R.M.K. COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

R.S.M Nagar, Puduvoyal, Gummidipoondi Taluk,

Thiruvallur District, Tamil Nadu- 601206

Affiliated to Anna University, Chennai / Approved by AICTE, New Delhi

Accredited by NAAC with A Grade /All the Eligible UG Programs are Accredited by NBA, New Delhi / An ISO 9001:2015 Certified Institution

B.TECH. Degree in

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CURRICULUM AND SYLLABI

REGULATIONS – 2022

CHOICE BASED CREDIT SYSTEM

B.E. / B.TECH- ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
REGULATIONS – 2022
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The B.Tech. Artificial Intelligence & Data Science Graduates of R.M.K. College and Engineering Technology will:

PEO 1 : Work effectively in inter-disciplinary field with the knowledge of Artificial Intelligence and Data Science to develop appropriate solutions to the real-world problems.

PEO 2: Excel in professional career and pursue higher education in the field of Artificial Intelligence and Data Science.

PEO 3: Apply their knowledge to the technological revolution through life-long learning.

PEO 4: Excel as socially committed engineers or entrepreneurs with high ethical and moral values.

PROGRAM OUTCOMES (POs)

After the successful completion of the program, the graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution ofcomplex 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 engineeringproblems and design system components or processes that meet the specifiedneeds 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 andmodeling 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 andunderstanding of the engineering and management principles and apply theseto one's own work, as a member and leader in a team, to manage projects andin 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)

After the successful completion of the program, the graduates will be able to:

After the successful completion of the program, the graduates will be able to:

1. Apply fundamental concepts of Artificial Intelligence and Data Science to solve technical problems.
2. Utilize Artificial Intelligence and Data Science tools to provide innovative business solutions.
3. Implement the domain knowledge to achieve successful career as an employee, entrepreneur and an engineering professional.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES(PEOs) WITH PROGRAMME OUTCOMES(POs)

A broad relation between the programme objective and the outcomes is given in thefollowing table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
I	3	3	3	3	2	2	2	1	1	1	1	1
II	3	3	3	3	2	1	1	1	3	3	1	3
III	2	2	2	2	2	3	2	3	3	1	1	1
IV	3	3	3	3	2	2	2	3	3	3	2	1
I	3	3	3	3	2	2	2	1	1	1	1	1

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is givenin the following table

PROGRAMME SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
I	3	3	3	3	3	3	2	1	1	1	1	2
II	3	3	3	3	3	3	2	1	1	1	1	2
III	2	2	2	2	3	2	2	2	3	2	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES

YEAR	SEMESTER	COURSE NAME	PROGRAM OUTCOMES											
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
YEAR I	**SEMESTER I**	Matrices and Calculus	✓	✓	✓	✓	✓	✓	✓					✓
		Engineering Chemistry	✓	✓				✓	✓					✓
		Problem Solving using C++	✓	✓	✓					✓	✓	✓		✓
		Software Development Practices	✓	✓	✓		✓	✓		✓	✓	✓		✓
		Digital Principles and System Design	✓	✓	✓					✓	✓	✓		✓
		Computer aided Engineering Graphics	✓		✓		✓					✓		
		Product Development Lab-1												
		Heritage of Tamils												
		Induction Program						✓	✓	✓	✓	✓	✓	✓
	SE	Transforms and Numerical Methods	✓	✓	✓	✓	✓	✓						✓

		Data Structures	✓	✓	✓					✓	✓	✓		✓
		Physics for Computer Science and Information Technology	✓	✓	✓	✓								
		Professional Communication									✓	✓		✓
		Java Programming	✓	✓	✓		✓			✓	✓	✓		✓
		Database Management System	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Product Development Lab - 2												
		Environmental Sciences and Sustainability (Non Credit)	✓	✓				✓	✓			✓		✓
		Tamils and Technology						✓	✓	✓	✓	✓	✓	✓
		Yoga for Stress Management												
YEAR II	**MESTER III**	Universal Human Values II: Understanding Harmony						✓	✓	✓	✓	✓	✓	✓
		Discrete Mathematics	✓	✓	✓	✓								
		Advanced Java Programming	✓	✓	✓	✓				✓	✓	✓		✓
		Design and Analysis of Algorithms	✓	✓	✓	✓	✓			✓	✓	✓		✓
		Artificial Intelligence	✓	✓	✓					✓	✓	✓		✓
		Data Science using Python	✓	✓	✓	✓	✓			✓	✓	✓		✓
		Product Development Lab-3	✓	✓	✓	✓	✓			✓	✓	✓		✓
		Aptitude and Coding Skills I	✓	✓							✓	✓		
		Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Value Education (Non Credit)												
	SEMESTER IV	Probability and Statistics	✓	✓	✓	✓								
		Operating Systems	✓	✓	✓	✓	✓			✓	✓	✓		✓
		Computer Organization and Architecture	✓	✓	✓		✓			✓	✓	✓		✓
		Machine Learning	✓	✓	✓		✓			✓	✓	✓		✓
		Web Development Frameworks	✓	✓	✓		✓			✓	✓	✓		✓
		Professional Elective I												
		Product Development Lab-4												
		Aptitude and Coding Skills II	✓	✓							✓	✓		
		Yoga/Personality Development (Non Credit)												
YEA R III	**SEM ES**	Open Elective I												
		Professional Elective II												

		Professional Elective III													
		Deep Learning	✓	✓	✓		✓			✓	✓	✓		✓	
		Data Exploration, Feature Engineering and Visualization	✓	✓	✓		✓			✓	✓	✓		✓	
		Advanced Aptitude and Coding Skills I	✓	✓	✓						✓	✓			
		Internship and Career Readiness Course	✓	✓	✓						✓	✓			
		Indian Constitution (Non Credit)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	SEMESTER VI	Professional Ethics						✓	✓	✓	✓	✓	✓	✓	
		Open Elective II													
		Professional Elective IV													
		Professional Elective V													
		Automation Theory and Compiler Design	✓	✓	✓					✓	✓	✓		✓	
		Object Oriented Software Engineering	✓	✓	✓			✓		✓	✓	✓		✓	
		Reinforcement and Ensemble Learning	✓	✓	✓	✓	✓			✓	✓	✓		✓	
		Advanced Aptitude and Coding Skills II	✓	✓							✓	✓			
YEAR IV	**SEMESTER VII**	Professional Ethics						✓	✓	✓	✓	✓	✓	✓	
		Open Elective III													
		Open Elective IV													
		Professional Elective VI													
		Natural Language Processing	✓	✓	✓		✓			✓	✓	✓		✓	
		Big Data Analytics	✓	✓	✓		✓			✓	✓	✓		✓	
		MLOps	✓	✓	✓		✓			✓	✓	✓		✓	
		Essence of Indian Knowledge Tradition (Non Credit)	✓	✓							✓	✓			
	SEMESTER VIII	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

