Principles of responsible AI: fairness, reliability, privacy, security
- Challenges in deploying ethical AI solutions
- Cost management and monitoring in Azure AI
- AI-900 certification preparation and mock tests
- Final capstone project: Build and deploy a complete AI solution using Azure

Suggested Lab Exercises
- Create an ML model with Azure ML Studio
- Perform sentiment analysis on a dataset
- Build a facial recognition system with Computer Vision API
- Develop a multilingual chatbot using Azure Bot Services
- Apply content moderation and text translation APIs

Course Outcomes (COs):
1. Understand basic AI/ML concepts and real-world applications.
2. Explore Azure AI services including Computer Vision, NLP, and Conversational AI.
3. Apply machine learning concepts using Azure Machine Learning Studio.
4. Demonstrate use of responsible AI principles on Azure.
5. Prepare and qualify for the AI-900 certification with hands-on labs.

Text Books

1. **Microsoft Certified Azure AI Fundamentals Study Guide (Exam AI-900)** – Julian Sharp (Microsoft Press)
2. **Hands-On Azure for Developers** – Mustafa Toroman
3. **Artificial Intelligence: A Guide for Thinking Humans** – Melanie Mitchell

Reference Books and Resources

- Microsoft Learn AI-900 Learning Paths – https://learn.microsoft.com
- **Practical Artificial Intelligence with Azure** – Rabeb Othmani
- **Azure AI Fundamentals (AI-900) Exam Ref** – Jim Cheshire
- AI School by Microsoft – https://aischool.microsoft.com

Syllabus for Semester VII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0703-03 Course: Fog Computing
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:
To provide foundational and practical knowledge of Fog Computing by exploring its architecture, middleware, communication protocols, and applications in IoT–Edge–Cloud integrated environments.

Unit I:
Introduction of Edge and Fog Computing: Internet of Things (IoT) and New computing paradigms, Fog computing: A platform for Internet of Things and analytics, Emergence of edge computing, Legal aspects of operating IoT applications in the fog. Edge Architecture: Multi-Tier cloud computing framework; Data services with clouds at home; Characteristics and features of Fog Computing, Benefits and Challenges of Fog Computing, Comparison: Cloud vs Edge vs Fog

Unit II:
Networking for Edge & Fog: Integrating IoT + Fog + Cloud Infrastructures: System modeling and research Challenges, Management and Orchestration of network slices in 5G, Fog, Edge, and Clouds, Real-time and Latency-sensitive Applications

Unit III:
System Design: Optimization problems in fog and edge computing, Middleware for fog and edge Computing: Design issues, A Lightweight container middleware for edge cloud architectures, Communication Protocols: MQTT, CoAP, HTTP, Resource Management and Scheduling in Fog Computing.

Unit IV:
Data Processing: Data management in fog computing, Predictive analysis to support fog application deployment, Using machine learning for protecting the security and privacy of Internet of Things (IoT) systems, fog Computing realization for Big data analytics, Open-source Tools for Fog Simulation: iFogSim

Unit V:
Applications and Case Studies: Fog computing realization for Big data analytics, Smart Cities and Transportation, Smart Healthcare Systems, Industrial IoT (IIoT) and Industry 4.0, Smart Agriculture and Environmental Monitoring, Smart Grid and Energy Management, Video Surveillance and Security Systems

Course Outcomes
On successful completion of the course, student shall be able to
1. Understand the concepts of Fog Computing and its architecture in comparison to Cloud and Edge Computing.
2. Design and evaluate integrated IoT–Fog–Edge–Cloud network architectures
3. Apply middleware design, communication protocols, and resource management strategies for efficient system design in fog computing
4. Apply data management, predictive analytics, and machine learning techniques in fog-based IoT systems.

5. Apply fog computing models and tools to real-world problems.

Text Books:

1. R. Buyya, S.N. Srirama, Fog and Edge Computing: Principles and Paradigms, Wiley-Blackwell
2. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya, Wiley

Reference Books

1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing

Syllabus for Semester VII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0703-09 Course: Reinforcement Learning
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:

- Understand the foundational concepts of reinforcement learning and its differences from supervised and unsupervised learning.
- Explore value functions, policies, and models using MDP frameworks.
- Implement both tabular and approximate RL algorithms.
- Apply RL techniques to control and real-world problem-solving.

Unit I: Basics of RL
Introduction to Reinforcement learning, examples , Elements of reinforcement learning , Limitations and Scope, An extended example, multi-armed bandits, k-armed bandit problem, action-value methods, the 10-armed testbed, incremental implementation, tracking a nonstationary problem, optimistic initial values, upper-confidence, bound action selection, associative search (contextual bandits)

Unit II: Markov Decision Processes (MDP)
States, Actions, Transition Probabilities, Rewards, Return, Discounted Return, Transition Probability and Reward Function, Optimality Equation for Value and Action-Value Functions, Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration

Unit III: Temporal-Difference Learning
Monte Carlo Methods: First-Visit, Every-Visit, Temporal-Difference (TD) Learning, TD(0), TD(λ), Eligibility Traces, SARSA (on-policy control), Q-Learning (off-policy control), ε-Greedy Exploration

Unit IV: Function Approximation and Deep Q-Networks (DQN)
Need for Approximation: Large/Continuous State Spaces, Linear Function Approximation, Nonlinear Approximation using Neural Networks, Deep Q-Networks (DQN): Architecture, Experience Replay and Target Network, Enhancements: Double DQN, Dueling DQN, Prioritized Replay,

Unit V: Policy Gradient Methods and Actor-Critic
Policy Gradients - Advantage Actor Critic (A2C) and Asynchronous Advantage Actor Critic (A3C) – Model based Reinforcement Learning – Challenges, Exploration Strategies: Softmax, Upper Confidence Bound (UCB), Entropy, Multi-Agent Reinforcement Learning, Ethics and Safety in RL Systems

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

1. Understand the fundamental principles and terminology of reinforcement learning.
2. Formulate decision-making problems as Markov Decision Processes.
3. Implement tabular model-free RL algorithms like SARSA and Q-learning.
4. Apply function approximation techniques and deep learning in RL.
5. Evaluate and analyze policy-based methods and actor-critic architectures.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction 2. (Adaptive Computation and Machine Learning series) 2 nd edition, A Bradford Book; 2018.
2. Martijn van Otterlo, Marco Wiering, Reinforcement Learning: State-of-the-Art, Springer-Verlag Berlin Heidelberg, 2012

Reference Books

1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press Ltd., 2016
2. Reinforcement Learning with MATLAB, MathWorks Inc., 2020.

Syllabus for Semester VII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0704-03 Course: Data Engineering and Cloud
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Unit 1: Introduction to Cloud Data Engineering
- Data engineering fundamentals and roles
- Overview of cloud data platforms: AWS, Azure, GCP
- Data pipeline concepts: Batch vs Streaming
- Cloud-based data architecture: lake house, warehouse, data lake
- Case studies and use cases from various industries

Unit 2: Data Ingestion and Storage
- Batch ingestion using Azure Data Factory, AWS Glue, GCP Dataflow
- Streaming ingestion using Kafka, Azure Event Hubs, Amazon Kinesis, Pub/Sub
- Cloud Storage Solutions: S3, Azure Blob, GCS, HDFS
- Structured, semi-structured, and unstructured data handling
- Hands-on: Ingest and store data in AWS S3 / Azure Data Lake / GCS

Unit 3: Data Transformation and Processing
- ETL/ELT design patterns
- Processing with Spark (Databricks, EMR, Synapse Spark Pools)
- SQL-based transformation tools: Big Query, Redshift, Azure Synapse
- Handling schema evolution, partitioning, and clustering
- Hands-on: Build a Spark pipeline to transform CSV/JSON data on cloud

Unit 4: Data Orchestration and Workflow Automation
- Scheduling and orchestration: AWS Step Functions, Azure Data Factory Pipelines, GCP Composer (Airflow)
- Error handling and retries, notifications
- Workflow monitoring and logging
- Hands-on: Build a multi-stage data pipeline using orchestration tools

Unit 5: Real-Time Data Processing and Analytics
- Introduction to real-time analytics and Lambda architecture
- Real-time data pipelines using Kinesis / Azure Stream Analytics / Dataflow
- Data quality, governance, lineage, and compliance
- Visualization and reporting: Power BI, Quick Sight, Looker Studio
- Capstone Project: Design and implement a data pipeline from ingestion to visualization

Suggested Lab Exercises
- Load IoT/CSV data to cloud storage and run Spark job
- Real-time data stream ingestion using Kafka or Kinesis
- Use Azure Synapse or Big Query to run complex queries
- Build ETL pipelines with AWS Glue or ADF
- Monitor and orchestrate workflows with Airflow or Step Functions

Course Outcome
1. Understand data engineering lifecycle and its importance in modern data ecosystems.
2. Design and implement ETL/ELT pipelines using cloud-native tools.
3. Utilize managed services for big data storage, processing, and orchestration.
4. Work with real-time data processing using streaming technologies.
5. Evaluate and optimize cloud-based data workflows for performance and cost.

Text Books

1. **Data Engineering with Python** – Paul Crickard
2. **Designing Data-Intensive Applications** – Martin Kleppmann
3. **Fundamentals of Data Engineering** – Joe Reis and Matt Housley

Reference Books & Resources

1. **Google Cloud Certified Professional Data Engineer Study Guide** – Dan Sullivan
2. **Azure Data Engineer Associate Certification Guide (DP-203)** – David E. Rendon
3. **AWS Certified Data Analytics Study Guide** – Asif Abbasi
4. **Cloud Academy, A Cloud Guru, and Microsoft Learn modules**
5. **Official Cloud Documentation:**
    - https://cloud.google.com/data-engineering
    - https://learn.microsoft.com
    - https://docs.aws.amazon.com

Syllabus for Semester VIII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0801-03 Course: Bio-informatics
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:

1. Provide an introduction to the field of Bioinformatics.
2. Describe how bioinformatics data is stored and organized.
3. Provide an approach to build search query and sequence alignment.
4. Provide methods for genome analysis.

UNIT-I

Introduction to Bioinformatics: Genome Sequences, ORFs, Genes, Introns, Exons, Splice Variants, DNA/RNA Secondary Structure, Retrieval methods for DNA sequence, protein sequence, and protein structure information.

UNIT-II

Databases – Format and Annotation: Conventions for database indexing and specification of search terms, as well as Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence and structure databases; organism-specific databases. Data retrieval tools – Entrez, DBGET and SRS, Submission of (new and revised) data.

UNIT-III

Sequence Similarity Searches: Local versus global, Distance metrics, Similarity and homology, scoring matrices, PAM, BLOSUM, PSSM, Dot Plot.
Dynamic programming algorithms: Needleman-Wunsch and Smith-Waterman, Heuristic Methods of sequence alignment, FASTA, BLAST, and PSI BLAST.

UNIT-IV

Multiple Sequence Alignment and software tools for pair-wise and multiple sequence alignment, ClustalW algorithm - Feng Doolittle algorithm.
Phylogenetic Analysis: Methods of phylogenetic analysis, UPGMA, WPGMA, neighbor joining method, Fitch/Margoliash method, Character Based Methods.

UNIT-V

Genome Analysis: Whole genome analysis, existing software tools, Genome Annotation and Gene Prediction, Comparative genomics, orthologs, paralogs. Bioinformatics in the Pharmaceutical Industry- Drug discovery.

Course Outcomes:

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

1. Demonstrate the fundamentals of biological processes and data acquisition.
2. Apply sequence alignment algorithms to search biological databases.
3. Implement phylogenetic tree construction algorithms.
4. Analyze genes and their sequences for applications such as drug discovery.

Text Books

1. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
2. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC Mathematical Biology & Medicine), by Sorin Draghici

3. Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
4. Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

Reference Books

1. D. Baxevanis and F. Oulette, (2002) "Bioinformatics : A practical guide to the analysis of genes and proteins", Wiley Indian Edition.
2. Cynthia Gibas and Per Jambeck (2001), "Developing Bioinformatics Computer Skills". O'Reilly press, Shorff Publishers and Distributors Pvt. Ltd., Mumbai.
3. Bryan Bergeron MD (2003), "Bioinformatics Computing". Prentice Hall India(Economy Edition)

Syllabus for Semester VIII, Track 3 B. Tech. Computer Science & Engineering
Course Code: 25CS01TH0802-03 Course: Soft Computing
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives:
To introduce students to the concepts and techniques of soft computing such as neural networks, fuzzy systems, genetic algorithms, and swarm intelligence, and enable them to apply these methods for solving complex, imprecise, and optimization-based real-world problems.

Unit I: Unit I: Introduction to Soft Computing: Soft computing vs. hard computing, Characteristics of soft computing, Components of soft computing: Neural Networks, Fuzzy Logic, Genetic Algorithms, Swarm Intelligence, Typical applications in engineering and AI systems.

Unit II: **Artificial Neural Networks:** Biological neuron vs. artificial neuron, Activation functions and network architecture (single-layer, MLP, etc.), Learning rules: Hebbian, Gradient descent, Perceptron, Delta, Adaline, Madaline models, Hopfield networks, RBF networks, Self-Organizing Maps, Counter-Propagation networks, Recurrent and associative memory networks.

Unit III: **Fuzzy Systems:** Crisp sets vs. fuzzy sets, membership functions, Fuzzy set operations and relations, Fuzzy if-then rules (e.g., Mamdani); fuzzy inference systems, Fuzzification and defuzzification techniques, Fuzzy controllers and applications.

Unit IV: **Genetic Algorithm:** Basic Genetic Algorithm, Fitness function, Evaluation, Selection, Crossover and Mutation, Chromosome Encoding, Roulette wheel selection, genotype and phenotype. Optimization problem solving using Genetic Algorithm.

Unit V: **Swarm Intelligence:** Collective Behavior and Swarm Intelligence, Social Insects, Particle Swarm Optimization (PSO) Algorithm, Optimization using PSO. Ant Colony Optimization (ACO) concepts, Artificial Pheromone, Ant model to solve the traveling salesman problem.

Course Outcomes
On successful completion of the course, student shall be able to
1. Understand the concepts of soft computing and its components.
2. Design and train artificial neural networks for classification and prediction tasks.
3. Apply fuzzy logic principles for reasoning and control problems.
4. Apply genetic algorithms for optimization problem.
5. Utilize bio-inspired algorithms to solve complex optimization problems.

Text Books:

1. J. S. R. Jang, C. T. Sun & E. Mizutani, “Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence”, PHI, 2008.
2. Klir and Yuan, "Fuzzy sets and Fuzzy logic – Theory and Applications", Prentice Hall of India , 2000.
3. Jacek M. Zurada, "Introduction to Artificial Neural System", West Publishing Company.
4. S. Rajasekaran, G.A. Vijaya Lakshmi Pai, "Neural Network, Fuzzy Logic and Genetic Algorithm Synthesis and Applications", PHI publication.

Reference Books:

1. Bart Kosko , "Neural Networks and Fuzzy Systems", PHI, 1994.
2. Timothy J. Ross , "Fuzzy Logic with Engineering Applications", McGraw-Hill, 3rd ed. 2010.

Track 4:
Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Syllabus for Semester IV, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01PR0404-04 Course: Software Lab-II Open-Source Tool for AIML

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

Syllabus:

1. Introduction to Machine Learning Tools
   - Overview of Scikit-learn library
   - Exploring various machine learning algorithms
   - Data preprocessing and feature engineering techniques

2. Deep Learning Frameworks
   - Introduction to Keras, TensorFlow, and PyTorch
   - Neural network architectures and training
   - Transfer learning and fine-tuning pre-trained models

3. Natural Language Processing (NLP) Libraries
   - Introduction to NLTK (Natural Language Toolkit)
   - Text preprocessing and cleaning
   - Text classification and sentiment analysis using NLTK

4. Advanced NLP with Spacy
   - Overview of Spacy library for NLP tasks
   - Named Entity Recognition (NER)
   - Dependency parsing and text processing

5. Web Scraping Techniques
   - Introduction to web scraping
   - Extracting data using Beautiful Soup library
   - Building web spiders with Scrapy

6. Data Visualization and Monitoring
   - Introduction to data visualization with Grafana
   - Monitoring and analyzing data using Grafana dashboards
   - Integrating data sources with Minikube

7. Internet of Things (IoT) Development
   - Introduction to Arduino and Raspberry Pi platforms
   - Building IoT applications using Python
   - Sensor integration and data acquisition

8. Project Work
   - Hands-on project to apply the learned concepts and tools
   - Students will work on a real-world problem using the acquired skills

Course Outcomes

On successful completion, of course student will able to:

1. Demonstrate proficiency in utilizing popular machine learning tools and libraries such as Scikit-learn, Keras, TensorFlow, and PyTorch
2. Apply natural language processing techniques using NLTK and Spacy libraries to process, analyze, and extract information from textual data
3. Develop skills in web scraping by utilizing tools like Beautiful Soup and Scrapy to extract relevant data from websites and understand the fundamentals
4. Gain hands-on experience in Internet of Things (IoT) development by working with Arduino, Raspberry Pi, and related tools

Text/Reference Books

1. Scikit-learn: Machine Learning in Python. Pedregosa, F., et al. (2011). Journal of Machine Learning Research, 12, 2825-2830.
2. Deep Learning with Python. Chollet, F. (2017). Manning Publications.
3. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit. Bird, S., et al. (2009). O'Reilly Media.
4. WebScraping with Python: A Comprehensive Guide. Ryan Mitchell. (2018). O'Reilly Media

Syllabus for Semester V, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01PR0504-04 **Course: Software Lab-III Advanced Python lab**
L: 0Hr, P: 4 Hrs, Per Week **Total Credits: 2**

Course Objectives

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

1. **Advanced-Data Types and Operations**
   List comprehensions and generator expressions. Nested lists, tuples, and dictionary operations.
2. **Object-Oriented Programming (OOP) in Python**
   Creating and using classes and objects. Implementing constructors, destructors, and instance methods.
3. **Exception Handling and Debugging**
   Handling errors using try-except-else-finally, raising exceptions with raise, Debugging techniques and using assert statements.
4. **File Handling and Data Processing**
   Working with different file formats (CSV, JSON, XML), Reading and writing binary files. Using pandas for data analysis and manipulation.
5. **Functional Programming Concepts**
   Using lambda, map(), filter(), and reduce(), Decorators and generators, List comprehensions vs. generator expressions.
6. **Advanced Libraries and Frameworks:**
   Working with NumPy for numerical computing, Using Matplotlib and Seaborn for data visualization, and Introduction to Flask/Django for web development.
7. **Web Scraping and API Handling**
   Extracting data from websites using Beautiful Soup and Scrapy

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

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

Text Books

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

Reference Books

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

Syllabus for Semester V, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0506-04 **Course: Applied AI and Expert Systems**

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

Course Objectives:

1. To understand Basic Concepts of Artificial Intelligence and Expert Systems.
2. To provide knowledge on Various Techniques and Tools involved in Artificial Intelligence

Unit I: PROBLEMS AND SEARCH

Searching strategies- Uninformed Search- breadth first search, depth first search, uniform cost search, depth limited search, iterative deepening search, bidirectional search - Informed Search- Best first search, Greedy Best first search, A* search – Constraint satisfaction problem, Local
searching strategies.