PROFESSIONAL ELECTIVES

VERTICALS	**COURSE NAME**	**PROGRAM OUTCOMES**											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
ADVANCED	Business Intelligence and Analytics	✓	✓	✓		✓			✓	✓	✓		✓
	Social Network Analytics	✓	✓	✓		✓			✓	✓	✓		✓

	Text and Speech Analytics	✓	✓	✓					✓	✓	✓		✓
	Image And Video Analytics	✓	✓	✓		✓			✓	✓	✓		✓
	Stream Processing and Analytics	✓	✓	✓		✓			✓	✓	✓		✓
	Cognitive Science and Analytics	✓	✓	✓		✓			✓	✓	✓		✓
	Image and Video Analytics	✓	✓	✓					✓	✓	✓		✓
	Capstone Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
APPLIED AI	AI in BLOCK CHAIN	✓	✓	✓		✓			✓	✓	✓		✓
	Computer Vision	✓	✓	✓					✓	✓	✓		✓
	Intelligent Robots	✓	✓	✓		✓			✓	✓	✓		✓
	Generative Ai	✓	✓	✓		✓			✓	✓	✓		✓
	Game Development								✓	✓	✓		✓
	Industrial IoT	✓	✓	✓		✓			✓	✓	✓		✓
	Capstone Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AI AND CLOUD COMPUTING	Cloud Foundations	✓	✓	✓		✓			✓	✓	✓		✓
	Virtualization	✓	✓	✓		✓			✓	✓	✓		✓
	DevOp	✓	✓	✓		✓			✓	✓	✓		✓
	Data Engineering in Cloud	✓	✓	✓		✓			✓	✓	✓		✓
	Machine Learning for NLP in Cloud	✓	✓	✓		✓			✓	✓	✓		✓
	Cloud Services Management	✓	✓	✓		✓			✓	✓	✓		✓
	Capstone Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HIGH PERFORMANCE COMPUTING	Multi-Core Architecture and Programming	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
	GPU Computing	✓	✓	✓					✓	✓	✓		✓
	Quantum Computing	✓	✓	✓					✓	✓	✓		✓
	Scalable Machine Learning	✓	✓	✓					✓	✓	✓		✓
	Optimization Methods in Machine Learning	✓	✓	✓					✓	✓	✓		✓
	Capstone Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
COMP	Soft Computing	✓	✓	✓		✓			✓	✓	✓		✓
	Applied AI and ML	✓	✓	✓	6	✓			✓	✓	✓		✓

	Recommender Systems	✓	✓	✓		✓			✓	✓	✓		✓
	Knowledge Engineering	✓	✓	✓		✓			✓	✓	✓		✓
	Capstone Project	✓	✓	✓		✓			✓	✓	✓		✓
INTELLIGENT HEALTHCARE	AI and ML for Healthcare	✓	✓	✓		✓			✓	✓	✓		✓
	Health Care Analytics	✓	✓	✓		✓			✓	✓	✓		✓
	Clinical Data Science	✓	✓	✓		✓			✓	✓	✓		✓
	Deep Learning in Genomics and Life Sciences	✓	✓	✓		✓			✓	✓	✓		✓
	Capstone Project	✓	✓	✓		✓			✓	✓	✓		✓

R.M.K. COLLEGE OF ENGINEERING AND TECHNOLOGY

[An Autonomous Institution]
R.S.M Nagar, Kavaraipettai, Gummidipoondi Taluk, Thiruvallur District, Tamil Nadu- 601 206
Affiliated to Anna University, Chennai / Approved by AICTE, New Delhi/ Accredited by NAAC with A+ Grade
An ISO 9001:2015 Certified Institution / All the Eligible UG Programs are accredited by NBA, New Delhi.

B.E. / B.TECH- ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
REGULATIONS – 2022
CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTER CURRICULUM

SEMESTER –I								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA101	Matrices and Calculus	BSC	5	3	0	2	4
2	22CH101	Engineering Chemistry	BSC	5	3	0	2	4
3	22CS101	Problem Solving using C++	ESC	5	3	0	2	4
4	22CS102	Software Development Practices	ESC	5	3	0	2	4
5	22EC101	Digital Principles and System Design	ESC	5	3	0	2	4
LABORATORY COURSES WITH THEORY COMPONENT								
6	22GE101	Computer aided Engineering Graphics	ESC	3	1	0	2	2
LABORATORY COURSES								
7	22GE111	Product Development Lab-1	EEC	2	0	0	2	1
THEORY COURSES								
8.	22GE201	Heritage of Tamils	HSMC	1	1	0	0	1
MANDATORY COURSES								
9.		Induction Program (Non Credit)	MC	3Weeks				
TOTAL				**31**	**17**	**0**	**14**	**24**

SEMESTER –II								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1	22GE301	Tamils and Technology	HSMC	1	1	0	0	1
THEORY COURSES WITH LABORATORY COMPONENT								
2	22MA201	Transforms and Numerical Methods	BSC	5	3	0	2	4
3	22CS201	Data Structures	ESC	5	3	0	2	4
4	22PH201	Physics for Computer Science and Information Technology	BSC	5	3	0	2	4
5	22HS101	Professional Communication	HSMC	4	2	0	2	3
6	22CS202	Java Programming	ESC	5	3	0	2	4
7	22CS203	Database Management System	PCC	5	3	0	2	4
LABORATORY COURSES								
8	22GE211	Product Development Lab - 2	EEC	2	0	0	2	1
MANDATORY COURSES								
9	22CH104	Environmental Sciences and Sustainability (Non Credit)	MC	2	2	0	0	0
AUDIT COURSES								
10		Yoga for Stress Management	AC	1	1	0	0	0
THEORY COURSES								
TOTAL				**35**	**21**	**0**	**14**	**25**

SEMESTER – III								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	22GE302	Universal Human Values II: Understanding Harmony	HSMC	4	2	0	2	3
2.	22MA301	Discrete Mathematics	BSC	4	3	1	0	4
THEORY COURSES WITH LABORATORY COMPONENT								
3.	22AI301	Artificial Intelligence	PCC	5	3	0	2	4
4.	22AI302	Data Science using Python	PCC	4	2	0	2	3
5.	22CS305	Advanced Java Programming	ESC	5	3	0	2	4
6.	22CS306	Design and Analysis of Algorithms	PCC	5	3	0	2	4
LABORATORY COURSES								
7.	22CS313	Product Development Lab 3	EEC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8.	22CS311	Aptitude and Coding Skills I	EEC	2	0	0	2	1
9.	22AI313	Internship	EEC	0	0	0	0	1
AUDIT COURSES								
10.		Value Education (Non Credit)	AC	1	1	0	0	0
			TOTAL	**32**	**17**	**1**	**14**	**25**

*2 weeks for one credit. Internship during 2 Semester Summer Vacation

SEMESTER – IV								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	22CS302	Computer Organization and Architecture	ESC	3	3	0	0	3
2.		Professional Elective I	PEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
3.	22MA401	Probability and Statistics	BSC	5	3	0	2	4
4.	22CS304	Operating Systems	PCC	4	2	0	2	3
5.	22AI401	Machine Learning	PCC	5	3	0	2	3
6.	22CS403	Web Development Frameworks	PCC	5	3	0	2	4
LABORATORY COURSES								
7.	22CS413	Product Development Lab-4	PCC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8.	22CS411	Aptitude and Coding Skills II	EEC	2	0	0	2	1
AUDIT COURSES								
1.		Yoga/Personality Development (Non Credit)	AC	1	1	0	0	0
			TOTAL	**30**	**18**	**0**	**12**	**22**

SEMESTER – V								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1		Open Elective I	OEC	3	3	0	0	3
2		Professional Elective II	PEC	3	3	0	0	3
3		Professional Elective III	PEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
4	22AI501	Deep Learning	PCC	5	3	0	2	4
5	22AI502	Data Exploration, Feature Engineering and Visualization	PCC	5	3	0	2	4
EMPLOYABILITY ENHANCEMENT COURSES								
6	22CS511	Advanced Aptitude and Coding Skills I	EEC	2	0	0	2	1
7	22AI512	Internship and Career Readiness Course	EEC	2	0	0	2	1
MANDATORY COURSES								
8		Indian Constitution (Non Credit)	MC	1	1	0	0	0
			TOTAL	**24**	**16**	**0**	**8**	**19**

*2 weeks for one credit. Internship during 4 Semester Summer Vacation

SEMESTER – VI								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Open Elective II	OEC	3	3	0	0	3
2.	22AI602	Automata Theory and Compiler Design	PCC	3	3	0	0	3
3.		Professional Elective IV	PEC	3	3	0	0	3
4.		Professional Elective V	PEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
5.	22CS602	Object Oriented Software Engineering	PCC	5	3	0	2	4
6.	22AI601	Reinforcement and Ensemble Learning	PCC	5	3	0	2	4
EMPLOYABILITY ENHANCEMENT COURSES								
7.	22CS611	Advanced Aptitude and Coding Skills II	EEC	2	0	0	2	1
8.	22AI611	Mini Project	EEC	2	0	0	2	1
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER – VII								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1		Professional Ethics	HSMC	3	3	0	0	3
2		Open Elective III	OEC	3	3	0	0	3
3		Open Elective IV	OEC	3	3	0	0	3
4		Professional Elective VI	PEC	3	3	0	0	3
LAB INTEGRATED THEORY COURSES								
5	22AI701	Big Data Analytics	PCC	5	3	0	2	3
6	22AI702	Natural Language Processing	PCC	5	3	0	2	4
LAB COURSE								
7	22AI711	MLOps	PCC	2	0	0	2	1
MANDATORY COURSES								
8		Essence of Indian Knowledge Tradition (Non Credit)	MC	1	1	0	0	0
			TOTAL	**25**	**19**	**0**	**6**	**20**

SEMESTER – VIII								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
EMPLOYABILITY ENHANCEMENT COURSES								
1	22AI811	Project Work	EEC	16	0	0	16	8
			TOTAL	**16**	**0**	**0**	**16**	**8**

CREDIT SUMMARY

S. No.	Subject Area	Credits Per Semester								Credit Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	1	4	3	-	-	-	3	-	11	6.67%
2	BSC	8	8	4	4	-	-	-	-	24	14.55%
3	ESC	14	8	4	3	-	-	-	-	25	17.58%
4	PCC	-	4	11	11	8	11	8	-	53	3212%
5	PEC	-	-	-	3	6	6	3	-	18	10.91%
8	OEC	-	-	-	-	3	3	6	-	12	7.27%
7	EEC	1	1	3	1	2	2	-	8	18	10.91%
8	MC			✓	✓	✓		✓			
	Total	24	25	25	22	19	22	20	8	165	100%

HSMC – Humanities and Social Sciences including Management courses; **BSC** – Basic Science Courses; **ESC** – Engineering Science Courses including workshop, drawing, basics of electrical/mechanical/computer etc.; **PCC** – Professional Core Courses; **PEC** – Professional Elective Courses relevant to chosen specialization/branch; **OEC** – Open Subjects–Electives from other technical and/or emerging subjects **EEC** – Project Work, Seminar and Internship in Industry or elsewhere

PROFESSIONAL ELECTIVES

ELECTIVE VERTICALS:

VERTICAL I- ADVANCED ANALYTICS								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22AI901	Business Intelligence and Analytics	PEC	4	2	0	2	3
2.	22AI902	Social Network Analytics	PEC	3	3	0	0	3
3.	22AI903	Text and Speech Analytics	PEC	3	3	0	0	3
4.	22AI904	Image And Video Analytics	PEC	3	3	0	0	3
5.	22AI905	Stream Processing and Analytics	PEC	3	3	0	0	3
6.	22AI906	Cognitive Science and Analytics	PEC	3	3	0	0	3

VERTICAL II - APPLIED AI								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22AI908	AI in BLOCK CHAIN	PEC	3	3	0	0	3
2.	22AI909	Computer Vision	PEC	3	3	0	0	3
3.	22AI910	Intelligent Robots	PEC	3	3	0	0	3
4.	22AI911	Generative Ai	PEC	3	3	0	0	3
5.	22CS925	Game Development	PEC	3	3	0	0	3
6.	22CS921	Industrial IoT	PEC	3	3	0	0	3