Unit II: REASONING

Symbolic Reasoning Under Uncertainty- Statistical Reasoning - Weak Slot-And-Filler-Structure Semantic nets – Frames- Strong Slot-And-Filler Structure-Conceptual Dependency-Scripts- CYC.

Unit III: KNOWLEDGE REPRESENTATION

Knowledge Representation - Knowledge representation issues - Using predicate logic - Representing Knowledge Using Rules. Syntactic- Semantic of Representation – Logic & slot and filler - Game Playing – Minimal search- Alpha beta cutoffs –Iteratic deepening planning – component of planning system – Goal stack planning.

Unit IV: NATURAL LANGUAGE PROCESSING

Natural Language Processing –Syntactic processing, semantic analysis-Parallel and Distributed AI-Psychological modeling- parallelism and distributed in reasoning systems – Learning - Connectionist Models – Hopfield networks, neural networks

Unit V: EXPERT SYSTEMS

Common Sense –qualitative physics, commonsense ontologies- memory organization - Expert systems –Expert system shells- explanation – Knowledge acquisition -Perception and Action – Real time search- robot architecture.

Course Outcomes

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

1. Describe the concept of intelligent agents and their interaction with the environment through percepts and actions.
2. Apply informed search and exploration strategies to solve AI-related problems.
3. Demonstrate understanding of AI techniques for knowledge representation, planning, and handling uncertainty.
4. Analyze decision-making processes and learning algorithms in AI systems.
5. Explain the concept of Knowledge Representation.

Text Books

1. Elaine Rich, Kevin Knight, “Artificial Intelligence”, 3/e, Tata McGraw Hill, 2009.
2. Russell, “Artificial intelligence: A modern Approach, Pearson Education ,3rd edition,2013

Reference Books

1. Artificial Intelligence and Expert system by V. Daniel hunt, Springer press,2011.
2. Nilsson N.J.,” Principles of Artificial Intelligence”, Morgan Kaufmann.1998

Syllabus for Semester VI, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TP0602-04 Course: Computer Vision

L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Course Objectives :

The objective of this course is to introduce foundational and advanced concepts of image processing and computer vision. Students will learn techniques for image formation, enhancement, feature extraction, segmentation, and pattern recognition, enabling them to analyze and interpret image data for real-world vision applications.

Unit I: Image Processing Foundations

Introduction to basic image processing techniques – Classical filtering operations – Thresholding techniques – Edge detection methods – Corner and interest point detection – Mathematical morphology – Texture analysis.

Unit II: **Image Formation and Processing**

Overview of image formation and processing – State-of-the-art methods – Fundamentals of image formation – Geometric transformations: Orthogonal, Euclidean, Affine, and Projective – Fourier Transform – Convolution and Filtering – Image enhancement and restoration – Histogram processing techniques.

Unit III: **Feature Extraction**

Edge detectors: Canny, LoG, DoG – Line detection using Hough Transform – Corner detection: Harris and Hessian Affine – Orientation histogram methods – Local descriptors: SIFT, SURF, HOG, GLOH – Scale-space analysis with image pyramids and Gaussian derivatives – Gabor filters and Discrete Wavelet Transform (DWT).

Unit IV: **Image Segmentation**

Segmentation using region growing and edge-based approaches – Advanced methods: Graph Cuts, Mean-Shift, Markov Random Fields (MRFs) – Texture-based segmentation – Introduction to object detection methods.

Unit V: **Pattern Analysis**

Clustering techniques: K-Means, K-Medoids, Mixture of Gaussians – Classification: Discriminant functions, Supervised, Unsupervised, and Semi-supervised learning – Classifiers: Bayes, K-Nearest Neighbors (KNN), Artificial Neural Networks (ANN) – Dimensionality reduction techniques: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Independent Component Analysis (ICA) – Non-parametric classification methods.

Course Outcomes

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

1. Apply foundational image processing operations including filtering, thresholding, and morphological analysis.
2. Understand and implement image formation models and geometric transformations.
3. Extract meaningful features from images using modern descriptors and scale-space analysis.
4. Perform image segmentation and object detection using classical and graph-based techniques.

5. Analyze and classify image data using pattern recognition and dimensionality reduction techniques.

Text Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011
2. T2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003

Reference Books

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, 2004
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 200
3. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Addison-Wesley, 1992
4. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Edition, Academic Press / Morgan Kaufmann, 1990

Syllabus for Semester VI, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0603-04 **Course: Trustworthy and Explainable AI**

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

Course Objectives

1. Introduce concepts of trust, safety, fairness, and explainability in AI systems.
2. Provide practical tools and methods for interpretable ML models.
3. Discuss ethical implications, accountability, and regulations in AI deployment.
4. Prepare students to design AI systems that are transparent and trustworthy.

Unit I

Introduction to Trustworthy AI: Need for trustworthy AI, Principles of trustworthy AI (fairness, accountability, transparency, ethics), Overview of AI risks including bias, safety, and adversarial attacks, Trust challenges in AI applications, Real-world case studies of AI failures due to lack of trust

Unit II

Fundamentals of Explainable AI (XAI): Explainability in AI systems, Black-box vs white-box models, Importance of model interpretability, Types of explanations (local vs global, model-specific vs model-agnostic), Introduction to LIME, SHAP, partial dependence plots, Saliency maps and rule-based explanations

Unit III

Fairness, Bias, and Ethical Considerations: Types and sources of bias in AI systems, Fairness metrics (statistical parity, equal opportunity, equalized odds), Techniques for mitigating bias (pre-processing, in-processing, post-processing), Ethical implications of biased AI, Introduction to ethical frameworks and responsible AI design

Unit IV

Robustness, Safety, and Accountability: Adversarial examples and vulnerabilities in AI, Model robustness techniques, Explainability for debugging and validation, Human-in-the-loop systems, Accountability and auditability in AI, Overview of AI regulations (GDPR, AI Act), Safety and compliance in deployed AI systems

Unit V

Applications and Tools for Trustworthy AI: Practical tools for XAI and fairness (AIF360, What-If Tool, Interpret ML), Use cases in healthcare, finance, and criminal justice, Explainability in NLP and computer vision, Causal inference and counterfactual explanations, Design of fair and interpretable ML systems, Hands-on mini-project on building a trustworthy AI model

Course Outcome

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

1. Understand the principles and challenges involved in designing trustworthy and ethical AI systems.
2. Apply explainable AI techniques to interpret predictions of machine learning models.
3. Analyze and mitigate bias and fairness issues in datasets and AI algorithms.
4. Evaluate the robustness, accountability, and regulatory compliance of AI systems.
5. Use open-source tools and frameworks to de

Text Books

1. "Interpretable Machine Learning" by Christoph Molnar, Leanpub.
2. The Ethical Algorithm: The Science of Socially Aware Algorithm Design by Michael Kearns and Aaron Roth, Oxford University Press, 1st Edition, 2019.
3. Fairness and Machine Learning: Limitations and Opportunities by Solon Barocas, Moritz Hardt, and Arvind Narayanan, fairmlbook.org, Online Edition, 2023.

Reference Books

1. Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way by Virginia Dignum, Springer, 1st Edition, 2019.
2. Explainable AI: Interpreting, Explaining and Visualizing Deep Learning edited by Wojciech Samek, Grégoire Montavon, Andrea Vedaldi, Lars Kai Hansen, and Klaus-Robert Müller, Springer, 1st Edition, 2019.

Syllabus for Semester VI, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TP0604-04 **Course: Natural Language Processing**

L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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.

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.

UNIT II

Lexical Analysis, Part-of-Speech (POS) Tagging, Approaches for POS Tagging, Rule-Based, Stochastic, Hybrid Approach, Taggers Evaluations, Applications of Tagging.

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, 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.
4. Dipanjan Sarkar, Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition, Apress Media, LLC, California, 2019, ISBN: 978-1484243534.

Reference Books

1. Natural Language Processing with Python: From Basics to Advanced Projects, Second Edition, 2024, Cuantum Technologies LLC. Plano, ISBN: 979-8894968483.
2. Jyotika Singh, Natural Language Processing in the Real World: Text Processing, Analytics, and Classification, First edition, 2023, CRC Press is an imprint of Taylor & Francis Group, LLC, ISBN: 978-1003264774.
3. Gerhard Paaß and Sven Giesselbach, Foundation Models for Natural Language Processing: Pre-trained Language Models Integrating Media, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer Nature Switzerland Pte Ltd. 2022, ISBN: 978-3031231896.
4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, Inc., USA, Revised First edition, May 2022, ISBN: 978-1098136796.

Syllabus for Semester VII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TP0701-04 **Course: ML for Multimedia Content Analysis**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:
The objective of this course is to provide students with theoretical foundations and practical skills in applying machine learning techniques for analyzing and understanding multimedia content such as images, audio, and video. Students will learn both traditional and deep learning methods tailored for multimedia data.

Unit I: Introduction to Multimedia and ML Basics
Multimedia data types: images, audio, video, and text – Challenges in multimedia content analysis – Overview of machine learning: supervised and unsupervised learning – Data preprocessing: feature extraction, normalization, augmentation – Evaluation metrics: accuracy, precision, recall, F1-score, ROC.

Unit II: **Classical ML for Multimedia Content**
Feature-based representations: color histograms, texture features, MFCCs, SIFT, HOG – Dimensionality reduction: PCA, LDA, t-SNE – Classification algorithms: KNN, SVM, Decision Trees, Random Forest – Clustering: K-Means, DBSCAN, Gaussian Mixture Models – Applications: CBIR, speaker recognition, scene classification.

Unit III: **Deep Learning for Multimedia Analysis**
Neural networks and backpropagation – Convolutional Neural Networks (CNNs) for image and video data – Recurrent Neural Networks (RNNs) and LSTM for audio/sequential content – Transfer learning with pre-trained models (VGG, ResNet, MobileNet) – Use cases: image classification, object detection, segmentation.

Unit IV: **Multimodal and Temporal Analysis**
Multimodal learning: combining audio, video, and text – Feature fusion: early, late, and hybrid strategies – Action and event recognition in video – Audio-visual emotion recognition – Temporal modeling: video summarization, keyframe extraction.

Unit V: **Advanced Topics and Applications**
Generative models: Autoencoders and GANs – Self-supervised and contrastive learning – Audio-visual speech recognition – Streaming and real-time multimedia ML – Case studies: DeepFake detection, content moderation, content recommendation systems.

Course Outcomes
On successful completion of the course, the student shall be able to:
1. Understand multimedia data types and prepare them for analysis.
2. Apply classical machine learning models to multimedia content.
3. Utilize deep learning models for image, audio, and video understanding.
4. Develop multimodal systems that combine various forms of media.
5. Implement advanced techniques and explore current applications in multimedia AI.

Text Books:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016

References:

1. Ze-Nian Li, Mark S. Drew, Fundamentals of Multimedia, 2nd Edition, Pearson
2. A. Krizhevsky et al., Imagenet Classification with Deep Convolutional Neural Networks, NeurIPS, 2012

Syllabus for Semester VII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TP0702-04 **Course: MLOps and Federated Learning**

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

Course Objectives:

1. Understand the MLOps Principles and its Lifecycle.
2. Explore the ML Model Development and Production Readiness
3. Interpret the MLOps deployment, monitoring, and governance in practice.
4. Understand the Fundamentals of Federated Learning.

Unit 1: Introduction to MLOps and Foundational Concepts

Overview of MLOps**:** Introduction to MLOps, challenges, DevOps vs MLOps, MLOps to mitigate risk and ensure Responsible AI.

People of MLOps**:** Roles and responsibilities of Subject Matter Experts, Data Scientists, Data Engineers, Software Engineers, DevOps, Model Risk Managers/Auditors, and Machine Learning Architects in the ML life cycle.

Key MLOps Features**:** Model Development, Productionalization and Deployment, Introduction to Monitoring, Iteration, and Governance.

Unit-2 ML Model Development and Production Readiness

Developing Models: Machine Learning Model, Data exploration, Feature Engineering, and Selection, Experimentation, Evaluating, and Comparing Models, Version Management and Reproducibility.

Preparing for Production: Runtime Environments, Model Risk Evaluation, Quality Assurance for Machine Learning, Machine Learning Security, Model Risk Mitigation.

Unit 3: MLOps in Practice: Deployment, Monitoring, and Governance

Deploying to Production**:** CI/CD Pipelines for ML, Building and testing ML Artifacts, Deployment Strategies and considerations for sending models to production, Maintenance in Production, Containerization, and Scaling Deployments.

Monitoring and Feedback Loop**:** Model Degradation, Drift Detection in practice, Feedback Loop: Logging, Model Evaluation, Online Evaluation.

Model Governance**:** Establishing governance policies and matching governance with risk level Current Regulations Driving MLOps Governance, Emergence of Responsible AI and its key elements, A template for MLOps Governance.

Unit 4: Real-World MLOps Applications and Case Studies

MLOps in Practice: Consumer Credit Risk Management, MLOps in Practice: Marketing Recommendation Engine, MLOps in Practice: Consumption Forecast.

Unit 5: Fundamentals of Federated Learning

Centralized vs Federated Learning, Privacy-preserving ML techniques, Federated Averaging FL architecture: client-server model, aggregation, Challenges in FL, Federated transfer learning, and vertical FL, MLOps and FL integration pipelines.

Course Outcomes:

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

1. Apply foundational MLOps principles to manage machine learning workflows.
2. Apply ML model development and MLOps practices for deployment and governance.

3. Analyze real-world MLOps case studies to identify best practices and deployment challenges.
4. Use federated learning architectures to design privacy-preserving machine learning systems.

TEXT BOOKS:

1. Introducing MLOps: How to Scale Machine Learning Projects, Mark Treveil and Alok Shukla, O'Reilly Media, 2022.
2. Machine Learning Engineering with Python: Manage the end-to-end ML lifecycle with MLflow, Andrew P. McMahon, Packt Publishing, 2021.
3. Federated Learning: Privacy and Incentive, Qiang Yang, Yang Liu, Tianjian Chen, Yongxin Tong, Morgan & Claypool Publishers, 2020.

REFERENCE BOOKS:

1 MLOps Engineering at Scale, Carl Osipov, Manning Publications,2022.

2 Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications, Chip Huyen, O'Reilly Media, 2022.

Syllabus for Semester VII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0703-10 **Course: Reinforcement Learning**

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

---

1. Understand the fundamental concepts and components of reinforcement learning.
2. Explore and analyze model-free and model-based approaches to decision-making and learning in uncertain environments.
3. Use value-based and policy-based reinforcement learning algorithms.
4. Apply reinforcement learning methods to solve real-world problems.

Unit-1 Introduction to Reinforcement Learning

Reinforcement Learning, applications, Elements of Reinforcement learning, State, Action, Reward, Environment, Taxonomy of reinforcement learning agents, fully vs partially observed environment, limitations and scope, Extended example of Tic- Tac – Toe, Markov Processes, Markov Decision Processes (MDP), Markov Reward Process (MRP).

Unit-2 Planning and Exploration of Reinforcement Learning

Planning: Objective of a decision-making agent environment, Plan, Optimal policy, Comparison of Policies, Bellman Equation/State-Value Function, Action-Value Function, Action-Advantage Function, Optimality.

Exploitation and Exploration of Reinforcement Learning: Bandits- Single-state decision problem (Multi-Armed Bandit (MAB) problem), The cost of exploration, Approaches to solve MAB environments, Greedy Strategy, Random Strategy, Epsilon-Greedy Strategy

Unit-3 Model Free Reinforcement Learning

Monte Carlo Prediction (MC), First-Visit MC (FVMC), Every-Visit MC (EVMC), Temporal Difference Learning (TD), Learning to estimate from multiple steps, N-step TD learning, Forward-view TD(λ), Backward-view TD(λ), SARSA: On-Policy TD control, Q-learning: Off-Policy TD control, Double Q-learning

Model Based Reinforcement Learning: Dyna-Q.

Unit-4 Value Based Reinforcement Learning

Deep reinforcement learning agents with sequential feedback, evaluative feedback, sampled feedback, Function Approximation for Reinforcement Learning, Neural Fitted Q (NFQ), Deep Q-Network (DQN), Double Deep-Q Networks (DDQN), Dueling DDQN.

Unit-5 Policy Based Reinforcement Learning

Policy Gradient and Actor Critic Methods, REINFORCE Algorithm and Stochastic Policy Search, Vanilla Policy Gradient (VPG), Asynchronous Advantage Actor-Critic (A3C), Generalized Advantage Estimation (GAE), Advantage Actor-Critic(A2C), Deep Deterministic Policy Gradient (DDPG)

Course Outcomes:

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

1. Demonstrate different components of Reinforcement Learning.
2. Make use of exploration and exploitation strategies.
3. Apply Model based and Model Free Prediction techniques.
4. Make use of different value-based and policy-based Reinforcement Learning Algorithms.

TEXT BOOKS:

1. Reinforcement learning: An Introduction, Richard S. Sutton and Andrew G. Barto, Second Edition, MIT Press, 2018.
2. Deep Reinforcement Learning Hands-On, Maxim Lapan, Packt Publishing, 2018.
3. Algorithms for Reinforcement Learning, Csaba Szepesvari, Morgan & Claypool publication, 2010.
4. Deep Reinforcement learning: Frontiers of Artificial Intelligence, Mohit Sewak, first edition, Springer, 2019.
5. Grokking Deep Reinforcement Learning, Miguel Morales, Manning Publications, 2020.

REFERENCE BOOKS:

1. Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Keng, Wah Loon, Graesser, Laura, Addison Wesley Data & Analytics Series, 2020.
2. Reinforcement Learning: State-of-the-Art, Adaptation, Learning, and Optimization, Marco Wiering, Martijn van Otterlo, book series, ALO, volume 12, Springer, 2012.
3. Practical Deep Reinforcement Learning: A Guide to Training AI Agents with TensorFlow and OpenAI Gym, Ivan Gridin, Apress, 2020.

Syllabus for Semester VII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0703-04 **Course: Generative AI**

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

Course Objectives:

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

Unit-1 Fundamentals of Generative AI

Generative AI, Overview, history, applications, Generative vs. Discriminative models, Latent variables and representation learning, Types of generative models, challenges in Generative AI, Generative Model Lifecycle, Evaluation metrics: FID, IS, BLEU, Perplexity.

Unit-2 Autoencoders and GANs.

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

Unit-3 Large Language Models and Transformer Architectures

Introduction to LLMs, Evolution, Transformer architecture: self-attention, encoder-decoder structure, GPT, BERT, T5, LLaMA, DALL·E, fine-tuning paradigms, Applications: summarization, translation, code generation, chatbots, challenges and limitations.