VERTICAL III - AI AND CLOUD COMPUTING								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	22CS907	Cloud Foundations	PEC	4	2	0	2	3
2.	22CS909	Virtualization	PEC	3	3	0	0	3
3.	22CS910	DevOp	PEC	4	2	0	2	3
4.	22CS911	Data Engineering in Cloud	PEC	3	3	0	0	3
5.	22CS933	Machine Learning for NLP in Cloud	PEC	4	2	0	2	3
6.	22CS934	Cloud Services Management	PEC	3	3	0	0	3

VERTICAL IV – HIGH PERFORMANCE COMPUTING								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	22AI912	Multi-Core Architecture and Programming	PEC	3	3	0	0	3
2.	22AI913	GPU Computing	PEC	3	3	0	0	3
3.	22CS924	Quantum Computing	PEC	3	3	0	0	3
4.	22AI914	Scalable Machine Learning	PEC	3	3	0	0	3
5.	22AI915	Optimization Methods in Machine Learning	PEC	3	3	0	0	3

HONOURS DEGREE VERTICALS

COMPUTATIONAL INTELLIGENCE								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	22AI921	Soft Computing	PEC	3	3	0	0	3
2.	22AI922	Applied AI and ML	PEC	3	3	0	0	3
3.	22AI927	Recommender Systems	PEC	3	3	0	0	3
4.	22AI928	Knowledge Engineering	PEC	3	3	0	0	3
5.	22AI812	Capstone Project	PEC	12	0	0	12	6

INTELLIGENT HEALTHCARE								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	22AI923	AI and ML for Healthcare	PEC	3	3	0	0	3
2.	22AI924	Medical Image Analysis	PEC	3	3	0	0	3
3.	22AI925	Clinical Data Science	PEC	3	3	0	0	3
4.	22AI926	Deep Learning in Genomics and Life Sciences	PEC	3	3	0	0	3
5.	22AI812	Capstone Project	PEC	12	0	0	12	6

OPEN ELECTIVE – OFFERED TO OTHER DEPARTMENTS

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	22AI001	AI in Block Chain	OEC	3	3	0	0	3
2	22AI002	Soft Computing	OEC	3	3	0	0	3
3	22AI003	Computational Neuroscience	OEC	3	3	0	0	3
4	22AI004	Bio-Informatics	OEC	3	3	0	0	3
5	22AI005	Introduction To Generative Ai	OEC	3	3	0	0	3
6	22AI812	Capstone Project	PEC	12	0	0	12	6

R2022 CURRICULUM OF B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE WITH SPECIALIZATION IN COMPUTATIONAL INTELLIGENCE / INTELLIGENT HEALTHCARE

Additional 18 credits to be completed from the courses offered in the specific Professional Elective Verticals

R2022 CURRICULUM OF B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Additional 18 credits to be completed from the courses offered in any Professional Elective Verticals

B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE WITH MINOR DEGREE IN Internet of Things offered by Electronics and Communication Engineering

Additional 18 credits to be completed from the courses offered in SPECIFIC Professional Elective Vertical

R2022
MINOR DEGREE CURRICULUM OFFERED BY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
(for other B.E. / B.Tech. Programmes)

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SI. No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1.	22AI006	Introduction to Data Science	3	3	0	0	3
2.	22AI007	Introduction to Artificial Intelligence	3	3	0	0	3
3.	22AI008	Machine Learning Algorithms	3	3	0	0	3
4.	22AI009	Foundations of Deep Learning	3	3	0	0	3
5.	22AI812	Capstone Project	12	0	0	12	6

MINOR DEGREE IN
ADVANCED ANALYTICS / COMPUTATIONAL INTELLIGENCE / AI and CLOUD COMPUTING / INTELLIGENT HEALTHCARE

Additional 18 credits to be completed from the courses offered in the specific Professional Elective Verticals

R2022
B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE WITH MINOR DEGREE

SI. No	NAME OF THE MINOR DEGREE	OFFERRING DEPARTMENT
1.	Internet of Things	Electronics and Communication Engineering

SEMESTER – I

22MA101	MATRICES & CALCULUS (Common to All Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Explain the concepts of matrix algebra techniques needed for practical applications.
- Determine the curvature of the curves.
- Illustrate the simple applications of multivariable calculus and vector calculus.
- Elaborate the concept and application of multiple integrals.

UNIT I	MATRICES	15

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

Theory : 9

Experiments using SCILAB:

1. Introduction to SCILAB through matrices and general syntax.
2. Finding the Eigenvalues and Eigenvectors.
3. Plotting the graph of a quadratic form.

Laboratory: 6

UNIT II	SINGLE VARIABLE CALCULUS	15

Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature– Evolutes.

Theory: 9

Experiments using SCILAB:

1. Evaluating the radius of curvature.
2. Finding the coordinates of the center of curvature.
3. Tracing of Curves.

Laboratory: 6

UNIT III	MULTIVARIABLE CALCULUS	15

Partial derivatives (excluding Euler's theorem) – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables.

Theory: 9

Experiments using SCILAB:

1. Evaluating the maxima of functions of several variables.
2. Evaluating the minima of functions of several variables.
3. Evaluation of Jacobians.

Laboratory: 6

UNIT IV	MULTIPLE INTEGRALS	15

Double integrals – Change of order of integration – Area enclosed by plane curves – Triple integrals – Volume of solids.

Theory: 9

Experiments using SCILAB:

1. Evaluating area under a curve.
2. Evaluating area using double integral..
3. Evaluation of volume by integrals.

Laboratory: 6

UNIT V	VECTOR CALCULUS	15

Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane and Gauss divergence theorem (Statement only) – Simple applications involving cubes and rectangular parallelopipeds.

Theory: 9

Experiments using SCILAB:

1. Evaluating gradient.
2. Evaluating directional derivative.
3. Evaluating divergent and curl.

Laboratory: 6

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Use the matrix algebra methods to diagonalize the matrix.
CO2: Determine the evolute of the curve.
CO3: Apply differential calculus ideas on the function of several variables.
CO4: Evaluate the area and volume by applying the concept of multiple integration.
CO5: Utilize the concept of vector calculus in evaluating integrals.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES:

1. M. K. Venkataraman, "Engineering Mathematics", Volume I, 4th Edition, The National Publication Company, Chennai, 2003.
2. SivaramakrishnaDass, C. Vijayakumari, "Engineering Mathematics", Pearson Education India, 4th Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S.S. Sastry, "Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.

LIST OF EQUIPMENTS:

1. SCILAB- Open source

22CH101	ENGINEERING CHEMISTRY (Common to All Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To understand the water quality criteria and interpret its applications in water purification.
- To gain insights into the basic concepts of electrochemistry and implement its applications in chemical sensors.
- To acquire knowledge on the fundamental principle of energy storage devices and relate it to electric vehicles.
- To identify the different types of smart materials and explore their applications in Engineering and Technology.
- To assimilate the preparation, properties and applications of nanomaterials in various fields.

UNIT I	WATER TECHNOLOGY	15

Sources of water –Impurities - Drinking water quality parameters –Hardness and its types, problems - Municipal water treatment and disinfection (chlorination- break-point chlorination,UV, Ozonation). Boiler troubles- Scales and sludges, Boiler feed water: Requirements - Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment –Ion exchange demineralization - Principle, process and fouling. Desalination of brackish water: Reverse osmosis –principle-types of membranes, process and fouling.

(Theory-9)

Determination of total, temporary and permanent hardness of water by EDTA method.
Determination of chloride content of water sample by argentometric method.
Determination of alkalinity in water sample

(Laboratory-6)

UNIT II	ELECTROCHEMISTRY AND SENSORS	15

Introduction- Conductance- factors affecting conductance – Electrodes– origin of electrode potential – single electrode potential, standard electrode potential – measurement of single electrode potential –over voltage - reference electrodes (standard hydrogen electrode, calomel electrode)-ion selective electrode- glass electrode - Nernst equation (derivation),numerical problems, Electrochemical series and its applications.
Chemical sensors – Principle of chemical sensors – Breath analyzer– Gas sensors – CO2 sensors- Sensor for health care – Glucose sensor.

(Theory-9)

Determination of the amount of NaOH using a conductivity meter.
Determination of the amount of acids in a mixture using a conductivity meter.
Determination of the amount of given hydrochloric acid using a pH meter.

(Laboratory-6)

UNIT III	ENERGY STORAGEDEVICES AND ENERGYSOURCES	15

Batteries –Primary alkaline battery - Secondary battery - Pb-acid battery, Fuel cell - H2 – O2 fuel cell.
Batteries used in E- vehicle: Ni-metal hydride battery, Li-ion Battery, Li-air Battery
Nuclear Energy – Nuclear fission, fusion, differences, characteristics – nuclear chain reactions – light water nuclear reactor – breeder reactor.

(Theory-9)

Determination of single electrode potential of the given electrode.
Estimation of the iron content of the given solution using apotentiometer.
Determination of electrochemical cell potential (using different electrodes/ different concentrations of electrolytes)

(Laboratory-6)

UNIT IV	SMART MATERIALS FOR ENGINEERING APPLICATIONS	15

Polymers – Definition – Classification – smart polymeric materials - Preparation, properties and applications of Piezoelectric polymer - Polyvinylidene fluoride (PVDF), Electroactive polymer- Polyaniline (PANI) and Biodegradable polymer - Polylactic acid (PLA).
Polymer composites: Definition, Classification – FRP's – Kevlar.
Shape Memory Alloys: Introduction, Shape memory effect – Functional properties of SMAs – Types of SMA - Nitinol (Ni-Ti) alloys - applications.
Chromogenic materials:Introduction – Types - applications.

(Theory-9)

Determination of themolecular weight of polymer using Ostwald viscometer.
Application of polymeric fibers in 3D printing.

(Laboratory-6)

UNIT V	NANO CHEMISTRY	15

Introduction – synthesis – top-down process (laser ablation, chemical vapor deposition), bottom-up process (precipitation, electrochemical deposition) – properties of nanomaterials – types – nanotubes -carbon nanotubes, applications of CNT - nanocomposites – General applications of nanomaterials in electronics, information technology, medical and healthcare, energy, environmental remediation, construction and transportation industries.

(Theory-9)

Determination of concentration of $BaSO_4$ nanoparticles by conductometric titrations.
Preparation of ZnO nanocrystal by precipitation method.

(Laboratory-6)

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Interpret the water quality parameters and explain the various water treatment methods.
CO2: Construct the electro chemical cells and sensors.
CO3: Compare different energy storage devices and predict their relevance in electric vehicles.
CO4: Classify different types of smart materials, their properties and applications in Engineering and Technology.
CO5: Integrate the concepts of nano chemistry and enumerate its applications in various fields.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai PublishingCompany Pvt. Ltd., New Delhi, 2022.
2. SivasankarB., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2012.

REFERENCES:

1. S.S. Daraand S.S. Umare, "A Textbook of Engineering Chemistry",12thEdition, S.Chand&Company, NewDelhi, 2013.
2. V.R. Gowarikar, Polymer Science, 2nd edition, New Age International Publishers, 2021.
3. J. C. Kuriacose and J. Rajaram, "Chemistry in Engineering and Technology", Volume - 1&Volume -2, Tata McGraw-Hill Education Pvt. Ltd., 2010.
4. Geoffrey A. Ozin, Andre C. Arsenault and Ludovico Cademartiri, "Nanochemistry: A Chemical ApproachtoNanomaterials",2ndEdition,RSC publishers,2015.
5. PrasannaChandrasekhar,"Conductingpolymers,fundamentalsandapplications–Including Carbon Nanotubes and Graphene", Second Edition, Springer Science & Business Media, New York, 2019.
6. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", 6th edition, Pearson Education Pvt. Ltd., 2019.

LIST OF EQUIPMENTS:

1. Conductivity meter – 20 Nos.
2. pH meter - 19 Nos.
3. Potentiometer - 20 Nos.

22CS101	PROBLEM SOLVING USING C++ (Common to All Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To learn problem solving and programming fundamentals.
- To gain knowledge on pointers and functions.
- To apply the principles of object orientated programming.
- To understand operator overloading, inheritance and polymorphism.
- To use the functionalities of I/O operations, files build C++ programs using exceptions.

UNIT I	PROBLEM SOLVING AND PROGRAMMING FUNDAMENTALS	15

Computational thinking for Problem solving – Algorithmic thinking for Problem solving - Building Blocks - Problem Solving and Decomposition - Dealing with Error – Evaluation.
Overview of C – Data types – Identifiers – Variables – Storage Class Specifiers – Constants – Operators - Expressions – Statements – Arrays and Strings – Single-Dimensional – Two-Dimensional Arrays – Arrays of Strings – Multidimensional Arrays.