Unit 4: Introduction to Prompt Engineering

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

Unit 5: Explainable and Responsible Generative AI

Explainable AI basics, XAI techniques: SHAP, LIME, Integrated Gradients, attention visualization, Explainability in LLMs and GANs.

Responsible AI: principles, bias and fairness in generative models, Regulatory frameworks and ethical guidelines (EU AI Act, OECD AI Principles, NIST AI Risk Framework)

Course Outcomes:

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

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

TEXT BOOKS:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition,2022.
2. The Art of Prompt Engineering with ChatGPT: A Hands-On Guide - Learn AI Tools the Fun Way, Shroff/Hunter; First Edition,2023.
3. Interpretable Machine Learning,: A Guide for Making Black Box Models Explainable, Christoph Molnar ,Shroff/Molnar, Second Edition,2020.
4. Responsible AI: Best Practices for Creating Trustworthy AI Systems, Qinghua Lu, Liming Zhu, et al, Pearson publisher, Ist Edition, 2024.

REFERENCE BOOKS:

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

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

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

Syllabus for Semester VII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0704-04 **Course: Social Network and Recommendation Systems**

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

Course Objectives

1. To familiarize the concepts and techniques of social network analysis.
2. Apply network models and link analysis algorithms to real-world network data.
3. Analyze community structures and temporal dynamics in networks using various community detection and link prediction techniques.
4. Differentiate between recommender systems using collaborative and content-based filtering methods.
5. Evaluate the performance of link prediction and recommender systems using appropriate metrics and models.

UNIT I

What is social network analysis, Why Study Social Networks, Applications, Levels of Social Network Analysis, Graph Visualization Tools, Network Measures: Network Basics, Node Centrality, Assortativity, Transitive and Reciprocity, Similarity, Degeneracy.

UNIT II

Network growth models, Properties of real world networks, Random network model, Ring Lattice Network Model, Watts Strogatz model, Preferential Attachment model, Price's model, Local -world network growth model, Link analysis, Applications, Signed networks, Strong and weak Ties, Link analysis and algorithms, Page Rank, Personalized Page Rank, Divrank, Simrank, PathSim.

UNIT III

Community structure in networks, Applications, Types of communities, Community detection methods, Disjoint community detection, overlapping community detection, local community detection, community detection vs community search; evaluation. Link prediction, Applications, temporal changes in a network, Problem definition, Evaluating link prediction networks, Heuristic Models, probabilistic Models, Supervised Random walk, Information-theoretic model.

UNIT IV

Introduction to Recommender Systems, Goals of Recommender Systems, Basic Models of Recommender Systems, Domain-Specific Challenges, Applications, Model-Based Collaborative Filtering, Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box.

UNIT V

Content-Based Recommender Systems, Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations, Using Content-Based Models for Collaborative Filtering, Constraint-Based Recommender Systems, Case-Based Recommenders, Evaluating Recommender Systems, General Goals of Evaluation Design, Accuracy Metrics in Offline Evaluation.

Course Outcomes

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

1. Describe key concepts of social network analysis and recommendation systems.
2. Apply network growth models and link analysis algorithms to solve real-world network problems.
3. Analyze community structures, link prediction techniques, and their applications in dynamic and temporal networks.
4. Differentiate between recommender systems using model-based and content-based collaborative filtering approaches.
5. Assess the effectiveness of link prediction and recommender systems using accuracy metrics and evaluation frameworks.

Textbooks

1. Tanmoy Chakraborty, Social Network Analysis, Wiley India Pvt. Ltd., 2021, ISBN: 978-81-265-2007-7.
2. Charu C. Aggarwal, Recommender Systems, Springer International Publishing, 2016, ISBN: 978-3-319-29659-3.

Reference Books

1. Mohammad Gouse Galety, Chiai Al Atroshi, Buni Balabantaray, Sachi Nandan Mohanty, Social Network Analysis: Theory and Applications, Wiley India Pvt. Ltd., 2022, ISBN: 978-1-119-83673-5.
2. John Scott, Social Network Analysis, SAGE Publications Ltd; Fourth edition, 2017, ISBN: 978-1473952119
3. Daniel Schall, Social Network-Based Recommender Systems, Springer International Publishing, 2016, ISBN: 978-3319372297.
4. P. Pavan Kumar, S. Vairachilai, Sirisha Potluri, Sachi Nandan Mohanty, Recommender Systems Algorithms and Applications, CRC Press, First Edition, 2021, ISBN: 978-0-367-63187-1

Syllabus for Semester VIII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0801-04 Course: GPU Programming
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives :
The objective of this course is to introduce students to the fundamentals and advanced concepts of parallel computing. It covers parallel hardware architecture, programming paradigms, performance modeling, and practical implementation using CUDA, OpenMP, OpenACC, and other frameworks to solve computationally intensive problems efficiently.

Unit I: Introduction to Parallel Computing
Advances in computing architecture and technology – Motivation and need for parallel computing – Real-world examples – Challenges in parallelism – Flynn's taxonomy of computer architectures – Overview of CPU, GPU, and multicore systems – SIMT execution model.

Unit II: **Basics of Parallel Programming with CUDA**
Introduction to CUDA C – GPU architecture and execution model – Kernel-based data-parallel programming – CUDA thread hierarchy and execution – CUDA memory hierarchy (global, shared, constant, texture memory) – Thread synchronization and atomic operations – GPU utilisation and memory locality.

Unit III: **Parallel Programming Paradigms and Performance Modeling**
Design of parallel algorithms – Parallel algorithm paradigms – Analytical modeling of parallel programs – Amdahl's Law and Gustafson's Law – Scalability and work optimality – Message passing vs shared memory architectures – Concurrency and communication patterns – Basic operations (broadcast, scatter, gather).

Unit IV: **Advanced CUDA Programming and Optimization**
Data transfer techniques and CUDA streams – Synchronization and concurrency control – Floating-point precision and performance considerations – Efficient implementation of reduction operations and parallel prefix sums – Optimization strategies for memory access, execution time, and resource utilization.

Unit V: **Parallel Programming Frameworks and Case Studies**
OpenMP and OpenACC for shared memory parallelism – Introduction to OpenCL and GPGPU computing – Multi-GPU systems – Interfacing with OpenGL for visualization – Case studies demonstrating real-world applications in scientific computing, image processing, and machine learning.

Course Outcomes
On successful completion of the course, the student shall be able to:
1. Understand the need for parallel computing and classify system architectures.
2. Write basic GPU programs using CUDA and optimize them for memory and performance.
3. Analyze and design parallel algorithms considering hardware constraints.
4. Evaluate and improve the performance of parallel applications using theoretical models.
5. Apply various parallel programming frameworks like OpenMP, OpenACC, and OpenCL for diverse computing environments.

Text Books:

1. T1. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, Elsevier.
2. T2. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, 2nd Edition.

Syllabus for Semester VIII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0801-09 **Course: Generative Adversarial Network**

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

Course Objectives :

The objective of this course is to provide a comprehensive understanding of Generative Adversarial Networks (GANs), their architectures, evaluation techniques, and real-world applications. The course also aims to introduce advanced GAN variants, training techniques, and ethical implications of generative models.

Unit I: Deep Learning Review and Introduction to Generative Modeling

Review of Deep Learning essentials: Neural Networks, Activation Functions, Loss Functions, Optimizers – Introduction to Generative Models: Explicit vs Implicit Density Estimation – Generative vs Discriminative Models – Motivation for Generative Modeling – Introduction to GANs: Architecture, Generator, Discriminator – Mathematical Formulation and Advantages of GANs.

Unit II: **GAN Architectures and Variants**

Building a simple GAN using PyTorch or TensorFlow – Training dynamics: convergence, instability – Vanilla GAN – Deep Convolutional GANs (DCGAN) – Conditional GANs (cGAN) – Least Squares GAN (LSGAN).

Unit III: **Advanced GAN Techniques**

Wasserstein GAN (WGAN) – CycleGAN – Progressive Growing of GANs – StyleGAN and StyleGAN2 – Self-Attention GANs – BigGAN – InfoGAN – Transfer Learning with Pretrained GANs.

Unit IV: **Evaluation and Stabilization of GANs**

Evaluation Metrics: Inception Score, Frechet Inception Distance (FID), Precision & Recall – Human-centered evaluation – Challenges in GAN evaluation – Training stabilization techniques: Feature Matching, Minibatch Discrimination, Label Smoothing – Importance of Evaluation in Generative Modeling.

Unit V: **Applications and Ethics of GANs**

Applications: Image Synthesis & Editing, Super-resolution (SRGAN), Data Augmentation, Video Generation, Text-to-Image Synthesis (DALL·E, AttnGAN), Image-to-Image Translation (CycleGAN, Pix2Pix), Privacy Preservation – Ethical Considerations: Fairness, Bias, Deepfakes, Adversarial Attacks & Defenses – Recent Trends: Diffusion Models vs GANs – Open Challenges and Future Directions.

Course Outcomes

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

1. Understand the principles and components of GANs and their mathematical formulation.
2. Implement and train various GAN architectures for image synthesis and editing tasks.
3. Apply advanced GAN variants for specific generative tasks and analyze their effectiveness.
4. Evaluate GAN outputs using established quantitative and qualitative metrics.
5. Explore real-world applications of GANs and assess ethical implications in generative

AI.

Text Books:

1. T1. Jakub Langr, Vladimir Bok, GANs in Action: Deep Learning with Generative Adversarial Networks, Manning Publications, 1st Edition, 2019
2. T2. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media, 2nd Edition, 2023
3. T3. François Chollet, Deep Learning with Python, Manning Publications, 2nd Edition, 2021

References:

1. R1. Jakub M. Tomczak, Max Welling, Deep Generative Models, Now Publishers, 1st Edition, 2023
2. R2. Rafael Valle, Hands-On Generative Adversarial Networks with Keras, Packt Publishing, 1st Edition, 2019
3. R3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 1st Edition, 2016

Syllabus for Semester VIII, Track 4 B. Tech. Computer Science & Engineering (AIML)

Course Code: 25CS01TH0802-04 **Course: Agentic AI**

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

Course Objectives

1. To introduce the core concepts and design principles of agentic AI systems.
2. To understand how agents perceive, act, and learn in dynamic environments.
3. To explore the architectures and algorithms enabling autonomous decision-making.
4. To analyze ethical implications and real-world applications of agent-based AI.

Unit I

Foundations of Agentic AI: Definition and scope of agentic AI, Rational agents and agent-based systems, PEAS (Performance measure, Environment, Actuators, Sensors), Types of agents – reflex, model-based, goal-based, utility-based, learning agents, Agent architectures and design paradigms

Unit II

Environment and Agent Interactions: Agent-environment interface, Task environments and their classification, Properties of environments – deterministic vs stochastic, fully vs partially observable, discrete vs continuous, multi-agent systems and communication, Cooperation, competition, and coordination in agent systems

Unit III

Learning and Planning in Agentic Systems: Introduction to planning in intelligent agents, Search algorithms for planning, Reactive vs deliberative planning, Learning agents and reinforcement learning basics, Exploration vs exploitation, Model-based and model-free learning in agentic systems

Unit IV

Autonomous and Goal-Oriented Behavior: Autonomy in agents, Goal formulation and intention recognition, Goal hierarchies and utility-based decision making, Agent deliberation cycles, Meta-reasoning and self-adaptive agents, Integration of learning and reasoning in autonomous agents

Unit V

Applications and Ethics in Agentic AI: Applications in robotics, smart assistants, autonomous vehicles, multi-agent simulation and gaming, Trust, safety, and ethics in agentic behavior, Value alignment and human-agent collaboration, Future directions in AGI and agent-based AI

Course Outcomes (COs):

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

1. Explain the foundational models and types of intelligent agents.
2. Classify environments and describe agent-environment interactions.
3. Apply planning and learning algorithms within agentic systems.
4. Design autonomous agents capable of goal-driven behavior.
5. Evaluate ethical, safety, and application aspects of agentic AI systems.

Text Books

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig, Pearson, 4th Edition
2. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations by Yoav Shoham and Kevin Leyton-Brown, Cambridge University Press, 1st Edition

Reference Books

1. Intelligent Agents: Foundations and Applications by Gerhard Weiss, Springer, 1st Edition
2. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto, MIT Press, 2nd Edition

Track 5:
Computer Science and Engineering
(Artificial Intelligence and
Data Science)

Syllabus for Semester IV, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01PR0404-05 **Course: Software Lab-II Data Exploration and Handling Lab**

L: 0Hrs, P: 4Hrs, 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.

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

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).

Text 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 V, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01PR0504-05 **Course: Software Lab-III Web Technologies Lab**

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

Course Objectives:

1. To comprehend the fundamentals of React with JavaScript and JSX for creating templates with React components and their importance in building reusable UI elements.
2. To familiarize the students with essential skills for modern front-end web applications by the use of ReactJS features.
3. To learn to implement client-side routing using React Router for Single Page Applications (SPAs).

Introduction to React: ReactJS Introduction, Advantages of React JS, Introduction to JSX,
Difference between JS and JSX, Templating using JSX, Working with React, createElement, Expressions, logical operators, specifying attributes, children and Fragments.

React Components overview: Types of components, Controlled, Split Up, Composable, Reusable, Component Declarations and Styling Components, Conditional Rendering, List Rendering.

Props and State: State and its significance, Read state and setState, Passing data to components using props, Validating props using prop Types, Supplying default values to props using default Props.

Event Handling: Lifecycle Methods, Handling events in React Components, React Forms, Controlled Components, Uncontrolled components.

Routing with React Router: Need of react Router, React Router Installation, Components in React Router, Adding Navigation using Link component.

Course Outcomes

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

1. Understand the fundamentals of React with JavaScript and JSX.
2. Build and reuse functional and class-based React components effectively.
3. Utilize props and state effectively to manage data flow and UI interactions in React applications
4. Handle user events and implement conditional rendering based on user interaction.
5. Demonstrate dynamic routing and navigation in a React application.

Text Books:

1. React Up & Running: Building Web Applications - Stoyan Stefanov, O'Reilly Media, Second Edition, 2021.
2. Learning React: Modern Patterns for Developing React Apps - Alex Banks & Eve Porcello, O'Reilly Media, Second Edition, 2020.

3. React in Action 1st Edition - Mark Tielens Thomas, Manning Pubns Co, First Edition, 2018.

Reference Books

1. Pure React- a step-by-step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch

Syllabus for Semester V, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TH0506-05 **Course: Data Analysis and Visualization**
L: 3Hrs, P: 0Hrs, Per Week **Total Credits: 3**

Course Objectives

1. To understand data analytics life cycle for solving challenging business problems.
2. To adopt appropriate statistical procedures for analysis based on goals and nature of data.
3. To employ best practices in data visualization to develop charts, maps tables and other visual representations of data.

UNIT - I: Introduction and Overview
Importance of analytics and visualization, data preprocessing, Basic Analysis Techniques, Data Analytics Lifecycle and Different Phases

UNIT - II: Association Rules and Regression
Association Rules : Overview, Apriori Algorithm, Evaluation of Candidate Rules, Frequent Itemsets and Rule Generation, Validation and Testing, Diagnostics.
Regression: Linear Regression, Logistic Regression, Choice of a Model.

UNIT - III: Classification and Clustering
Clustering : Overview, k-Means, k-Modes, Partitioning around Medoids (PAM), Hierarchical Agglomerative and Density Clustering Methods. **Classification**: Decision Trees – Overview, Detecting Significant Split, Algorithms and Evaluation; Naïve-Bayes – Bayes' Theorem, Naïve Bayes
Classifier, Smoothing; Diagnostics of Classifiers.

UNIT - IV: Time Series Analysis
Time Series Analysis: Box-Jenkins Methodology, ARIMA (Auto Regressive Integrated Moving Average) Model, Choice of a Model, Overview of ARMAX, Spectral Analysis and GARCH.

UNIT - V : Data Visualization Understanding
Understanding Data Visualization Principles, Mapping Data onto Aesthetics, Visualizing - Distributions, Proportions, Time Series, Trends and Uncertainty; Commonly used File Formats and Software.

UNIT - VI : Creating Stories with Data
Why Planning?, Creating Interesting Stories with Data – Reader-driven Narratives, Author-driven Narratives; Perceptions and Presentation Methods, Best Practices in Visualization, Interactive Visualization, Event Listeners and Layouts, Case Studies for Visualization.

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

1. Apply data preprocessing and basic data analysis techniques.
2. Conduct data analytics using scientific methods.
3. Analyze time series data.
4. Create presentations and visualizations.

Text Books

1. David Dietrich, Barry Heller and Beibel Yang, - Data Science and Big Data Analytics – Discovering, Analyzing, Visualizing, and Presenting Data, John Wiley and Sons [EMC Education Services], 2015.
2. Claus O. Wilke, - Fundamentals of Data Visualization – A Primer on Making Informative and Compelling Figures, O'Reilly, 2019.
3. Python: Data Analytics and Visualization, Packt Publishing, 2017.

Reference Books

1. Jiawei Han, Micheline Kamber and Jian Pei, - Data Mining Concepts and Techniques, 3rd edition; Morgan Kaufmann Publishers, 2011.

Syllabus for Semester VI, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TP0602-05 **Course: NoSQL Databases**

L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:

To provide students with a comprehensive understanding of non-relational (NoSQL) database technologies, their architecture, data models, and applications in large-scale distributed systems. The course equips learners with practical skills in using key-value stores, document-oriented, column-family, and graph databases, with a focus on consistency models, distribution strategies, and use-case-driven data modeling.

UNIT-I

Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing, Aggregate Oriented Databases. Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access

Unit II:

Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication. Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums. Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes, Map-Reduce, Basic Map-Reduce, MapReduce on databases, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental MapReduce Key-Value Databases,

Unit III:

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

Unit IV:

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: Mongo DB

Unit V:

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

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, student shall be able to

1. Describe the need for NoSQL and compare different aggregate-oriented data models.
2. Explain distribution strategies and consistency models in NoSQL databases.
3. Apply key-value store concepts and perform operations using Redis.
4. Perform CRUD operations and manage data in document databases like MongoDB.
5. Use columnar (Cassandra) and graph (Neo4j) databases for scalable and connected data modeling.

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, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TH0603-05 **Course: Data Privacy and Security**

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

Course Objectives:

To become familiar with the fundamental concepts of data security and privacy mechanisms along with an understanding of hiding data in text and images

Syllabus:

Unit I: Introduction: Security goals, Cryptographic Attacks, Services and Mechanism, Techniques. Traditional Symmetric Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers. Introduction to Modern Symmetric-Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers

Unit II: Data Encryption Standard (DES): Introduction, DES Structure, DES Analysis, Multiple DES,
Security of DES. Advanced Encryption Standard (AES): Introduction, Transformations, Key Expansion, AES Ciphers, Analysis of AES. Asymmetric-Key Cryptography: Introduction, RSA Cryptosystem, Rabin Cryptosystem, Elgamal Cryptosystem, Elliptic Curve Crypto Systems

Unit III: Cryptographic Hash Functions: Introduction, Iterated Hash function, SHA-512, WHIRLPOOL. Digital Signature: Comparison, Process, Services, Attacks on Digital Signature, Digital Signature Standard. Data Hiding in Text: Basic Features, Applications of Data Hiding, Watermarking, Intuitive Methods, Simple Digital Methods, Data Hiding in Text, Innocuous Text, Mimic Functions.