List of Exercises:

1. Write C/C++ programs for the following:
   a. Find the sum of individual digits of a positive integer.
   b. Compute the GCD of two numbers.
   c. Find the roots of a number (Newton‘s method)
2. Write C/C++ programs using arrays:
   a. Find the maximum of an array of numbers.
   b. Remove duplicates from an array of numbers.
   c. Print the numbers in an array after removing even numbers.
3. Write C/C++ programs using strings:
   a. Checking for palindrome.
   b. Count the occurrences of each character in a given word.

UNIT II	POINTERS AND FUNCTIONS	15

Pointers -Variables – Operators – Expressions – Pointers and Arrays – Functions - Scope Rules – Function Arguments – return Statement – Recursion – Structures – Unions – Enumerations.

List of Exercises:

1. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members:
   EID, Ename, Designation, DOB, DOJ, Basicpay
   Note that DOB and DOJ should be implemented using structure within structure.
2. Compute internal marks of students for five different subjects using structures and functions.

UNIT III	CLASSES AND OBJECTS	15

Concepts of Object Oriented Programming – Benefits of OOP – Simple C++ program - Classes and Objects - Member functions - Nesting of member functions - Private member functions - Memory Allocation for Objects - Static Data Members - Static Member functions - Array of Objects - Objects as function arguments - Returning objects - friend functions – Const Member functions - Constructors – Destructors.

List of Exercises:

1. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.
2. Program to illustrate default constructor, parameterized constructor and copy constructors.

UNIT IV	OPERATOR OVERLOADING, INHERITANCE AND POLYMORPHISM	15

Operator Overloading - Overloading Using Friend functions – Inheritance – Types of inheritance

– Virtual Base Class - Abstract Class – Constructors in Derived Classes - member class: nesting of classes.
Pointer to objects – this pointer- Pointer to derived Class - Virtual functions – Pure Virtual Functions – Polymorphism.

List of Exercises:

1. Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.
2. Write a Program to Demonstrate Friend Function and Friend Class.
3. Program to demonstrate inline functions.
4. Program for Overriding of member functions.
5. Write C++ programs that illustrate how the following forms of inheritance are supported:
   a) Single inheritance b)Multiple inheritance c)Multi level inheritance d)Hierarchical inheritance.

UNIT V	**I/O, FILES AND EXCEPTIONS**	**15**

C++ Streams – Unformatted I/O - Formatted Console I/O – Opening and Closing File – File modes - File pointers and their manipulations – Templates – Class Templates – Function Templates - Exception handling.

List of Exercises:

1. Program to demonstrate pure virtual function implementation.
2. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
3. Write a Program to Demonstrate the Catching of all Exceptions.
4. Mini project.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Solve problems using basic constructs in C.
CO2: Implement C programs using pointers and functions.
CO3: Apply object-oriented concepts and solve real world problems.
CO4: Develop C++ programs using operator overloading and polymorphism.
CO5: Implement C++ programs using Files and exceptions.

TEXT BOOKS:

1. Herbert Schildt, “The Complete Reference C++”, 4th edition, MH, 2015. (Unit 1 & 2)
2. E Balagurusamy,”Object Oriented Programming with C++”, 4th Edition, Tata McGraw-Hill Education, 2008. (Unit 3, 4 & 5)

REFERENCES:

1. Karl Beecher,”Computational Thinking: A beginner's guide to problem-solving and programming”, BCS Learning & Development Ltd, 2017. (Unit 1)
2. Nell Dale, Chip Weems, “Programming and Problem Solving with C++”, 5th Edition, Jones and Barklett Publishers, 2010.
3. John Hubbard, “Schaum's Outline of Programming with C++”, MH, 2016.
4. Yashavant P. Kanetkar, “Let us C++”, BPB Publications, 2020
5. ISRD Group, “Introduction to Object-oriented Programming and C++”, Tata McGraw-Hill Publishing Company Ltd., 2007.
6. D. S. Malik, “C++ Programming: From Problem Analysis to Program Design”, Third Edition, Thomson Course Technology, 2007.
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01297200240671948837_shared/overview

LIST OF EQUIPMENTS:

1. Standalone desktops with C/C++ compiler (or) Server with C/C++ compiler.

22CS102	SOFTWARE DEVELOPMENT PRACTICES (Common to All Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To discuss the essence of agile development methods.
- To set up and create a GitHub repository.
- To create interactive websites using HTML
- To design interactive websites using CSS.
- To develop dynamic web page using Java script.

UNIT I	AGILE SOFTWARE DEVELOPMENT AND Git and GitHub	15

Software Engineering Practices – Waterfall Model - Agility – Agile Process – Extreme Programming - Agile Process Models – Adaptive Software Development – Scrum – Dynamic Systems Development Method – Crystal – Feature Driven Development – Lean Software Development – Agile Modeling – Agile Unified Process – Tool set for Agile Process.

Introduction to Git –Setting up a Git Repository - Recording Changes to the Repository - Viewing the Commit History - Undoing Things - Working with Remotes -Tagging - Git Aliases - Git Branching - Branches in a Nutshell - Basic Branching and Merging - Branch Management - Branching Workflows - Remote Branches - Rebasing.

Introduction to GitHub – Set up and Configuration - Contribution to Projects, Maintaining a Project – Scripting GitHub.

List of Exercises:

1. Form a Team, Decide on a project:
    a) Create a repository in GitHub for the team.
    b) Choose and follow a Git workflow
        - Each team member can create a StudentName.txt file with contents about themselves and the team project
        - Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository.
        - Team members can now create a Pull request to merge the branch to master branch or main development branch.
        - The Pull request can have two reviewers, one peer team member and one faculty. Reviewers can give at least one comment for Pull Request updating.
        - Once pull request is reviewed and merged, the master or main development branch will have files created by all team members.
2. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews.
3. Form a Team, Decide on a project:
    c) Create a repository in GitHub for the team.
    d) Choose and follow a Git workflow
        - Each team member can create a StudentName.txt file with contents about themselves and the team project
        - Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository.
        - Team members can now create a Pull request to merge the branch to master branch or main development branch.
        - The Pull request can have two reviewers, one peer team member and one faculty. Reviewers can give at least one comment for Pull Request updation.
        - Once pull request is reviewed and merged, the master or main development branch will have files created by all team members.

4. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews.

UNIT II	HTML	15

Introduction – Web Basics – Multitier Application Architecture – Cline-Side Scripting versus Server-side Scripting – HTML5 – Headings – Linking – Images – Special Characters and Horizontal Rules – Lists – Tables – Forms – Internal Linking – meta Elements – Form input Types – input and datalist Elements – Page-Structure Elements.

List of Exercises:

1. Create web pages using the following:
    - Tables and Lists
    - Image map
    - Forms and Form elements
    - Frames

UNIT III	CSS	15

Inline Styles – Embedded Style Sheets – Conflicting Styles – Linking External Style Sheets – Positioning Elements – Backgrounds – Element Dimensions – Box Model and Text Flow – Media Types and Media Queries – Drop-Down Menus – Text Shadows – Rounded Corners – Colour – Box Shadows – Linear Gradients – Radial Gradients – Multiple Background Images – Image Borders – Animations – Transitions and Transformations – Flexible Box Layout Module – Multicolumn Layout.

List of Exercises:

1. Apply Cascading style sheets for the web pages created.

UNIT IV	JAVASCRIPT BASICS	15

Introduction to Scripting – Obtaining user input – Memory Concepts – Arithmetic – Decision Making: Equality and Relational Operators – JavaScript Control Statements – Functions – Program Modules – Programmer-defined functions – Scope rules – functions – Recursion – Arrays – Declaring and Allocating Arrays – References and Reference Parameters – Passing Arrays to Functions – Multidimensional arrays.

List of Exercises:

1. Form Validation (Date, Email, User name, Password and Number validation) using JavaScript.

UNIT V	JAVASCRIPT OBJECTS	15

Objects – Math, String, and Date, Boolean and Number, document Object – Using JSON to Represent objects – DOM: Objects and Collections – Event Handling.

List of Exercises:

1. Implement Event Handling in the web pages.

Mini Projects-Develop any one of the following web applications (not limited to one) using above technologies.

a. Online assessment system
b. Ticket reservation system
c. Online shopping
d. Student management system
e. Student result management system
f. Library management
g. Hospital management
h. Attendance management system

i. Examination automation system
j. Web based chat application

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Apply agile development methods in software development practices.
CO2: Set up and create a GitHub repository.
CO3: Develop static and dynamic webpages using HTML.
CO4: Design interactive personal or professional webpages using CSS.
CO5: Develop web pages using Java script with event-handling mechanism.

TEXT BOOKS:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill International Edition, Nineth Edition, 2020.
2. Scott Chacon, Ben Straub, "Pro GIT", Apress Publisher, 3rd Edition, 2014.
3. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", Pearson, 5th Edition, 2018.

REFERENCES:

1. Roman Pichler, "Agile Product Management with Scrum Creating Products that Customers Love", Pearson Education, 1 st Edition, 2010.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2011.
3. Stephen Wynkoop and John Burke, "Running a Perfect Website", QUE, 2nd Edition, 1999.
4. Chris Bates, "Web Programming – Building Intranet Applications", 3rd Edition, Wiley Publications, 2009.
5. Gopalan N.P. and Akilandeswari J., "Web Technology", Second Edition, Prentice Hall of India, 2014.
6. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094421427470336209 9_shared/overview

LIST OF EQUIPMENTS:

Systems with either Netbeans or Eclipse

Java/JSP/ISP Webserver/Apache

Tomcat / MySQL / Dreamweaver or

Equivalent/ Eclipse, WAMP/XAMP

22EC101	DIGITAL PRINCIPLESAND SYSTEMS DESIGN (Common to All Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To acquire the knowledge in Digital fundamentals and its simplification methods.
- To familiarize the design of various combinational digital circuits using logic gates.
- To realize various sequential circuits using flip flops.
- To interpret various clocked sequential circuits.
- To elucidate various semiconductor memories and related technology.
- To build various logic functions using Programmable Logic Devices.

UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES	9

Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms, min term and max term, Simplification of Boolean expressions-Karnaugh map,Implementation of Boolean expressions using logic gates and universal gates.

List of Experiments:

1. Implementation of Boolean expression using logic gates.

UNIT II	COMBINATIONAL LOGIC CIRCUITS	9

Design of combinational circuits - Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/De-mux, Parity Generator/Checker

List of Experiments:

1. Design of adders
2. Design ofsubtractors.
3. Design of binary adder using IC7483
4. Design of Multiplexers &Demultiplexers.
5. Design of Encoders and Decoders.
6. Implementation of a boolean function using a multiplexer.

UNIT III	SEQUENTIAL CIRCUITS	9

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Asynchronous and Synchronous Counters Design - Shift registers, Universal Shift Register

List of Experiments:

1. Design and implementation of 3 bit ripple counters.
2. Design and implementation of 3 bit synchronous counter
3. Design and implementation of shift registers

UNIT IV	SYNCHRONOUSSEQUENTIAL CIRCUITS DESIGN	9

Design of clocked sequential circuits - Moore/Mealy models, state minimization, state assignment, circuit implementation

UNIT V	MEMORY AND PROGRAMMABLE LOGIC DEVICES	9

Basic memory structure ROM: PROM – EPROM – EEPROM –RAM – Static and dynamic RAM – Programmable Logic Devices: Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Implementation of combinational logic circuits using PLA, PAL.

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Implement digital circuits using simplified Boolean functions.
CO2: Realize Combinational circuits for a given function using logic gates.
CO3: Demonstrate the operation of various counters and shift registers using Flip Flops.
CO4: Analyze Synchronous Sequential circuits.
CO5: Summarize the various types of memory devices.
CO6: Design the Combinational circuits using Programmable Logic Devices.
CO7: Perform practical exercises as an individual and / or team member to manage the task in time.
CO8: Express the experimental results with effective presentation and report.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, Digital Design, With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6th Edition, Pearson, 2018.
2. S.Salivahanan and S.Arivazhagan,Digital Circuits and Design, 5th Edition, Oxford University Press, 2018.

REFERENCES:

1. A.Anandkumar, Fundamental of digital circuits, 4th Edition, PHI Publication,2016.
2.WilliamKleitz, Digital Electronics-A Practical approach to VHDL, Prentice Hall International Inc, 2012.
3.CharlesH.Roth, Jr. andLarry L. Kinney, Fundamentals of Logic Design, 7th Edition, Thomson Learning, 2014.
4.Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson Education Inc, 2017.
5.John.M Yarbrough, Digital Logic: Applications and Design, 1st Edition, Cengage India, 2006.

NPTEL LINK: https://nptel.ac.in/courses/108/105/108105132/

LIST OF EQUIPMENTS:

22GE101	COMPUTER AIDED ENGINEERING GRAPHICS (Common to All Branches)	L	T	P	C
		1	0	2	2

OBJECTIVES:

The Course will enable learners to:

- To help students understand universal technical drawing standards.
- To provide training on drafting software to draw part models.
- To demonstrate the concepts of orthographic and isometric projections.
- To use drawing skills for communicating concepts, ideas for engineeringproduct design.
- Use pictorial views to visualize and draw the isometric view of the objects.