Unit IV: Data Hiding in Images: LSB Encoding, BPCS
Steganography, Lossless Data Hiding, Spread Spectrum Steganography, Data Hiding by Quantization, Patchwork, Signature Casting in Images, Transform Domain Methods, Robust Data Hiding in JPEG Images, Robust Frequency Domain Watermarking, Detecting Malicious Tampering

Unit V: Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data
Mining, Privacy on the Web, E-Mail Security, Impacts on Emerging Technologies. Legal and Ethical Issues in Computer Security: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security

Course Outcomes

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

CO1: To learn the basic concepts related to data security and understand the different types of symmetric key ciphers.

CO2: To understand and apply the concepts of encryption standards.

CO3: To understand hash functions and to learn the basic concepts of hiding data in text and images.

CO4: To understand the concepts of privacy, authentication, web and email security

Textbooks:

1. Cryptography and Network Security by Behrouz A. Forouzan, Dedeep Mukhopadhyay, TMH, 2nd edition, 2013.
2. Data Privacy and Security by Salomon, David, Springer, 2003
3. Security in Computing by Charles Pfleeger, Shari Lawrence Pfleeger, 5th Edition, PHI,2015.

Reference Books

1. Information Security: Principles and Practice by Mark Stamp, Wiley InterScience,2011.
2. Computer Security: Art and Science by Matt Bishop, First Edition, Addison Wesley,2002.
3. Cryptography and Network Security by William Stallings, Pearson Education,7^{th} edition,2017.

Syllabus for Semester VI, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TP0604-05 **Course: Natural Language Processing**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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.

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.

UNIT II

Lexical Analysis, Part-of-Speech (POS) Tagging, Approaches for POS Tagging, Rule-Based, Stochastic, Hybrid Approach, Taggers Evaluations, Applications of Tagging.
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, 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.
4. Dipanjan Sarkar, Text Analytics with Python: A Practitioner's Guide to Natural Language Processing, Second Edition, Apress Media, LLC, California, 2019, ISBN: 978-1484243534.

Reference Books

1. Natural Language Processing with Python: From Basics to Advanced Projects, Second Edition, 2024, Cuantum Technologies LLC. Plano, ISBN: 979-8894968483.
2. Jyotika Singh, Natural Language Processing in the Real World: Text Processing, Analytics, and Classification, First edition, 2023, CRC Press is an imprint of Taylor & Francis Group, LLC, ISBN: 978-1003264774.
3. Gerhard Paaß and Sven Giesselbach, Foundation Models for Natural Language Processing: Pre-trained Language Models Integrating Media, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer Nature Switzerland Pte Ltd. 2022, ISBN: 978-3031231896.
4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, Inc., USA, Revised First edition, May 2022, ISBN: 978-1098136796.

Syllabus for Semester VII, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TP0701-05	**Course: Image Analysis and Computer Vision**
L: 3Hrs, P: 2Hrs, Per Week	**Total Credits: 4**

Course Objectives:

1. To gain a deep understanding of core concepts in image analysis and computer vision, including multi-dimensional signal processing, image formation, image alignment, feature extraction, pattern analysis, and visual geometric modeling.
2. To investigate advanced topics such as motion analysis, object tracking, and emerging research areas in computer vision, enabling contributions to cutting-edge research and advancements in the field.
3. To explore a wide range of applications, including biometrics, medical imaging and diagnosis, document processing, surveillance systems, and advanced rendering techniques.

Unit I:

Image processing system, Digital Image Formation and Camera Geometry, sampling and quantization of an Image, Basic relationship between pixels, Image representation, types of images (binary, grayscale, color, indexed), and Mathematical operations.

Unit II:

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

Unit III:

Morphological Image Processing: Erosion, Dilation, Opening, Closing, Hit or Miss Transformation, Boundary Extraction, Hole Filing, Extraction of Connected components. Image Segmentation: Point, Line, edge detection, boundary detection, Thresholding, region based segmentation.

Unit IV:

Adaboost algorithm: binary classification, face detection, Adaboost for Computation of Haar-like features; Image Segmentation; Object recognition and shape representation, Pattern Analysis: Clustering: K-Means, K-Medoids, Classification: Supervised, Un-supervised, Semi-supervised.

Unit V:

Classifiers: KNN, ANN models; Viola Jones algorithm for face detection and Boosting: Features, Integral images, Boosting, cascade; Activity Recognition in videos, Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods, deep neural architectures and applications.

Course Outcomes

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

1. Understand and apply fundamental principles of digital image formation, pixel relationships, quantization, and feature-based image alignment.
2. Extract image features using descriptors, perform morphological operations and segmentation techniques for image analysis.
3. Implement morphological and region-based segmentation techniques to isolate meaningful structures from digital images.
4. Apply machine learning algorithms for object recognition, classification, and activity recognition in images and videos.

Text Books:

1. Computer Vision: Algorithms and Applications by R. Szeliski, Springer, 2011.
2. John Willam, K. Pratt, Digital Image Processing. Willey & Sons (3rd Edition).
3. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill, 2nd ed., 2011.
4. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall, 1998.

Reference Books

1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012

Syllabus for Semester VII, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TP0702-05 **Course: Deep Learning-II**

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

Course Objectives:

1. Understanding the fundamentals of deep learning and its applications in generative models.
2. Learning to train and evaluate generative models on different types of data such as images, text, and audio.
3. Developing practical skills in implementing and fine-tuning generative models using popular deep learning frameworks.

Unit I:

Directed Graphical Models: Probability Theory, Joint Distributions, representations of joint distribution, graphical representation of joint distribution, reasoning in a Bayesian network, Causal Reasoning, Evidential Reasoning, Independencies encoded by a Bayesian network (Case 1: Node and its parents), Independencies encoded by a Bayesian network (Case 2: Node and its non-parents), Independencies encoded by a Bayesian network (Case 3: Node and its descendants)

Unit II:

Markov Networks: Motivation, Factors in Markov Network, Local Independencies in a Markov Network, Using joint distributions for classification and sampling, concept of a latent variable.

Unit III:

Restricted Boltzmann Machines: Introduction to Restricted Boltzmann Machines, RBMs as Stochastic Neural Networks, Unsupervised Learning with RBMs, Computing the gradient of the log likelihood, Motivation for Sampling.

Unit IV:

Markov Chains: Introduction to Markov Chains, Need of Markov Chains, Setting up a Markov Chain for RBMs, Training RBMs using Gibbs Sampling, Training RBMs using Contrastive Divergence.

Unit V:

Variational Autoencoders: Revisiting Autoencoders, Variational Autoencoders: The Neural Network Perspective, Variational autoencoders: (The graphical model perspective), Neural Autoregressive Density Estimator, Masked Autoencoder Density Estimator.

Course Outcomes:

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

1. Use probability concepts to build directed graphical models and Markov networks.
2. Solve problems using Restricted Boltzmann Machines and Markov chains.
3. Apply auto-encoder model to find solution of a given problem.

Text Books:

1. Ian Good fellow and Yoshua Bengio and Aaron Courville. *Deep Learning*. An MIT Press book. 2016.
2. Charu C. Aggarwal. *Neural Networks and Deep Learning: A Textbook*. Springer. 2019.
3. Christopher Bishop. *Pattern Recognition and Machine Learning*. Springer Verlag, 2006.

Reference Books:

1. *Deep Learning from Scratch: Building with Python from First Principles* by Seth Weidman published by O`Reilley.
2. *Grokking Deep Learning* by Andrew W. Trask published by Manning Publications.

Syllabus for Semester VII, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TH0703-5 **Course: Large Scale Data Analysis**

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

Course Objectives

1. To cover the key concepts, design principles, and systems to analyse large-scale data in order to extract novel and transformative insights.
2. To become proficient in the most popular big data computing frameworks in order to apply technology to solve various large scale data analytic problems.

UNIT I

Introduction to Large Scale Data Analytics and its need; Big Data: Characteristics, Challenges and applications, 3Vs, 6Vs definition, Data processing and platforms: stored data and real-time. Web data analysis: Link Analysis - Page Rank, Modified page rank, Search Engine Optimization using page rank.

UNIT II

Introduction to Big Data Platforms, Big data computing framework: Hadoop - Introduction to Hadoop, Overview of Hadoop ecosystem, Hadoop Architecture; big data storage: Hadoop Distributed File System, HBase Architecture, Map Reduce: Introduction, internal working, Map reduce way of designing solutions with examples.

UNIT III

System optimization for big data processing, improvements of map-reduce framework optimization for task scheduling and load balancing of map-reduce, job scheduling of Hadoop and its improvement, performance optimization of HDFS. Visual representations for accessing large data: Tag Clouds, Information Landscapes like In-SPIRE, InfoSky or any other for large dataset visualization. Visualization of Geo-Spatial Information, topical cluster visualization using ThemeRiver.

UNIT IV

Database Techniques for large scale data: Databases and their Evolution, Relational databases Vs NoSQL databases, NoSQL Solutions for Big Data Management- Consistency Availability Partition Tolerance (CAP), NoSQL data models: key-value stores, column-based stores, graph-based stores, document-based stores. Cassandra: Introduction, Architecture, Data Replication in Cassandra, Data model: cluster, keyspace, column family, Cassandra Keyspace Operations, CURD Operations, Cassandra CQL: data types, collections.

UNIT V

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

Large-scale machine learning: Introduction, Machine Learning with MLlib, Linear and logistic regression, classification and clustering with Big Data tool like Spark or Hadoop; cloud-native data analytics.

Course Outcomes

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

1. Apply appropriate Machine Learning algorithms, big data techniques and optimization to address various problems.
2. Perform big data analytics on structured and unstructured data, using various data analytic techniques.
3. Use NoSql Databases for analyzing large data sets.
4. Analyze large scale data by visualization of data.

Text Books

1. Tom White; Hadoop: The Definitive Guide, 4th Edition, O'Reilly, 2015.
2. Bill Chambers, Matei Zaharia; Spark: The Definitive Guide, O'Reilly Media, Inc., February 2018
3. Rajkumar Buyya, Amir Vahid Dastjerdi, Rodrigo N. Calheiros; Big data: principles and paradigms, Morgan Kaufmann, June 2016.

Reference Books

1. Aris Gkoulalas-Divanis, Abderrahim Labbi; “Large-Scale Data Analytics”, Springer 2014, DOI: https://doi.org/10.1007/978-1-4614-9242-9.
2. Hien Luu; Beginning Apache Spark 2: With Resilient Distributed Datasets, Spark SQL, Structured Streaming And Spark Machine Learning Library, Apress, 2018
3. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.

Syllabus for Semester VII, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TH0704-05 **Course: Time Series Analysis**

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

Course Objectives

1. To understand Time Series Analysis.
2. To introduce the tools and Models for basic concepts of Time Series Analysis.
3. To apply the Time Series Model Selection research models to solve problems.

Unit I

TIME SERIES DATA: EXAMPLES AND BASIC CONCEPTS : Introduction, Examples of Time Series Data, Understanding Autocorrelation, The Wold Decomposition, The Impulse Response Function, Superposition Principle ,Parsimonious Model.

Unit II

VISUALIZING TIME SERIES DATA STRUCTURES: GRAPHICAL TOOLS: Introduction, Graphical Analysis of Time Series, Graph Terminology, Graphical Perception, Principles of Graph Construction, Aspect Ratio, Time Series Plots, Bad Graphics.

Unit III

STATIONARY MODELS: Basics of Stationary Time Series Models, Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Transformation of Data.

Unit IV

NONSTATIONARY MODELS: Introduction, Detecting Nonstationarity , Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA Models, Concentration Measurements from a Chemical Process, The EWMA Forecast.

SEASONAL MODELS: Seasonal Data, Seasonal ARIMA Models, Forecasting using Seasonal ARIMA Models.

Unit V

TIME SERIES MODEL SELECTION: Introduction, Finding the “BEST” Model, Internet Users Data, Model Selection Criteria, Impulse Response Function to Study the Differences in Models, Comparing Impulse Response Functions for Competing Models.

Course Outcomes:

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

1. The students should get acquainted with the main concepts of Time Series theory and methods of analysis.
2. Students should master traditional methods of Time Series analysis, intended mainly for working with time series data.
3. Understanding the underlying concepts in the time series and frequency domains
4. Demonstrate advanced understanding of the concepts of time series and their application.

Text Books

1. Murat Kulahci Technical University of DenmarkA JOHN WILEY & SONS, INC., PUBLICATION “TIME SERIES ANALYSIS AND FORECASTING BY EXAMPLE”.

Reference Books

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Freta M. Ljung “Time Seies Analysis Forecasting and Control”.

Syllabus for Semester VIII, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TH0801-05 **Course: Generative AI**

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

Course Objectives:

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

Unit 1: Fundamentals of Generative AI

Generative AI, Overview, history, applications, Generative vs. Discriminative models, Latent variables and representation learning, Types of generative models, challenges in Generative AI, Generative Model Lifecycle, Evaluation metrics: FID, IS, BLEU, Perplexity.

Unit 2: Autoencoders and GANs

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

Unit 3: Large Language Models and Transformer Architectures

Introduction to LLMs, Evolution, Transformer architecture: self-attention, encoder-decoder structure, GPT, BERT, T5, LLaMA, DALL·E, fine-tuning paradigms, Applications: summarization, translation, code generation, chatbots, challenges and limitations.

Unit 4: Introduction to Prompt Engineering

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

Unit 5: Explainable and Responsible Generative AI

Explainable AI basics, XAI techniques: SHAP, LIME, Integrated Gradients, attention visualization, Explainability in LLMs and GANs.

Responsible AI: principles, bias and fairness in generative models, Regulatory frameworks and ethical guidelines (EU AI Act, OECD AI Principles, NIST AI Risk Framework)

Course Outcomes:

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

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

TEXT BOOKS:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition,2022.
2. The Art of Prompt Engineering with ChatGPT: A Hands-On Guide - Learn AI Tools the Fun Way, Shroff/Hunter; First Edition,2023.
3. Interpretable Machine Learning,: A Guide for Making Black Box Models Explainable, Christoph Molnar ,Shroff/Molnar, Second Edition,2020.
4. Responsible AI: Best Practices for Creating Trustworthy AI Systems, Qinghua Lu, Liming Zhu, et al, Pearson publisher, Ist Edition, 2024.

REFERENCE BOOKS:

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

Syllabus for Semester VIII, Track 5 B. Tech. Computer Science & Engineering (AI&DS)

Course Code: 25CS01TH0802-05 **Course: Financial Engineering**

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

Course Objectives:

To provide a foundational understanding of financial systems and equip students with quantitative methods for analyzing and managing financial instruments and risks.

Unit I:

Basic Elements of Financial Systems and Financial Management Fundamentals of Financial Systems and Domain Knowledge of Financial Management.

Unit II:

Mathematical Background Introduction to Stochastic Calculus: Wiener processes and Ito's lemma, Stochastic Differential Equations, Martingales and Measures Numerical procedures: Binomial & trinomial trees, Monte Carlo simulation; finite difference methods.

Unit III:

Options and Futures Markets Forward and futures contracts: Basic definition, Differences between Forwards & Futures, Futures & Forwards on Commodities & Currencies, Valuation of Futures, Interest Rate Futures.

Unit IV:

Swaps: Currency Swaps, Interest Rate Swaps Options: Definitions, Payoff Diagrams, General Arbitrage Relationships, The Binomial Method, Applications to Hedging & Speculating, Delta Hedging, Arbitraging mis-priced Options, Pricing of Stock Options on Stock Indices, Currencies, and Futures.

Unit V:

Financial Risk Management Introduction: Different types of risk; approaches to risk management; history of bank regulation. Greek letters: Definitions and how they are used.

Course Outcomes

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

1. Explain the structure of financial systems and fundamentals of financial management.
2. Apply stochastic calculus and related models to financial analysis.
3. Use numerical methods for option pricing and financial problem-solving.
4. Analyze derivatives for valuation, hedging, and speculation.
5. Evaluate financial risks and apply risk management techniques.

Text Books

1. Mathematics for Finance: An Introduction to Financial Engineering, 2nd Edition, by M. Capinski and T. Zastawniak, Springer, 2010
2. Introduction to the Mathematics of Finance: From Risk Management to Options Pricing, by S. Roman, Springer, 2004

Reference Books

1. Options, Futures and Other Derivatives, by J. C. Hull, 10th Edition, Pearson, 2018

2. Introduction to the Economics and Mathematics of Financial Markets, by J. Cvitanic and F. Zapatero, Prentice-Hall of India, 2007

Track 6:
Computer Science and Engineering
(Data Science and Analysis)

Syllabus for Semester IV, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01PR0404-06 **Course: Software Lab-II Data Exploration and Handling Lab**

L: 0Hrs, P: 4Hrs, 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.

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

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).

Text 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 V, Track 6 B. Tech. Computer Science & Engineering (DSA)
Course Code: 25CS01PR0504-06 Course: Software Lab-III Web Technologies Lab
L: 0Hr, P: 4 Hrs, Per Week Total Credits: 2

Course Objectives:

1. To comprehend the fundamentals of React with JavaScript and JSX for creating templates with React components and their importance in building reusable UI elements.
2. To familiarize the students with essential skills for modern front-end web applications by the use of ReactJS features.
3. To learn to implement client-side routing using React Router for Single Page Applications (SPAs).

Introduction to React: ReactJS Introduction, Advantages of React JS, Introduction to JSX,
Difference between JS and JSX, Templating using JSX, Working with React, createElement, Expressions, logical operators, specifying attributes, children and Fragments.

React Components overview: Types of components, Controlled, Split Up, Composable, Reusable, Component Declarations and Styling Components, Conditional Rendering, List Rendering.

Props and State: State and its significance, Read state and setState, Passing data to components using props, Validating props using prop Types, Supplying default values to props using default Props.

Event Handling: Lifecycle Methods, Handling events in React Components, React Forms, Controlled Components, Uncontrolled components.

Routing with React Router: Need of react Router, React Router Installation, Components in React Router, Adding Navigation using Link component.

Course Outcomes

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

1. Understand the fundamentals of React with JavaScript and JSX.
2. Build and reuse functional and class-based React components effectively.
3. Utilize props and state effectively to manage data flow and UI interactions in React applications
4. Handle user events and implement conditional rendering based on user interaction.
5. Demonstrate dynamic routing and navigation in a React application.

Text Books:

1. React Up & Running: Building Web Applications - Stoyan Stefanov, O'Reilly Media, Second Edition, 2021.
2. Learning React: Modern Patterns for Developing React Apps - Alex Banks & Eve Porcello, O'Reilly Media, Second Edition, 2020.
3. React in Action 1st Edition - Mark Tielens Thomas, Manning Pubns Co, First Edition, 2018.

Reference Books

1. Pure React- a step-by-step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch

Syllabus for Semester V, Track 6 B. Tech. Computer Science & Engineering(DSA)
Course Code: 25CS01TH0506-06 Course: Data Analysis and Visualization
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives

1. To understand data analytics life cycle for solving challenging business problems.
2. To adopt appropriate statistical procedures for analysis based on goals and nature of data.
3. To employ best practices in data visualization to develop charts, maps tables and other visual representations of data.

UNIT - I: Introduction and Overview
Importance of analytics and visualization, data preprocessing, Basic Analysis Techniques, Data Analytics Lifecycle and Different Phases

UNIT - II: Association Rules and Regression
Association Rules : Overview, Apriori Algorithm, Evaluation of Candidate Rules, Frequent Itemsets and Rule Generation, Validation and Testing, Diagnostics.
Regression: Linear Regression, Logistic Regression, Choice of a Model.

UNIT - III: Classification and Clustering
Clustering : Overview, k-Means, k-Modes, Partitioning around Medoids (PAM), Hierarchical Agglomerative and Density Clustering Methods. **Classification**: Decision Trees – Overview, Detecting Significant Split, Algorithms and Evaluation; Naïve-Bayes – Bayes' Theorem, Naïve Bayes
Classifier, Smoothing; Diagnostics of Classifiers.

UNIT - IV: Time Series Analysis
Time Series Analysis: Box-Jenkins Methodology, ARIMA (Auto Regressive Integrated Moving Average) Model, Choice of a Model, Overview of ARMAX, Spectral Analysis and GARCH.

UNIT - V : Data Visualization Understanding
Understanding Data Visualization Principles, Mapping Data onto Aesthetics, Visualizing - Distributions, Proportions, Time Series, Trends and Uncertainty; Commonly used File Formats and Software.

UNIT - VI : Creating Stories with Data
Why Planning?, Creating Interesting Stories with Data – Reader-driven Narratives, Author-driven Narratives; Perceptions and Presentation Methods, Best Practices in Visualization, Interactive Visualization, Event Listeners and Layouts, Case Studies for Visualization.

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

1. Apply data preprocessing and basic data analysis techniques.
2. Conduct data analytics using scientific methods.
3. Analyze time series data.
4. Create presentations and visualizations.

Text Books

1. David Dietrich, Barry Heller and Beibel Yang, - Data Science and Big Data Analytics – Discovering, Analyzing, Visualizing, and Presenting Data, John Wiley and Sons [EMC Education Services], 2015.

2. Claus O. Wilke, - Fundamentals of Data Visualization – A Primer on Making Informative and Compelling Figures, O'Reilly, 2019.
3. Python: Data Analytics and Visualization, Packt Publishing, 2017.

Reference Books

1. Jiawei Han, Micheline Kamber and Jian Pei, - Data Mining Concepts and Techniques, 3rd edition; Morgan Kaufmann Publishers, 2011.

Syllabus for Semester VI, Track 6 B. Tech. Computer Science & Engineering(DSA)
Course Code: 25CS01TP0602-06 Course: Natural Language Understanding and Analytics
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Course Objectives:

1. To introduce the fundamental concepts, linguistic foundations, and preprocessing techniques essential for processing and analyzing natural language data.
2. To enable students to design and implement NLP solutions using statistical models, machine learning, and deep learning techniques, including word embeddings and transformers, for real-world applications.

Unit I: Introduction to NLP and Text Processing
Introduction to NLP; Levels of NLP- Phonology, morphology, syntax, semantics, pragmatics, discourse; Applications of NLP. Text Processing and Preprocessing: Tokenization, Normalization, Stopword removal, Stemming, lemmatization, Morphological Analysis; Finite State Transducers.

Unit II: **Language Modeling and Sequence Labeling**
Role of language models; N-gram Language Models; Smoothing Techniques, evaluating language models, Part-of-speech tagging and Named Entities; Sequence Models- Hidden Markov Models, Maximum Entropy Markov Models (MEMM) and Conditional Random Fields (CRF); Maximum Entropy models.

Unit III: **Syntax, Parsing, and Semantics**
Constituency parsing, Dependency parsing, Parsing algorithms, CYK, Earley, Transition-based Parsing, Treebanks and their role in syntactic analysis, probabilistic CFGs (PCFGs), Lexicalized PCFGs; Lexical semantics and word-sense disambiguation, Semantic Role Labelling.

Unit IV: **Discourse Processing and Contextual Models**
Discourse Processing: Anaphora and Coreference Resolution and Discourse Connectives; Introduction to Word Embedding, Word2Vec, GloVe; Contextualized Word Embeddings: TagLM, ELMO, ULMFIT, etc.

Unit V: **Deep Learning for NLP**
Introduction to Neural Networks for NLP, Recurrent neural networks and their limitations, LSTMs/GRUs, Neural Sequence Models, Attention Mechanism, BERT

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

1. Perform essential NLP preprocessing tasks to prepare text for linguistic analysis.
2. Apply statistical and machine learning to solve NLP tasks like language modeling, part-of-speech tagging, named entity recognition, etc.
3. Analyze syntactic, semantic structures using parsing techniques, semantic role labeling, and word sense disambiguation to understand meaning representation in language.
4. Design NLP solutions using statistical, machine learning, and deep learning methods incorporating word embeddings and contextual language models for various applications.

Text Books:

1. D. Jurafsky and R. Martin; Speech and Language Processing; 2nd edition, Pearson Education, 2009.
2. Christopher D. Manning and Hinrich Schutze, “Foundations of Natural Language

Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
3. Delip Rao and Brian McMahan, "Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning", O'Reilly Media, 2019.
4. Charniack and Eugene, Statistical Language Learning, MIT Press, 1993.

Reference Books:
1. Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal; NLP: A Paninian Perspective, Prentice Hall, New Delhi, 1994.
2. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.

Syllabus for Semester VI, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TH0603-06 Course: Network Security and Cryptography
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Unit I:
Types of Attacks and Software Vulnerabilities, System Security: Buffer overflow and malicious software, Intrusion detection system, Firewalls. Mathematics of Cryptography.

Unit II:
Classical Ciphers, Modern Block ciphers: DES, Triple DES, Blowfish, AES. Block cipher modes of operation, Asymmetric key ciphers: RSA.

Unit III:
Message Integrity and Authentication: Requirements of Hash functions and MAC, Algorithms: MD5, SHA-1, Whirlpool, HMAC.
Digital Signatures: Algorithms: RSA, DSS, Attacks, variations and applications.

Unit IV:
Key Management: Symmetric key distribution, Symmetric key agreement, Public key distribution. Entity Authentication: Password based, Challenge Response protocols, Zero knowledge protocols, Biometrics.

Unit V:
Security protocols at Application layer: PGP, SET, Kerberos
Security protocol at Network layer: IPSec
Security protocol at Transport layer: SSL and TLS

Course Outcomes

On successful completion of the course, student shall be able to
1. Understand different attacks and its counter measures.
2. Apply knowledge of Mathematics required for cryptography.
3. Apply security services for providing information security.
4. Analyse various standard security protocols

Textbooks:
1. Cryptography & Network Security: Behrouz A. Forouzan, Debdeep Mukhopadhyay, MGH.
2. Cryptography & Networks Security Principles & Practice: William Stallings, Pearson Education.

Reference Books
1. Network Security and Cryptography: Bernard Menezes, 1st Edition, Cengage Learning

Syllabus for Semester VI, Track 6 B. Tech. Computer Science & Engineering (DSA)
Course Code: 25CS01TP0604-06 Course: Business Intelligence and Analytics
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Course Objectives:

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

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

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

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

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

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

Course Outcomes
On successful completion of the course, student shall be able to
1. Able to analyze Business Intelligence, Analytics and Decision Support
2. Explain the technologies for decision making
3. Apply predictive modelling techniques
4. Understand the use of BI in real world applications
5. Understand the expert systems.

Text Books:

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

Reference Books

1. M Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, “Business Intelligence and Analytics: System for Decision Support”, 10th Edition, Pearson Global Edition, 2013

Syllabus for Semester VII, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TP0701-06 **Course: Next Generation Databases**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:

To introduce students to modern database paradigms beyond traditional relational models, focusing on the design, architecture, and use-cases of NoSQL databases such as key-value, document, columnar, and graph systems, while emphasizing distributed data management, consistency models, and real-world applications in scalable, high-performance environments.

UNIT-I

Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Aggregate Data Models; Aggregates, Key-Value and Document Data Models, Column-Family Stores, Data Models; Relationships, Graph Databases, Schemaless Databases

Unit II:

Distribution Models: Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.
Consistency: Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums. Version Stamps

Unit III:

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

Unit IV:

Document oriented database: Document, Collection, Naming, Features of document database, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection

Unit V:

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

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

Course Outcomes

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

1. Understand the limitations of relational databases and the motivation behind NoSQL systems.
2. Identify and describe key NoSQL data models including key-value, document, columnar, and graph.
3. Explain data distribution techniques and consistency models in NoSQL databases. Perform CRUD and query operations using document-oriented and key-value databases.

4. Evaluate the use of columnar and graph databases for analytical 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 VII, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TP0702-06 **Course: Big Data Analytics**
L: 2Hrs, P: 2Hrs, Per Week **Total Credits: 3**

Course Objectives:

1) To analyze big data using machine learning techniques.
2) To understand the basic concepts of big data analytics and the Big Data landscape.

Unit I:
Introduction to Big Data: Introduction to Big Data, its types and characteristics, Big Data Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools, NoSQL, Hadoop. History of Hadoop, Apache Hadoop, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Technology Landscape: NoSQL databases: why, advantages, Hadoop: Features, advantages, Hadoop1.0-Hadoop2.0, overview of Hadoop ecosystems.

Unit II:
Introduction to Hadoop and MongoDB: Hadoop Distributed File System (HDFS), HBase, Hadoop Map-Reduce, Map-reduce way of designing solutions with examples. Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator).
NoSQL Databases: NoSQL vs. Relational Database MongoDB: Create Database, Create Collection, Document operations like Insert, update, query, delete, Using JSON, creating and generating a unique key, support for dynamic queries, Data types in MongoDB, CRUD (Create, Read, Update, Delete), Aggregation, Indexing, Sharding, Map-Reduce functions.

Unit III:
Cassandra: Architecture, Data Replication in Cassandra, Data model: cluster, keyspace, column family, Cassandra Keyspace Operations: Create, Alter, drop, Table Operations: create, alter, drop, truncate, index, CURD Operations, Cassandra CQL: data types, collections.

Unit IV:
Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). **Introduction to Pig:** What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.

Unit V:
Spark and Big Data Analytics: Spark, Introduction to Data Analysis with Spark. Text, Web Content and Link Analytics: Introduction, Text Mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph.

Course Outcomes

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

1. Identify and list various Big Data concepts, tools and applications.
2. Develop programs using HADOOP framework.
3. Use NoSql Databases for analyzing large data sets.
4. Use Hadoop Cluster to deploy Map Reduce jobs, PIG, HIVE and Spark programs.
5. Analyze the given data set and identify deep insights from the data set.

Text Books:

4. Seema Acharya and Subhashini Chellappan “Big data and Analytics” Wiley India Publishers, 2nd Edition, 2019
5. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman; Big Data for Dummies; Wiley India, 2015.

Reference Books

1. P. Simon, Too Big to Ignore: The Business Case for Big Data; Wiley, 2015
2. Tom White, “Hadoop: The Definitive Guide” 4th Edition, O’Reilly Media, 2015

Syllabus for Semester VII, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TH0703-6 **Course: Customer Relationship Management**

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

Course Objectives

1. To make the students understand the organizational need, benefits and process of creating long-term value for individual customers.
2. To disseminate knowledge regarding the concept of Salesforce and Salesforce technologies.
3. To enable the students understand the technological and human issues relating to implementation of Customer Relationship Management in the organizations.

UNIT I :

Introduction to CRM and Salesforce : Definition and importance of CRM, Key CRM concepts, Benefits of CRM for businesses, Introduction to Salesforce, Salesforce's role in business processes, Salesforce Cloud offerings , Overview of Salesforce architecture, Multi-tenant cloud architecture, Salesforce Data Model (Objects, Records, Fields), Understanding Tabs, Apps, and Objects

UNIT II :

Salesforce Administration Basics : Understanding Salesforce Setup menu, Creating and managing users, Profiles, Roles, and Permission Sets, Organizing security settings (Organization-Wide Defaults, Sharing Rules), Data Validation Rules, Creating and customizing Objects, Object Relationships, Creating and managing Fields, Workflow Rules, Process Builder, and Flow.

UNIT III:

Introduction to Apex Programming : Apex basics (Syntax, Variables, Methods), Apex classes and triggers, Working with SOQL and SOSL (Salesforce Object Query Language, Handling exceptions in Apex, Apex Triggers, Writing Apex triggers to handle database events, Trigger context variables and best practices, Governor limits and optimization techniques.

Unit IV:

Advanced Salesforce Development – Lightning Web Components (LWC) : Overview of Lightning Web Components (LWC), LWC architecture and lifecycle, Creating and deploying LWC components, Handling events in LWC, Working with Apex from LWC, LWC Integration with Salesforce Data, Displaying Salesforce data in LWC, Handling record pages and lightning layouts, Best practices for LWC development.

UNIT V :

Salesforce Integration and Deployment, Salesforce Reports: Overview of integration in Salesforce, Integration tools: REST API, SOAP API, and Bulk API, Salesforce Connect, Introduction to Mulesoft for Salesforce integration, Introduction to Salesforce DX, Source-driven development and version control, Continuous Integration and Continuous Delivery (CI/CD) in Salesforce., Introduction to reports, types of reports, report builder, formatting reports, dashboard introduction, dashboard generation, charts in dashboards, limitations of Salesforce reports.

Course Outcomes:

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

1. Understand the fundamentals of Salesforce and its role in CRM.
2. Gain practical skills in configuring and managing Salesforce environments.
3. Apply the basics of Salesforce development using Apex to customize the platform.
4. Develop modern web applications on the Salesforce platform using Lightning Web Components.
5. Integrate Salesforce with external systems and deploy applications in a production environment.

Text Books

1. Jason Ouellette; Development with the Force.com Platform, Second Edn, Addison Wesley, 2011. 2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018.
2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018
3. Judith W .Kincaid , Customer Relationship Management Getting it Right, Pearson Education
4. Customer Centricity –Focus on right customer for strategic advantage, by Peter Fader, Wharton Digital Press, 2012

Reference Books

1. Learning Salesforce Development with Apex – Paul Battisson
2. Salesforce for Beginners – Sharif Shaalan

Syllabus for Semester VII, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TH0704-06 Course: Financial Analytics

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

Course Objectives

Students will be able to build their competencies in financial analysis and decision making, apply quantitative methods of financial analysis in their regular businesses, analyse real- life proposals for financial investment in a meaningful manner, to be industry-ready through application of analytical tool.

UNIT I :

Introduction to Financial Analytics: Introduction to Financial Analytics, Definition, relevance and scope, recent trends in financial analytics, Analytical thinking, Role of a Financial Analyst, Data Driven Financial Decision, Decision making under uncertainty financial analytics, Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance, Asset Returns, Bond Yields and Prices, Implied Volatility.

UNIT II :

Introduction to Analysis of Financial Data Using Statistical Tools: Statistical concepts; Probability, Normal, Lognormal, distribution properties, multi variate returns, Data visualization, Understanding data in finance, cleaning and pre-processing of data, Application of software on different forms of financial data set- Time Series and Cross Sectional Data.

UNIT III :

Financial Modelling: Introduction to Basic Financial Functions in Excel, Discounted Cash flows, Annuity, PMT, PV, NPV, IRR, Financial modelling using Ratios, An overview of Discounted Cash Flow, NPV, IRR, Sensitivity and Simulation analysis, What if Analysis. income statement and financial statements using Excel.

UNIT IV :

Application of Data Science across Financial Services: Learn about Financial Data Analytics with respect to Data Science in Financial Services, Artificial Intelligence and Machine Learning in Financial Services, Usage of AI in Algorithmic Stock Trading, Automated Robo-Advisors, Fraud Detection and Prevention.

UNIT V :

Optimal Portfolio Allocation: Capital Allocation Line (CAL) and Optimal Portfolio, Lending and Borrowing on the CAL, analysis using indifference curves. CAPM- Features of Markowitz analysis, expected returns from historical averages, efficient frontier. Risk-Return Trade-off & Quadratic Utility: Investments and trade consumption across time, trade-off between risk and return, decision making under uncertainty, indifference curves, quadratic utility function, etc.

Course Outcomes:

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

1. Explain the concept of advanced financial management and risk analysis
2. Demonstrate an understanding on analysis of financial data using different statistical tools
3. Apply knowledge of data science across financial services
4. Assess the financial services on the basis of machine learning and artificial intelligence

Text Books

1. M. J., & Hugen, D. L . Financial analytics with R: building a laptop laboratory for data science Bennett, Cambridge University Press.
2. Hilpisch, Y. " O'Reilly Python for Finance: Analyze big financial data, Media, Inc.".

3. Consoli, S., Reforgiato Recupero, D., & S. Data Science for Economics and Finance. Methodologies and Applications, Springer Nature.

Reference Books

1. Aldridge, I., & Avellaneda, M. John Big data science in finance- Wiley & Sons.
2. Lukomnik, J., & Hawley, J. P Moving Beyond Modern Portfolio Theory- Investing that Matters,. :. Routledge.
3. Reilly, F. K., & Brown, K. C Investment Analysis and Portfolio Management., Cengage Learning.
4. Rees, M. John. Principles of financial modelling: model design and best practices using Excel and VBA. Wiley & Sons.

Syllabus for Semester VIII, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TH0801-06 **Course: Image and Video Analytics**

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

Course Objectives:

1. To understand the fundamental concepts related to image and video analysis like multi-dimensional image processing, image formation, image alignment, feature extraction, pattern analysis, visual geometric modelling, etc.
2. A brief view of various enhancement techniques, different models and various algorithms used for digital image and video processing are discussed in the course. It also explores topics like motion analysis, tracking and other topics with the scope of research to be able to contribute towards the research and further developments in the field of image and video analysis.
3. To understand various applications ranging from Biometrics, Medical diagnosis, document processing, to surveillance, advanced rendering etc.

Unit I:

Image representation and image analysis tasks, Image representations, digitization properties, analysis of color images, Data structures for Image Analysis, Levels of image data representation, Digital Image Formation and Camera Geometry, sampling and quantization of an Image.

Unit II:

Local pre-processing, Image smoothing, Edge detectors, Zero-crossings of the second derivative, Scale in image processing, Canny edge detection, Parametric edge models, Edges in multi-spectral images, Local pre-processing in the frequency domain, Line-detection by local pre-processing operators, Image restoration

Unit III:

Morphological Image Analysis: Erosion, Dilation, Opening, Closing, Hit or Miss Transformation, Boundary Extraction, Hole Filing, Extraction of Connected components. Image Segmentation: Point, Line, edge detection, boundary detection, Thresholding, region based segmentation.

Unit IV:

Video Processing: Digital Video analysis, Time varying Image Formation models, 3D motion models, Geometric Image formation, Motion Estimation- Optical flow, general methodologies, background subtraction and modelling, pixel based motion estimation, Lucas Kanade algorithm, Kalman filter.

Unit V:

Video Segmentation, Action Recognition, Object detection in videos: Basics of background modeling and foreground detection, connected component labelling, etc., Object recognition in images and videos, Viola Jones algorithm for face detection, Case study of applications like automated video surveillance.

Course Outcomes

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

1. Understand fundamental concepts of image representation, digitization, and camera geometry for analyzing color and grayscale images.
2. Implement image preprocessing techniques for feature enhancement.
3. Analyze and perform image segmentation and analysis using morphological operations.
4. Design and evaluate algorithms for video motion analysis, object recognition, and real-world applications.

Text Books

1. Computer Vision: Algorithms and Applications by R. Szeliski, Springer, 2011.
2. John Willam, K. Pratt, Digital Image Processing. Willey & Sons (3rd Edition).
3. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill, 2nd ed., 2011.
4. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall, 1998.

Reference Books

1. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992.
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.
3. Image Processing, Analysis, and Machine Vision. Sonka, Hlavac, and Boyle. Thomson.
4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012 5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012

Syllabus for Semester VIII, Track 6 B. Tech. Computer Science & Engineering (DSA)

Course Code: 25CS01TH0802-06 Course: Time Series Analysis
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives

1. To understand Time Series Analysis.
2. To introduce the tools and Models for basic concepts of Time Series Analysis.
3. To apply the Time Series Model Selection research models to solve problems.

Unit I

TIME SERIES DATA: EXAMPLES AND BASIC CONCEPTS : Introduction, Examples of Time Series Data, Understanding Autocorrelation, The Wold Decomposition, The Impulse Response Function, Superposition Principle ,Parsimonious Model.

Unit II

VISUALIZING TIME SERIES DATA STRUCTURES: GRAPHICAL TOOLS: Introduction, Graphical Analysis of Time Series, Graph Terminology, Graphical Perception, Principles of Graph Construction, Aspect Ratio, Time Series Plots, Bad Graphics.

Unit III

STATIONARY MODELS: Basics of Stationary Time Series Models, Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Transformation of Data.

Unit IV

NONSTATIONARY MODELS: Introduction, Detecting Nonstationarity , Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA Models, Concentration Measurements from a Chemical Process, The EWMA Forecast.
SEASONAL MODELS: Seasonal Data, Seasonal ARIMA Models, Forecasting using Seasonal ARIMA Models.

Unit V

TIME SERIES MODEL SELECTION: Introduction, Finding the "BEST" Model, Internet Users Data, Model Selection Criteria, Impulse Response Function to Study the Differences in Models, Comparing Impulse Response Functions for Competing Models.

Course Outcomes:

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

1. The students should get acquainted with the main concepts of Time Series theory and methods of analysis.
2. Students should master traditional methods of Time Series analysis, intended mainly for working with time series data.
3. Understanding the underlying concepts in the time series and frequency domains
4. Demonstrate advanced understanding of the concepts of time series and their application.

Text Books

1. Murat Kulahci Technical University of DenmarkA JOHN WILEY & SONS, INC., PUBLICATION "TIME SERIES ANALYSIS AND FORECASTING BY EXAMPLE".

Reference Books

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Freta M. Ljung "Time Seies Analysis Forecasting and Control".

Track 7:
Computer Science and Engineering
(Cyber Security)

Syllabus for Semester IV, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01PR0404-07 Course: Software Lab-II Open-Source Tools for Cyber Security

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

Course Objectives:

- To introduce students to open-source tools and IDEs used in network security.
- To provide students with hands-on experience in network scanning, vulnerability assessment, threat detection, and firewall configuration.
- To develop students' analytical and critical thinking skills for identifying and mitigating security threats.
- To prepare students to apply cybersecurity principles and practices in real-world scenarios.

Syllabus:

- Network Scanning and Enumeration (Wireshark, Nmap, Zenmap, Netcat etc.)
- Vulnerability Assessment (OpenVAS, Nikto, etc.)
- Lynis, Threat Detection using snort
- Firewalls (pfSense: Exploring pfSense for configuring network security and firewalls) and UFW (Uncomplicated Firewall)
- Creating virtual environments for secure testing and practice
- Web application security tools
- Case Studies and Real-World Scenarios (Security incidents analysis and best practices)

Course Outcomes

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

1. Perform network scanning and enumeration using open-source tools.
2. Conduct vulnerability assessments, threat detection and audits using appropriate tools.
3. Configure, manage firewalls for securing network environments and apply cybersecurity principles to real-world scenarios and case studies.

Textbooks:

1. **Network Security Assessment** by Chris McNab - Provides in-depth coverage of network scanning, enumeration, and vulnerability assessment tools and techniques.
2. **The Practice of Network Security Monitoring** by Richard Bejtlich - Offers insights into threat detection using tools like Snort and real-world network security monitoring practices.

Reference Books

1. **pfSense: The Definitive Guide** by Christopher M. Buechler and Jim Pingle - Comprehensive guide to pfSense for configuring network security and firewalls.
2. **Web Application Security: A Beginner's Guide** by Bryan Sullivan - Covers web application security tools and best practices.

Case Studies:

1. **Stuxnet Worm** - Analyze the Stuxnet worm as a case study for threat detection and incident response.
2. **Target Data Breach** - Study the Target data breach case as an example of a security incident analysis.

3. **WannaCry Ransomware Attack** - Explore the WannaCry ransomware attack as a case study for vulnerability assessment and mitigation.

Additional Resources:

1. **Wireshark User's Guide** - Official documentation for Wireshark to deepen understanding of network packet analysis.
2. **Nmap Network Scanning** by Gordon Fyodor Lyon - Comprehensive guide to Nmap for network scanning and enumeration.
3. **OpenVAS Documentation** - Official documentation for OpenVAS for vulnerability assessment.

Snort Intrusion Detection - Official documentation for Snort for intrusion detection

Syllabus for Semester V, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01PR0504-07 **Course: Software Lab-III Basics of Ethical Hacking Lab**

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

Course Objectives:

The objective of this lab is to provide students with hands-on experience in fundamental ethical hacking techniques and the practical application of various tools.

Experiment 1: Basic Network Scanning and Enumeration (CO1, CO3)
AIM: To perform host discovery and port scanning using Nmap and interpret results for basic
Tools: Nmap, Zenmap

Experiment 2: Vulnerability Assessment (CO1, CO3)
AIM: To perform vulnerability analysis and generate risk reports using automated tools.
Tools: OpenVAS or Nessus

Experiment 3: Password Cracking CO1, CO3)
AIM: To demonstrate password cracking techniques and analyze password security using John the Ripper.
Tools: John the Ripper

Experiment 4: Performing a DoS Attack Simulation in a Controlled Environment (CO1, CO3)
AIM: To simulate a basic Denial-of-Service (DoS) attack and analyze its effects on a test server.
Tools: LOIC, Hping3, or custom Python script (on virtual lab)

Experiment 5: Session Hijacking Demonstration (CO1)
AIM: To capture session data from an unencrypted login and understand session hijacking risks.
Tools: Wireshark, browser with HTTP login simulation (lab safe)

Experiment 6: Malware Analysis and Sniffing (CO2)
AIM: To analyze sniffed packets to identify malware propagation and types of sniffing attacks.
Tools: Wireshark, sample malware traffic from safe PCAP files

Experiment 7: Detecting Intrusions & Exploring Firewall Rules (CO2, CO3)
AIM: To configure Snort for intrusion detection and use UFW to block suspicious IPs or ports.
Tools: Snort, UFW, test network setup

Experiment 8: Case Study Analysis of Real-World Cyber Attacks and Their Mitigation (CO1, CO2, CO3)
AIM: To analyse real-world cyber-attack case studies (e.g., Equifax breach, WannaCry, SolarWinds) and evaluate the vulnerabilities exploited and defences implemented.
Tools: Internet research, structured report writing

Course Outcomes

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

1. Identify the vulnerability with respect to hacking, DDOS attack and session hijacking
2. Handle various types of malware and sniffing attacks on network
3. Implement various attacks scenarios and remedies and detecting the attack with IDS.

Textbooks:

1. **Network Security Assessment** by Chris McNab - Provides in-depth coverage of network scanning, enumeration, and vulnerability assessment tools and techniques.
2. **The Practice of Network Security Monitoring** by Richard Bejtlich - Offers insights into threat detection using tools like Snort and real-world network security monitoring practices.

Reference Books

1. **pfSense: The Definitive Guide** by Christopher M. Buechler and Jim Pingle - Comprehensive guide to pfSense for configuring network security and firewalls.
2. **Web Application Security: A Beginner's Guide** by Bryan Sullivan - Covers web application security tools and best practices.

Case Studies:

1. **Stuxnet Worm** - Analyze the Stuxnet worm as a case study for threat detection and incident response.
2. **Target Data Breach** - Study the Target data breach case as an example of a security incident analysis.
3. **WannaCry Ransomware Attack** - Explore the WannaCry ransomware attack as a case study for vulnerability assessment and mitigation.

Additional Resources:

1. **Wireshark User's Guide** - Official documentation for Wireshark to deepen understanding of network packet analysis.
2. **Nmap Network Scanning** by Gordon Fyodor Lyon - Comprehensive guide to Nmap for network scanning and enumeration.
3. **OpenVAS Documentation** - Official documentation for OpenVAS for vulnerability assessment.
4. **Snort Intrusion Detection** - Official documentation for Snort for intrusion detection

Syllabus for Semester V, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TH0506-07 **Course: Basics of Ethical Hacking**

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

Course Objectives:

1. Learn about the hacker mindset and the history of hackers
2. Understand basic networking and security technologies
3. Gain a basic understanding of security policy
4. Explore various vulnerability analysis techniques.

Unit-1: 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-2: Cryptography: Introduction to cryptography, private-key encryption, public-key encryption, Key exchange protocols, cryptographic hash functions, applications, Digital signatures, Attacks on cryptosystems.

Unit-3: Vulnerability Analysis & System Hacking: Vulnerability Analysis, Types of Vulnerability Analysis, Vulnerability Assessment Tools, System Hacking, Password Cracking, Penetration testing, Hiding Files, Clearing logs.

Unit-4: 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.

Unit-5: Sniffing: Malware and its propagation ways, Malware components, Types of malware, Concept of sniffing, Types of sniffing, Types of sniffing attacks
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, student shall be able to

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

Textbooks:

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, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TP0602-07 Course: Cryptography & Network Security
L: 3Hrs, P: 2Hrs, Per Week Total Credits: 4

Unit I: Types of Attacks and Software Vulnerabilities, System Security: Buffer overflow and malicious
software, Intrusion detection system, Firewalls. Mathematics of Cryptography.

Unit II: Classical Ciphers, Modern Block ciphers: DES, Triple DES, Blowfish, AES. Block cipher modes of operation, Asymmetric key ciphers: RSA.

Unit III: Message Integrity and Authentication: Requirements of Hash functions and MAC, Algorithms: MD5, SHA-1, Whirlpool, HMAC.
Digital Signatures: Algorithms: RSA, DSS, Attacks, variations and applications.

Unit IV: Key Management: Symmetric key distribution, Symmetric key agreement, Public key distribution. Entity Authentication: Password based, Challenge Response protocols, Zero knowledge protocols, Biometrics.

Unit V
Security protocols at Application layer: PGP, SET, Kerberos
Security protocol at Network layer: IPSec
Security protocol at Transport layer: SSL and TLS

Course Outcomes
On successful completion of the course, student shall be able to
1. Understand different attacks and its counter measures.
2. Apply knowledge of Mathematics required for cryptography.
3. Apply security services for providing information security.
4. Analyse various standard security protocols

Textbooks:
1. Cryptography & Network Security: Behrouz A. Forouzan, Debdeep Mukhopadhyay, MGH.
2. Cryptography & Networks Security Principles & Practice: William Stallings, Pearson Education.

Reference Books
1. Network Security and Cryptography: Bernard Menezes, 1st Edition, Cengage Learning

Syllabus for Semester VI, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TH0603-07 Course: Application Security

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

Course Objectives:

1. Learn about various types of mobile application development platforms.
2. Learn to use different mobile app penetration testing tools and frameworks.
3. Explore mobile application security concepts.

Unit I

Evolution of mobile apps, Mobile app security, OWASP mobile security project, Mobile security tools, Analyzing iOS Applications, Understanding the Security Model, Understanding iOS Applications, Jailbreaking Explained, Understanding the Data Protection API, Understanding the iOS Keychain, Understanding Touch ID, Reverse Engineering iOS Binaries

Unit II

Analyzing Android applications, Understanding security model, Reverse engineering applications, Attacking Android applications, Accessing storage and login, misusing insecure communications, Tools: Xposed framework, Cydia substrate

Unit III

Identifying and exploiting android implementation issues, reviewing pre- installed apps, Exploiting devices, Infiltrating user data, Writing secure android applications, Principle of least exposure, Storing files securely, Securing WebViews, Logging

Unit IV

Analyzing Windows Phone Applications, Understanding the Security Model, Understanding Windows Phone 8.x Applications, Building a test environment, Analyzing application binaries, Attacking Windows Phone Applications, Attacking Transport Security, Identifying Interprocess Communication Vulnerabilities, Patching
.NET Assemblies

Unit V

Identifying windows phone implementation issues, Identifying Insecure Application Settings Storage, Identifying Data Leaks, Identifying Insecure Data Storage, Insecure Random Number Generation, Insecure Cryptography and Password Use, Writing Secure Windows Phone Applications, Storing and Encrypting Data Securely, Securing Data in Memory and Wiping Memory, Secure XML Parsing, Avoiding Native Code Bugs

Course Outcomes

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

1. Understand different mobile app development operating systems.
2. Identify vulnerabilities in android, windows, blackberry and iOS phones.
3. Reverse engineer mobile apps on multiple platforms.
4. Set up mobile app security testing labs for different operating systems.
5. Secure mobile apps.

Textbooks:

1. The Mobile Application Hacker's Handbook by Dominic Chell, Tyrone Erasmus, Shaun Colley and Ollie Whitehouse. Wiley Publishing.

Syllabus for Semester VI, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TP0604-07 **Course: Vulnerability Assessment and Penetration Testing**

L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:

1. Learn about various hacking concepts and requirements of setting-up a penetration testing lab.
2. Learn to use Kali Linux and different penetration testing tools.
3. Explore advanced penetration testing concepts.

Unit I

Setting up virtual lab, Configuring the Network for Your Virtual Machine, Setting Up Android Emulators, Target Virtual Machines, Setting a Static IP Address, Setting up external servers, Using Kali Linux, Programming

Unit II

Tools of the trade, Using Metasploit Framework, Types of Shells, Msfcli, Creating standalone payloads, Information gathering, Red team recon, Finding Vulnerabilities, Capturing Traffic

Unit III

Exploitation, Exploiting WebDAV default credentials, Exploiting Open phpMyAdmin, Exploiting Third-party Web Applications, Exploiting NFS shares, Password attacks, Client-side exploitation - Browser, PDF, Java etc.

Unit IV

Social engineering, Mass email attacks, Multipronged attacks, Compromising the network, Bypassing anti-virus applications, Post exploitation, Privilege escalation, Lateral movement, Pivoting, Persistence

Unit V

Web application testing, Using BurpSuite, SQL injection, XPath injection, LFI, RFI, CSRF, XSS, Wireless attacks, Physical attacks, Stack-based buffer overflowin linux and windows, Known vulnerability in War-FTP, Locating & controlling EIP. Structured exception handler overwrites, Finding attack string in memory, Using a short jump, Fuzzing, Finding bugs with code review, Porting exploits, Replacing shellcode, Writing Metasploit modules, Exploitation mitigation techniques

Course Outcomes

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

1. Apply penetration testing concepts to network and applications.
2. Identify vulnerabilities in target technology and exploit them.
3. Carry out privilege escalation activities in breached networks.
4. Implement social engineering and physical attacking methods for penetration testing.
5. Design custom hacking scripts.

Textbooks:

1. Penetration Testing: A Hands-On Introduction to Hacking by Georgia Weidman|2014 Edition. No Starch Press.

2. The Hacker Playbook 3: Practical Guide to Penetration Testing by Peter Kim

Syllabus for Semester VII, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TP0701-07 **Course: Auditing IT Infrastructure for Compliance Theory**

L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives:

1. Learn about the importance of information security auditing and different auditing standards.
2. Understand audit scoping and perform standard-specific security audits in different types of organizations.
3. Explore higher level security governance concepts like CMMI, Quality Assurance etc.

Unit I: Introduction to COBIT, Using COBIT to Assess Internal Controls, COBIT Assurance Framework Guidance, ISACA IT Auditing Standards Overview, Risk Management Fundamentals, Quantitative Risk Analysis Techniques, IT Audit Risk and COSO ERM, Performing Effective IT Audits

Unit II: General Controls in Today's IT Environments, ITIL Service Management Best Practices, Systems Software and IT Operations General Controls, Evolving Control Issues: Wireless Networks, Cloud Computing, and Virtualization

Unit III: IT Application Control Elements, Selecting Applications for IT Audit Reviews, Auditing Applications under Development, Application Review Case Study: Client-Server Budgeting System, Importance of Reviewing IT Application Controls, Micro Project - IT Application Auditing

Unit IV: Software Engineering Concepts, CMMI: Capability Maturity Model for Integration, IT Audit, Internal Control, and CMMI, IT Auditing in SOA Environments, Computer-Assisted Audit Tools and Techniques (CAATTs)

Unit V: IT Controls and the Audit Committee, Role of the Audit Committee for IT Auditors, Audit Committee Review and Action on Significant IT Audit Findings, Compliance with IT-Related Laws and Regulations, Understanding and Reviewing Compliance with ISO Standards, Controls to Establish an Effective IT Security Environment. Auditing Telecommunications and IT Communications Networks, Building an Effective IT Internal Audit Function, Quality Assurance Auditing and ASQ Standards, Live Project - IT Security Auditing

Course Outcomes

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

1. Understand and identify different information security audit standards and frameworks.
2. Differentiate between the compliance requirements of different audit frameworks.
3. Carry out standard IT auditing procedures in organizations.
4. Perform analysis on audit findings and calculate cyber risk.
5. Generate quality audit reports and effectively communicate them to organizations.

Textbooks:

1. IT Audit, Control, and Security by Robert R. Moeller. Wiley Publishing.

Reference Books

1. Auditing Information and Cyber Security Governance – A Controls-Based Approach by Robert E. Davis|2021 Edition. CRC Press.

Syllabus for Semester VII, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TP0702-07 **Course: Secure Coding**

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

Course Objectives:

1. To comprehend the fundamentals of Secure coding and its significance.
2. To identify various security attacks on an application
3. To recognize and remove common coding errors that lead to vulnerabilities in an application.
4. To comprehend various secure coding techniques for developing a secure application.

Unit I Fundamentals of Secure Coding: Security, CIA Triad, Viruses, Trojans, and Worms In a Nutshell, Security Concepts- exploit, threat, vulnerability, risk, attack. Malware Terminology: Rootkits, Trapdoors, Botnets, Keyloggers, Honeypots. Active and Passive Security Attacks. IP Spoofing, Teardrop, DoS, DDoS, XSS, SQL injection, Smurf, Man in middle, Format String attack. Types of Security, Vulnerabilities- buffer overflows, Invalidated input, race conditions, access- control problems, weaknesses in authentication, authorization, or cryptographic practices. Access Control Problems.

Unit II Need for secure systems: Proactive Security development process, Secure Software Development Cycle (S-SDLC), Security issues while writing SRS, Design phase security, Development Phase, Test Phase, Maintenance Phase, Writing Secure Code – Best Practices SD3 (Secure by design, default and deployment), Security principles and Secure Product Development Timeline

Unit III Threat modeling process and its benefits: Identifying the Threats by Using Attack Trees and rating threats using DREAD, Risk Mitigation Techniques and Security Best Practices. Security techniques, authentication, authorization. Defense in Depth and Principle of Least Privilege

Unit IV Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, Insecure Coding Practices In Java Technology. ARP Spoofing and its countermeasures. Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors, Format String Bugs. Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks, Canary based countermeasures using StackGuard and Propolice. Socket Security, Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM.

Unit V Database and Web-specific issues: SQL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms. Validating Input and Interprocess Communication, Securing Signal Handlers and File Operations. XSS scripting attack and its types – Persistent and Non persistent attack XSS Countermeasures and Bypassing the XSS Filters

Course Outcomes

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

1. Understand the basics of secure programming
2. Analyze the most frequent programming errors leading to software vulnerabilities

3. Identify security problems in software
4. Comprehend and protect against security threats and software vulnerabilities
5. Apply their knowledge to the construction of secure software systems

Textbooks:

1. Writing Secure Code, Michael Howard and David LeBlanc, Microsoft Press.
2. Buffer Overflow Attacks: Detect, Exploit, Prevent by Jason Deckar, Syngress.
3. Threat Modeling, Frank Swiderski and Window Snyder, Microsoft Professional.

Reference Books

1. Robert C. Seacord, Secure Coding in C and C++, 2nd Edition, Addison-Wesley, 2013
2. CERT C CodingStandard. Available online: https://wiki.sei.cmu.edu/confluence/display/c/SEI+CERT+C+Coding+Standa rd
3. Wenliang Du, Computer Security – A hands-on Approach, Second Edition, Create space Independent Pub; 2019.

Syllabus for Semester VII, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TH0703-7 **Course: Incident Handling and Response**

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

Course Objectives:

1. To critically analyze and assess the impact of security incidents & response initiation
2. To recognize the importance of forensics and to follow well-defined processes and procedures
3. To understand & interpret the various stages in the lifecycle of forensic activities
4. To examine the technical, communication, and coordination aspects involved in providing an incident response

Unit 1: Preparing for the Inevitable Incident

Real-World Incidents, IR Management Essentials, Pre-Incident Preparation, Incident Handling vs Incident Response, Security Incident vs Security Event & Breach, First Responder

Unit 2: Incident Response Initiation

Stages of Incident Response, Security Incident Response Team Members, Incident Evidence, Incident Response Tools, Incident Investigation, Initial Lead Development, Incident Scope Discovery

Unit 3: Role of Forensics

The Forensic Process, Forensics Team Member Requirements, Forensics Team Policies and Procedures, Management of Forensics Evidence Handling, Forensics Tools, Legalities of Forensics, Forensics Team oversight

Unit 4: Incident Containment, Data Collection & Analysis

Live Data Collection, Forensic Duplication, Network Evidence Collection, EnterpriseServices, Data Analysis Methodology, Investigating Windows, Linux and MAC Operating Systems, Investigating Applications, Malware Triage

Unit 5: Part 1: Incident Eradication & Post-Incident Activities

Incident Analysis Report Writing, Remediation Team Forming, Remediation Plan Design, Remediation Implementation, Designing Strategic Recommendations, Employee Awareness & Training, Effective Stakeholder Communication

Part 2: Incident Response Governance

Incident Response Policies and Procedures, Legal Requirements and Considerations, Governmental Laws, Policies and Procedures, General Team Management, Corporate IT-Related Security Relationship with SIR&FT, Relationship Management.

Course Outcomes

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

1. Differentiate between cyber incidents and respond appropriately to them.
2. Use various digital forensic strategies and techniques to handle incidents and analyse them.
3. Conduct successful incident management activities in compliance with required standards.

Textbooks:

1. Incident Response & Computer Forensics, Third Edition by Jason T. Luttgens, Matthew Pepe & Kevin Mandia, Mc Graw Hill Education.
2. Computer Incident Response and Forensics Team Management: Conducting a Successful incident Response by Leighton R. Johnson III. Syngress Publishing

Syllabus for Semester VII, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TH0704-07 Course: Digital Forensics

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

Course Objectives:

The objective of this course is to familiarize students with

1. Different Cyber laws
2. Types of cyber crimes
3. The way investigations are done

Unit I

Introduction to Cyber Laws – In this module the students will get the basic understanding all the cyber laws that are currently in effect. Types of cybercrimes – In this module the students will learn the different types of cybercrimes along with analysis on different case studies.

Unit II

Social Media Investigation – This module will be a detailed case study analysis module which will focus on different social media crimes and the way they are investigated.

Unit III

Communication Device Based Investigation– In this module the students shall get in depth knowledge of introduction to the communication devices, knowledge on laws related to interception, knowledge on CDR, CDR formats, CDR analysis and investigations on VOIP communications using case studies.

Unit IV

Mobile Forensics – In this module the students will learn about the introduction to mobile forensics, types of memories on mobile phones, techniques of mobile forensics and the investigation process.

Unit V

Investigation on Financial Frauds and Cybercrime– In this module the students will learn about Introduction to investigation of financial frauds and cybercrime, steps to follow in case of financial frauds, Investigation on ATM withdrawal frauds, online transaction frauds, bank to bank transfer frauds and about the indicative notice under 91 CrPC issued to the banks.

Course Outcomes

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

1. Define types of cyber laws.
2. Evaluate about types of cybercrimes pertaining in today's cyber society.
3. Describe how investigations are done based on the case studies

Textbooks:

1. Combating Cyber Crimes by National Center for Justice and the Rule of Law
2. National Cyber-crime reference handbook by National Cyber Safety and Security Standards, Ministry of Defence, Ministry of Electronics and Information Technology

Reference Books

1. Electronic Crime Scene Investigation: A Guide for Law Enforcement U.S. Department of Justice, National Institute of Justice, https://www.ojp.gov/pdffiles1/nij/187736.pdf
2. National Cyber Crime Reference Handbook – III Edition, Indian Institute of Technology Tirupati (IIT Tirupati), Computer Centre, https://cc.iittp.ac.in/pdfs/Doc%202%20National%20Cyber%20Crime%20Reference%20 Handbook%20III%20Edition.pdf

Syllabus for Semester VIII, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TH0801-07 **Course: Executive Governance and Management in IT Security**

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

Course Objectives:

1. To understand formation of an organization wide information security strategy
2. To study approach behind interactions between the C-Suite of the company.
3. To know how to manage risks at an acceptable level
4. To critique creation of information security policies

Unit I: Information Security Strategy: Evolution of Information Security, Organization Historical Perspective, Understand the External Environment, The Internal Company Culture, Prior Security Incidents, Audits, Security Strategy Development Techniques

Unit II: Security Management Organization Structure: Relevance of Security Leadership Roles, Security Leader Titles, Techie versus Leader, The Security Leaders Library, Security Leadership Defined, Security Leader Soft Skills, Security Functions

Unit III: Managing the Risk: Accepting Organizational Risk, Risk Ownership Management, Qualitative vs Quantitative Risk Analysis, Risk Management Process, Risk Mitigation Options

Unit IV: Creation of Information Security Policies: Importance of Information Security Policies, Canned Security Policies, Policies, Standards, Guidelines Definitions, Approach for Developing Information Security Policies, Policy Review Process

Unit V: Security Compliance & Control Frameworks: Security Control Frameworks and Standard Examples, Existence of Standards, Integration of Standards and Control Frameworks, Auditing Compliance, Adoption Rate of Standards, The Standards/Framework Value Proposition Security Controls & Incidents

Course Outcomes

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

1. Use enterprise information security practices and various strategies.
2. Apply information security risk evaluation processes for modeling and solving real-world problems.
3. Analyze the impact of different information security policies in enterprise scenarios.
4. Estimate the value propositions of the information security frameworks.

Textbooks

1. Information Security Governance Simplified, Todd Fitzgerald, CRC Press

Reference Books

1. Enterprise Security: A Data-Centric Approach to Securing the Enterprise, Aaron Woody, Packt Publishing

Syllabus for Semester VIII, Track 7 B. Tech. Computer Science & Engineering (Cyber Security)

Course Code: 25CS01TH0802-07 **Course: Disaster Recovery & Business Continuity Management**

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

Course Objectives:

1. Understand the concept of business continuity
2. Learn the importance of a BCP (business continuity planning)
3. See how load balancing maintains business continuity
4. Know the details of DCP (Disaster recover plan)
5. Learn how to choose the right failure over solution

Unit I: Introduction to Business Continuity Management (BCM) and Disaster Recovery (DR) -Terms and definitions, BCP under a Governance and BCP Policy making Project Scope and Planning,

Unit II: Business Organization Analysis, BCP Team Selection, Resource Requirements, Legal and Regulatory Requirements, Business Impact Analysis

Unit III: Concepts of threat, vulnerabilities, and hazard - Risk Management process - Risk assessment, risk control options analysis, risk control implementation, risk controldecision, and risk reporting -Business Impact Analysis (BIA) concept, benefits andresponsibilities - BIA methodology - Assessment of financial and operational impacts, identification of critical IT systems and applications, identifications of recovery requirements and BIA reporting

Unit IV: IT recovery strategy, Business continuity strategy development framework - Cost-benefit assessment - Site assessment and selection - Selection of recovery options -Strategy considerations and selection - Linking strategy to plan - Coordinating with External Agencies -Business continuity plan contents - Information Systems aspects of BCP - Crisis Management - Emergency response plan and crisis communication plan - Awareness, training and communication - Plan activation - Business Continuity Planning Tools.

Unit V: Database recovery - Recovery Plan Development, Personnel Notification, DR site-concepts and management, Backups and Offsite Storage, Backup Media Formats, Software Escrow Arrangements, External Communications, Utilities Logistics and Supplies, Emergency Handling for Crisis Management, safety and rescue of personnel in emergency. Plan maintenance requirements and parameters - Change management and control - Business Continuity Plan Audits. Disaster Recovery – Definitions - Backup and recovery - Threat and risk assessment - Site assessment and selection - Disaster Recovery Road map - Disaster Recovery Plan (DRP)preparation - Vendor selection and implementation - Difference between BCP and DRP - Systems and communication security during recovery and repair, ISMS policies, ISO 27000

Course Outcomes

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

1. Identify the integral aspects of Business Continuity Management
2. Analyze common organizational risks and threats to business system continuity
3. Evaluate an organization’s ability to recover from a given disaster or event

4. Apply business continuity and disaster recovery principles to enhance abusiness continuity plan

Textbooks:

1. Disaster Recovery Handbook –M Wallace and Lawrence Webber, AMACOM; 3rd edition
2. Disaster Recovery Planning-S.S.Kambhmmettu

Reference Books

1. CISSP (Certified Information Systems Security Professional) Handbook

Track 8:
Computer Science and Engineering
(Information System)

Syllabus for Semester IV, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01PR0404-08 Course: Software Lab-II Advanced Linux
L: 0Hrs, P: 4Hrs, Per Week Total Credits: 2

Course Objectives:
The primary objective of this course is to provide students with in-depth knowledge and hands-on experience in advanced Linux system administration, shell scripting, and kernel-level programming.

Unit I: Linux Fundamentals and Host Administration
Linux installation, basic command-line usage, vi editor operations, software package management, user and group management, file permissions, bootloader (GRUB) configuration, hard disk partitioning and mounting, process monitoring and control, core system services, and kernel compilation.

Unit II: Shell Scripting and Linux Programming
Shell scripting basics, loops, conditionals, functions, system automation using scripts, introduction to Linux system programming, use of libipq, libnet, and libpcap libraries, packet handling, network control, and packet capture.

Unit III: Intranet Services Configuration
Linux networking fundamentals, DHCP server configuration, NFS server setup, Samba server setup, NIS server configuration, LDAP server installation and integration.

Unit IV: Internet Services and Security
FTP server configuration, SSH server setup, DNS configuration using BIND, web server deployment using Apache and Nginx, Squid proxy server setup, mail server configuration using Postfix and Dovecot, firewall configuration using iptables, VPN server deployment.

Unit V: Advanced Linux Kernel Programming
Kernel architecture, system call implementation, process management using task_struct, CPU scheduling, context switching, interrupt handling with softirqs and tasklets, synchronization using spinlocks and semaphores, timer management, page table and memory allocation, VFS internals, block layer, NVMe storage, TCP/IP networking stack.

Course Outcomes
On successful completion of the course, student shall be able to
1. Demonstrate proficiency in installing, configuring, and managing Linux systems, users, and core services.2.
2. Develop automated solutions using shell scripts and apply basic Linux programming with system libraries.3
3. Configure and manage intranet services such as DHCP, NFS, Samba, NIS, and LDAP.
4. Deploy and secure internet services including FTP, SSH, DNS, Web, Proxy, Mail, Firewall, and VPN servers.
5. Analyze and implement advanced Linux kernel functionalities including system calls, memory, scheduling, and networking.

Text Books:

1. Linux Administration: A Beginner's Guide", Wale Soyinka, McGraw-Hill Education
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder, Trent Hein, Ben Whaley, Dan Mackin, Pearson Education
3. Linux Kernel Development, Robert Love, Addison-Wesley

Reference Books

1. Understanding the Linux Kernel, Daniel P. Bovet, Marco Cesati, O'Reilly Media
2. Linux Command Line and Shell Scripting Bible, Richard Blum, Christine Bresnahan, Wiley

Syllabus for Semester V, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01PR0504-08 **Course: Software Lab-III Web Programming**
L: 0Hr, P: 4 Hrs, Per Week **Total Credits: 2**

Course Objectives:

1. To comprehend the fundamentals of React with JavaScript and JSX for creating templates with React components and their importance in building reusable UI elements.
2. To familiarize the students with essential skills for modern front-end web applications by the use of ReactJS features.
3. To learn to implement client-side routing using React Router for Single Page Applications (SPAs).

Introduction to React: ReactJS Introduction, Advantages of React JS, Introduction to JSX,
Difference between JS and JSX, Templating using JSX, Working with React, createElement, Expressions, logical operators, specifying attributes, children and Fragments.

React Components overview: Types of components, Controlled, Split Up, Composable, Reusable, Component Declarations and Styling Components, Conditional Rendering, List Rendering.

Props and State: State and its significance, Read state and setState, Passing data to components using props, Validating props using prop Types, Supplying default values to props using default Props.

Event Handling: Lifecycle Methods, Handling events in React Components, React Forms, Controlled Components, Uncontrolled components.

Routing with React Router: Need of react Router, React Router Installation, Components in React Router, Adding Navigation using Link component.

Course Outcomes

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

1. Understand the fundamentals of React with JavaScript and JSX.
2. Build and reuse functional and class-based React components effectively.
3. Utilize props and state effectively to manage data flow and UI interactions in React applications
4. Handle user events and implement conditional rendering based on user interaction.
5. Demonstrate dynamic routing and navigation in a React application.

Text Books:

1. React Up & Running: Building Web Applications - Stoyan Stefanov, O'Reilly Media, Second Edition, 2021.
2. Learning React: Modern Patterns for Developing React Apps - Alex Banks & Eve Porcello, O'Reilly Media, Second Edition, 2020.
3. React in Action 1st Edition - Mark Tielens Thomas, Manning Pubns Co, First Edition, 2018.

Reference Books

1. Pure React- a step-by-step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch

Syllabus for Semester V, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TH0506-08 **Course: Product and Project Management**
L: 3Hrs, P: 0Hrs, Per Week **Total Credits: 3**

Syllabus

Unit I:
Introduction to Product Management, Product Management Lifecycle, Product Manager vs Project Manager, Role and Characteristics of a Product Manager, Ideal Workflow of a Product Manager, Key terms in product management: Minimum Viable Product (MVP), Product Requirements Document (PRD), CI/CD etc.

Unit II:
Market Research, Competitor Analysis, Red Ocean & Blue Ocean, SWOT Analysis, Segment, Target, Position, Pricing Strategy

Unit III:
User Persona & Experience, Interview your Users, Persona Builder, Wireframes

Unit IV:
Introduction to Project Management, Project Manager Role, Triple Constraint, Project Management Framework, Stakeholder Engagement, Project Cycle Management

Unit V:
Project Life Cycle: Project Initiation, Execution and Closure, Project Monitoring and Risk Management, Case Study for Product and Project Management

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

1. Know the role and responsibilities of a product and project manager
2. Demonstrate techniques for the product development process
3. Exhibit skills in product and project strategy formulation
4. Apply product and project management tools for planning and tracking

Textbooks:
1. Inspired: How to Create Products Customers Love , by Marty Cagan
2. A Guide to the Project Management Body of Knowledge (PMBOK Guide)"

Syllabus for Semester VI, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TP0602-08 **Course: Mobile Apps Development**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

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, acase study on Mobile app development

Unit II

Building blocks of mobiles apps: App user interface designing –mobile UI resources (Layout, UI elements, Draw-able, Menu), 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

Native data handling: On device file I/O, shared preferences, Mobile databases such as SQLite, and enterprise data access (via Internet /Internet)

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)

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, JUnit for Android, Publishing Mobile Apps: Robotium, Monkey Talk ,Taking apps to market, Versioning, signing and packaging mobile apps, distributing apps on mobile market place, Localization, Prework for publishing app.

Course Outcomes

At the end of the course, students will be able to

1. Understand the different aspects of Mobile app development
2. Design mobile apps using Android as development platform
3. Apply the concepts of hardware, software co-design in building mobile applications
4. Perform testing signing, packaging and distribution of mobile apps

Text Books

1. Mobile Apps Development : Anubhav Pradhan , Anil V. Deshpande, 1st Edition, Wiley India
2. Android Application Development all in one for Dummies - Barry Burd, 1st Edition, John Wiley & Sons.
3. Foundations of Software Testing: Dorothy Graham, Erik van Veenendaal, Isabel Evans,Rex Black, 2nd Revised Edition, Cengage Learning

Reference Books

1. Teach Yourself Android Application Development 24 Hours- Lauren Darcy, 1st Edition, Pearson.

Syllabus for Semester VI, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TH0603-08 Course: Wireless Communication
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Unit I:
Introduction to wireless communication, Introduction to cellular system, Modulation Techniques, Spread Spectrum technique, Multiple Access Techniques

Unit II:
Digital Cellular Technologies: GSM: System Architecture, protocols, localization and calling, handover. General Packet Radio Service: Architecture, Mobility management, Location management.

Unit III:
Wireless Communication Protocols: IEEE 802.11, Bluetooth, Zigbee, RFID, Long Range (LoRa), LTE MIMO

Unit IV:
Support for Mobility: Mobile-IP protocol, Dynamic Host Configuration Protocol, Mobile Ad-hoc network: Introduction, Routing protocols Wireless Sensor Network: Introduction, Applications, Types of WSN, Challenges.

Unit V:
MAC and Routing Layer Design Issues: 802.15.4 for Wireless Sensor Networks, Routing, Clustering Algorithms. Wireless security: Introduction, Case study: Security in GSM, IEE802.11
Wireless security Protocols: WEP, WPA, WPA2, WPA3, Wireless Encryption Methods.

Course Outcomes:
At the end of the course students will be able to
1. Understand the basic concepts and principles of wireless communication.
2. Get acquainted with Cellular technologies like GSM and GPRS.
3. Differentiate between various wireless communication protocols
4. Evaluate routing, MAC design, and wireless security protocols.

Text Books:
1. Mobile Communication: Jochen Schiller, 2nd Edition, Pearson Education.
2. E. H. Callaway, Jr. E. H. Callaway, Wireless Sensor Networks Architecture and Protocols:, CRC Press
3. Wireless Network: The Definitive Guide by Matthew Gasi, O'relly.

Reference Books:
1. Wireless Communication: Theodore S. Rappaport, 2nd Edition, Pearson Education.
2. F. Zhao and L. Guibas, Wireless Sensor Network: Information Processing Approach, Elsevier, 2009
3. Videos of Swayam course on Wireless Ad Hoc and Sensor Networks

Syllabus for Semester VI, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TP0604-08 **Course: Internet of Things**
L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives

1. To introduce the terminology, technology, and its applications
2. To introduce the concept of M2M (machine to machine) with necessary protocols
3. To introduce the Python Scripting Language which is used in many IoT devices
4. To introduce the Raspberry PI platform, which is widely used in IoT applications
5. To introduce the implementation of web-based services on IoT devices

Unit I:
Introduction to IoT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs. IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates.

Unit II:
IoT & M2M : Machine to Machine, Difference between IoT and M2M, Software define Network. Network function virtualization, the difference between SDN and NFV for IoT, Basics of IoT System Management with NETCONF, YANG- NETCONF, YANG, SNMP, NETOPEER

Unit III:
Network & Communication aspects: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination. IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C)

Unit IV:
Challenges in IoT Design challenges, Development challenges, Security challenges, other challenges.

Unit V:
Domain-specific applications of IoT Home automation, City, Environment, Energy, Agriculture, Industry applications, Surveillance applications, and Other IoT applications Developing IoTs Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor-based applications through embedded system platform, Implementing IoT concepts with python. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors.

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

1. Understand the concepts of Internet of Things
2. Analyze basic protocols in wireless sensor network
3. Design IoT applications in different domain and be able to analyze their performance Implement basic IoT applications on embedded platform

Text Books

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"

2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

Reference Books

1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
2. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014

Syllabus for Semester VII, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TP0701-08 **Course: Customer Relationship Management**

L: 3Hrs, P: 2Hrs, Per Week **Total Credits: 4**

Course Objectives

1. To make the students understand the organizational need, benefits and process of creating long-term value for individual customers.
2. To disseminate knowledge regarding the concept of Salesforce and Salesforce technologies.
3. To enable the students understand the technological and human issues relating to implementation of Customer Relationship Management in the organizations.

UNIT I :

Introduction to CRM and Salesforce : Definition and importance of CRM, Key CRM concepts, Benefits of CRM for businesses, Introduction to Salesforce, Salesforce's role in business processes, Salesforce Cloud offerings , Overview of Salesforce architecture, Multi-tenant cloud architecture, Salesforce Data Model (Objects, Records, Fields), Understanding Tabs, Apps, and Objects

UNIT II :

Salesforce Administration Basics : Understanding Salesforce Setup menu, Creating and managing users, Profiles, Roles, and Permission Sets, Organizing security settings (Organization-Wide Defaults, Sharing Rules), Data Validation Rules, Creating and customizing Objects, Object Relationships, Creating and managing Fields, Workflow Rules, Process Builder, and Flow.

UNIT III:

Introduction to Apex Programming : Apex basics (Syntax, Variables, Methods), Apex classes and triggers, Working with SOQL and SOSL (Salesforce Object Query Language, Handling exceptions in Apex, Apex Triggers, Writing Apex triggers to handle database events, Trigger context variables and best practices, Governor limits and optimization techniques.

Unit IV:

Advanced Salesforce Development – Lightning Web Components (LWC) : Overview of Lightning Web Components (LWC), LWC architecture and lifecycle, Creating and deploying LWC components, Handling events in LWC, Working with Apex from LWC, LWC Integration with Salesforce Data, Displaying Salesforce data in LWC, Handling record pages and lightning layouts, Best practices for LWC development.

UNIT V :

Salesforce Integration and Deployment, Salesforce Reports: Overview of integration in Salesforce, Integration tools: REST API, SOAP API, and Bulk API, Salesforce Connect, Introduction to Mulesoft for Salesforce integration, Introduction to Salesforce DX, Source-driven development and version control, Continuous Integration and Continuous Delivery (CI/CD) in Salesforce., Introduction to reports, types of reports, report builder, formatting reports, dashboard introduction, dashboard generation, charts in dashboards, limitations of Salesforce reports.

Course Outcomes:

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

1. Understand the fundamentals of Salesforce and its role in CRM.
2. Gain practical skills in configuring and managing Salesforce environments.

3. Apply the basics of Salesforce development using Apex to customize the platform.
4. Develop modern web applications on the Salesforce platform using Lightning Web Components.
5. Integrate Salesforce with external systems and deploy applications in a production environment.

Text Books

1. Jason Ouellette; Development with the Force.com Platform, Second Edn, Addison Wesley, 2011. 2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018.
2. Mohith Shrivastava; Salesforce Lightning Application Development, 2018
3. Judith W .Kincaid , Customer Relationship Management Getting it Right, Pearson Education
4. Customer Centricity –Focus on right customer for strategic advantage, by Peter Fader, Wharton Digital Press, 2012

Reference Books

1. Learning Salesforce Development with Apex – Paul Battisson
2. Salesforce for Beginners – Sharif Shaalan

Syllabus for Semester VII, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TP0702-08 **Course: Context Aware Computing**
L: 2Hrs, P: 2Hrs, Per Week **Total Credits: 3**

Course Objectives:

1. To understand the fundamental principles of context-aware computing and its applications.
2. To learn context modeling, reasoning techniques, and their integration with pervasive systems.
3. To design and develop context-aware systems using sensors, mobile devices, and middleware.
4. To study real-world applications in smart environments like healthcare, smart cities, and transportation.

Unit I: Introduction to Context-Aware Computing

Definition and Need for Context-Aware Computing, History and Evolution of Context-Aware Systems, Types of Context: Physical (Location, Time, Environment), Social (User Identity, Activity, Behaviour), Device Context (Battery, Network, Sensors), Context-Aware Application Scenarios: Smart Homes, Smart Healthcare, Smart Classrooms and Campuses, Smart Transportation Systems, Architectures of Context-Aware Systems: Components (Sensor, Context Manager, Application Layer), Design Patterns for Context-Aware Systems

Unit II: Context Modeling and Reasoning

Context Modeling Approaches: Key-Value Pairs, Markup Scheme (XML), Object-Oriented Models, Ontology-Based Models (OWL, RDF), Graph-Based Models Context Reasoning Techniques: Rule-Based Reasoning, Decision Trees, Fuzzy Logic, Bayesian Networks, Ontology Reasoning using Description Logic, Context Inference Engines, Context Lifecycle Management: Acquisition, Interpretation, Reasoning, Distribution, Handling Uncertainty and Imperfect Context

Unit III: Context Acquisition and Management

Sources of Context: Sensors, Mobile Devices, Wearables, Web APIs, Context Acquisition Techniques: Physical Sensors (Temperature, GPS, Motion), Logical Sensors (App Usage, Browser History), Mobile Sensing, Context Aggregation and Filtering, Context Storage Models: Relational, NoSQL, Triple Stores, Context Distribution Mechanisms, Middleware for Context-Aware Systems: Context Toolkit, CoBrA, SOCAM, Context Broker

Unit IV: Context-Aware Systems Design

Service Discovery Based on Context, Context-Aware Adaptation Techniques: Application Behavior Based on Context, UI Personalization, Content Adaptation, Event-Driven vs Query-Based Context Processing, Frameworks & Tools: Android Context APIs, Java Context Frameworks, Google Awareness API, IFTTT, OpenHAB, Privacy, Security and Ethics in Context Awareness: Data Sensitivity, Anonymity, User Consent Mechanisms, Regulatory and Compliance Issues (GDPR, HIPAA)

Unit V: Applications and Case Studies
Context-Aware Healthcare Systems: Real-time patient monitoring, Fall detection and emergency alerts, Smart Transportation: Traffic-aware routing, Public transport personalization, Smart Classrooms/Campus: Attendance automation, Location-based alerts and services, Smart Retail: Proximity marketing, In-store analytics, Emerging Trends: Ambient Intelligence, Context-aware Edge and Fog Computing, AI-enhanced Context Inference, Ubiquitous and Pervasive Computing Integration

Course Outcomes:

1. Understand the fundamental concepts, types of context, and architecture of context-aware systems.
2. Apply appropriate context modeling and reasoning techniques.
3. Analyse various methods for context acquisition, storage, and dissemination.
4. Design and develop context-aware applications using available tools and frameworks.
5. Evaluate the effectiveness of context-aware systems through case studies in various domains.

Text Books:

1. Anind K. Dey, Understanding and Using Context, Springer LNCS
2. Manfred Tscheligi & Boris de Ruyter, Ambient Intelligence: European Conference Proceedings, Springer

Reference Books:

1. Jason Pascoe, Human-Computer Interaction in Context-Aware Systems, University of Kent Publications
2. Tao Gu, A Middleware for Context-Aware Mobile Services, IEEE Transactions.
3. Guanling Chen and David Kotz, A Survey of Context-Aware Mobile Computing Research, Dartmouth College Technical Report

Syllabus for Semester VII, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TH0703-08 **Course: Information Retrieval**

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

UNIT - I

Boolean retrieval, term vocabulary and postings lists, dictionaries and tolerant retrieval, index construction, index compression.

UNIT - II

Scoring, term weighting and the vector space model computing scores in a complete search system.

UNIT - III

Evaluation in information retrieval, relevance feedback and query expansion.

UNIT - IV

Probabilistic information retrieval, language models for information retrieval.

UNIT - V

Text classification and Naive Bayes, Vector space classification, Support vector machines and machine learning on documents. Web search basics, Web crawling and indexes, Link analysis.

Course Outcomes

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

1. Analyse various requirements in designing an information retrieval system.
2. Apply methods of metadata organization for effective information access.
3. Implement Machine learning and numerical methods in information retrieval.
4. Evaluate information retrieval Systems
5. Design web search system.

Text and Reference Books

1. An Introduction to Information Retrieval: Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Cambridge University Press.
2. Foundation of Statistical Natural Language Processing, Christopher D. Manning, Hinrich Schütze, The MIT Press.
3. Information Retrieval: Implementing and Evaluating Search Engines, Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, MIT Press.

Syllabus for Semester VII, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TH0704-08 Course: Cryptography and Network Security
L: 3Hrs, P: 0Hrs, Per Week Total Credits: 3

Course Objectives

1. To build strong fundamentals of cryptographic techniques and algorithms to realize Security Goals.
2. Understand authentication, access control, intrusion detection, and prevention.
3. Identify and mitigate software security vulnerabilities in existing systems.

UNIT I:
Introduction to Security Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Non repudiation, Classical Cryptographic Techniques.

UNIT II:
Symmetry key Cryptography Algebraic Structures, Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard. Key distribution, Attacks.

UNIT III:
Public key Cryptography Mathematical background, Number Theory. Modular Inverse, Extended Euclid Algorithm, Fermat's Little Theorem, Euler Phi-Function, Euler's theorem. RSA Algorithm, , Elliptic Curve Cryptography.

UNIT IV:
Message Authentication, Integrity and Key Management Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures, Key Management, Diffie- Hellman Key Exchange Kerberos, X.509

UNIT V:
Network Security Practices and Wireless Security Electronic Mail Security – PGP, – IP security – Web Security – The Secure Sockets Layer (SSL),Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things.

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

1. Analyse the Network Security Threats.
2. Apply cryptographic techniques and algorithms to build security-related applications.
3. Solve problems related to key generation and key exchange algorithms.
4. Implement necessary Security mechanisms to secure the Computer Network.
5. Understand the security concepts in Wireless network

Text Books

1. William Stallings; Cryptography & Networks Security Principles and Practice; 6th Edition
2. Pearson Education, 2013.
3. Atul Kahate; Cryptography and Network Security; 1st Edition; Tata McGraw Hill, 2008.
4. Behrouz A. Forouzan, Cryptography and network security MC Graw Hill 3rd Edition
5. C. Kaufman, R. Perlman, M. Speciner, “Network Security: Private Communication in a Public World”, Pearson Education, 2nd edition, 2002.

Reference Books

1. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
2. J. Edney, W.A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i", Pearson Education, 2004.
3. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
4. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.

Syllabus for Semester VIII, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TH0801-08 Course: Software Defined Network

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

Course Objectives:

1. To develop knowledge in networking fundamentals
2. To gain conceptual understanding of Software Defined Networks (SDN)
3. To study industrial deployment use-cases of SDN

Unit I: SDN Introduction and Architecture

Overview; History and evolution of SDN; Architecture of SDN; SDN Flavours; Scalability (Data Centres, Service provider networks, ISP Automation); Reliability (QoS, and Service Availability); Consistency (Configuration management, and Access Control Violations); Opportunities and Challenges; SDN Architecture: Network Operating System (NOS). SDN Architecture. Planes - data, management and control. Interfaces - northbound and southbound.

Unit II: SDN Protocols

SDN Protocol specifications: Border Gateway Protocol (BGP); Cisco Application Centric Infrastructure (ACI); OpenFlow. OpenFlow versions. Components of an OpenFlow Switch. Flow and group tables. Rule matching. Action handling. Table misses. Counters, metering and metadata.

Unit III: SDN Design and Development

Languages and functions available for programming SDNs, northbound API. Mininet. Software vs. Hardware SDN switch implementations - Open vSwitch, WhiteBox, ONL. Controller implementations - POX, NOX, Beacon, Floodlight. Special Purpose controllers - Flowvisor, RouteFlow.

Unit IV: SDN Programming

Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing, SDX; Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs.

Unit V: SDN Applications and Use Cases

Network Virtualization, Network Topology and Topological Information Abstraction, Data Centric Traffic Management, Wide Area Traffic Management, Wireless networks, SDN Use Cases: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering. Failures and Robustness Issues of SDN, SDN Security

Course Outcomes:

1. Examine the challenges and opportunities associated with adopting SDN compared to traditional approaches to networking
2. Analyse the functions and components of the SDN architecture
3. Discuss the major requirements of the design of an SDN protocol.
4. Design and create an SDN network consisting of SDN switches and a centralized controller.
5. Evaluate the emerging SDN applications.

Text Books:

1. Goransson, Paul, Chuck Black, and Timothy Culver. Software defined networks: a comprehensive approach, Morgan Kaufmann.
2. Nadeau, Thomas D., and Ken Gray. SDN: Software Defined Networks: an authoritative review of network programmability technologies, O'Reilly Media, Inc.

Reference Books

1. Stallings, William. Foundations of modern networking: SDN, NFV, QoE, IoT, and Cloud, Addison-Wesley Professional.
2. Oswald Coker, Siamak Azodolmolky. Software-Defined Networking with OpenFlow, Packt Publishing.

Syllabus for Semester VIII, Track 8 B. Tech. Computer Science & Engineering (Information Management)

Course Code: 25CS01TH0802-08 **Course: Cyber Physical Systems**

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

Course Objectives

1. To introduce the fundamental principles, architecture, and real-world applications of Cyber Physical Systems (CPS), including Industry 4.0 and IIoT integration.
2. To enable understanding of CPS modeling techniques, design drivers, and system requirements, including hardware, software, and communication technologies.
3. To develop awareness of security, privacy, and networking challenges in CPS.

Unit I:

Cyber Physical Systems in the Real World, Basic Principles of Cyber Physical Systems, Industry 4.0, IIoT Cyber Physical Systems Design Recommendations, CPS System Requirements, Cyber Physical System Application, Case study of Cyber Physical Systems, Motivation and examples of CPS, e.g. Energy, Medical, and Transportation cyber physical systems,

Unit II:

Key design drivers and quality attributes of CPS. Attributes of high confidence CPS, Hardware platforms for Cyber Physical Systems (Sensors/Actuators, Microprocessor/Microcontrollers), Wireless Technologies for Cyber Physical Systems

Unit III:

Structure of Models, Synchronous Reactive models, Dataflow models of computation, Timed models of computation

Unit IV:

Design of Embedded Systems (I/O Units, Multitasking and Scheduling), Internet of Things Architecture, CPS Architecture

Unit V:

Security and Privacy Issues in CPSs, Local Network Security for CPSs, Internet-Wide Secure Communication, Security and Privacy for Cloud-Interconnected CPSs, Case Study: Cybersecurity in Digital Manufacturing/Industry 4.0

Course Outcomes

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

1. Understand the need and purpose of the different components of Cyber Physical Systems.
2. Develop the ability to interact with Cyber Physical System.
3. Designing a new system and with which a product can be made.
4. Understand the semantics of a CPS model.
5. Analyse common methods used to secure cyber-physical systems.

Text Books:

1. Principles of Cyber Physical Systems, Rajeev Alur, MIT Press.
2. E. A. Lee, SanjitSeshia , "Introduction to Embedded Systems – A Cyber–Physical Systems Approach", Second Edition, MIT Press.

Reference Books:

1. Guido Dartmann, Houbing song, Ankeschmeink, “Big data analytics for Cyber Physical System”, Elsevier.
2. Houbing song, Danda B Rawat, Sabina Jeschke, Christian Brecher, “Cyber Physical Systems Foundations, Principles and Applications”, Elsevier.
3. Chong Li, MeikangQiu, “Reinforcement Learning for Cyber Physical Systems with Cyber Securities Case Studies”, CRC press.
4. Houbing Song, Glenn A.Fink, Sabina Jesche, “Security and Privacy in Cyber-Physical Systems: Foundations, Principles and Solutions”, IEEE Press.