UNIT I	INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CONIC SECTIONS	9

Introduction to Engineering Drawing - Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Conic curves - Ellipse, Parabola and Hyperbola by Eccentricity method.

(Theory - 3)

Drawing of a title block with necessary text, projection symbol and lettering using drafting software.
Drafting of Conic curves - Ellipse, Parabola and Hyperbola

(Laboratory - 6)

UNIT II	ORTHOGRAPHIC PROJECTION	9

Visualization concepts and Orthographic Projection - Layout of views – Orthographic Projection- Conversion of pictorial diagram into orthographic views.

(Theory - 3)

Drawing orthographic view of simple solids like Prism, Pyramids, Cylinder, Cone, etc, and dimensioning.
Drawing of orthographic views from the given pictorial diagram.

(Laboratory -6)

UNIT III	PROJECTION OF PLANES	9

Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method.

(Theory - 3)

Drawing of plane Surface inclined to HP.
Drawing of plane Surface inclined to VP.

(Laboratory -6)

UNIT IV	PROJECTION OF SOLIDS	9

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to HP by rotating object method.

(Theory - 3)

Drawing of simple solids like prism and pyramids when the axis is inclined to HP.
Drawing of simple solids like cylinder and cone when the axis is inclined to HP.

(Laboratory -6)

UNIT V	ISOMETRIC DRAWING	9

Principles of isometric view – Isometric view of simple solids – Prism, Pyramid, Cylinder and Cone.

(Theory - 3)

Drawing isometric projection of simple solids.
Modeling of 2D to 3D objects using drafting software.

(Laboratory -6)

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the various engineering standards required for drafting and explore knowledge in conic sections.

CO2: Draw the orthographic views of 3Dprimitive objects.

CO3: Describe the projection of plane surfaces by the rotating plane method.

CO4: Apply the projection concepts and drafting tools to draw projections of solids. **CO5:** Sketch the pictorial views of the objects using CAD tools.

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 15th Edition, 2019.

REFERENCES:

1. Bhatt N.D. "Engineering Drawing", Charotar Publishing House, 53rd edition ,2019.
2. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2019.
3. Engineering Drawing Practice for Schools and Colleges BIS SP46:2003 (R2008), Published by Bureau of Indian Standards (BIS), 2008.
4. Parthasarathy. N.S and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2019.
5. Gopalakrishna. K.R., Engineering Drawing Vol. 1 & 2, Subhas Publications, 27th Edition, 2017.

22GE111	PRODUCT DEVELOPMENT LAB - 1 (Common to All Branches)	L	T	P	C
		0	0	2	1

The students may be grouped into 3 to 4 and work under a project supervisor. The device/system/component/prototype Idea to be developed by the students and a final presentation to be done by the students about the idea generated at the end of the semester.

OBJECTIVES:

The Course will enable learners to:

- Understand the functionalities and limitation of various machine/equipment
- Demonstrate various operations that can be performed to machines
- Summarize the basic principles of machines to convert their ideas into products

I 1. Study of Manufacturing Processes (Carpentry, Plumbing, Machines and Welding).
2. Study of fundamental operations of 3D Printer and Scanner with Software.
3. Study of Smart Machining (CNC and Laser cutting) and Engraving Techniques.

II 1. Study of Fundamental of Circuit Design.
2. Study of PCB Milling Machine.
3. Study of Soldering and Desoldering.

III 1. Study of Computer Peripheral Devices (Processing Information Devices)

IV 1. Present the Product Idea Presentation - Phase – I.

TOTAL: 30 PERIODS

Note:
The students can select the prototype to be made of their choice after learning the above exercises.

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the concept of manufacturing processes.
CO2: Describe the working of the machine element.
CO3: Discuss the various applications of engineering materials
CO4: Summarize the basics of core engineering concepts.
CO5: Describe the process for converting ideas into products

LIST OF EQUIPMENTS:

1. CNC Router – 1 No.
2. 3D Printer – 1 No.
3. 3D Scanner – 1 No.
4. Laser cutting Machine – 1 No.
5. Centre lathe – 2 Nos.
6. Arc welding transformer with cables and holders – 2 Nos.
7. Plumbing tools – 2 Nos.
8. Carpentry tools – 2 Nos.
9. Multimeter – 10 Nos.
10. Drilling Machine – 1 No.
11. Solder Stations 5 Sets
12. Desoldering Machine – 1 No.
13. PCB Milling Machine – 1 No.
14. Variable Power Supply – 1 No.
15. Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc. – 10 Sets
16. Personal Desktop Computers – 30 Nos.

SEMESTER – II

22MA201	TRANSFORMS AND NUMERICAL METHODS (Common to CSE / ADS)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Introduce the concepts of Laplace transforms and Z-transforms.
- Illustrate the application of transforms in solving differential and difference equations.
- Explain the Numerical methods for handling algebraic and transcendental equations.
- Introduce the numerical techniques for interpolation, differentiation and integration.

UNIT I	LAPLACE TRANSFORMS	15

Laplace transforms – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms –Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform – Convolution theorem (Statement only).

Theory: 9

Experiments using SCILAB:

1. Finding Laplace transform of a function.
2. Finding inverse Laplace Transforms.
3. Determine the input for given output function of Laplace Transform.

Laboratory: 6

UNIT II	Z – TRANSFORMS	15

Z-transforms – Elementary properties – Inverse Z-transforms – partial fractions method – residues method – Convolution theorem.

Theory: 9

Experiments using SCILAB:

1. Finding Z –transform of a sequence.
2. Finding convolution of two sequences.
3. Plotting the input and output function of Z transform.

Laboratory: 6

UNIT III	SOLUTION OF DIFFERENTIAL AND DIFFERENCE EQUATIONS	15

Solution of linear ordinary differential equation of second order with constant coefficients and first order simultaneous equations with constant coefficients using Laplace transform. Formation of difference equations – Solution of first and second order difference equations with constant coefficients using Z-transform.

Theory: 9

Experiments using SCILAB:

1. Solving second order Ordinary Differential Equation.
2. Finding the Laplace transform and its inverse of a function numerically.
3. Finding the Z-transform numerically

Laboratory: 6

UNIT IV	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	15

Solution of algebraic and transcendental equations by Newton Raphson method - Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Gauss Seidel Iterative method– Eigenvalues of a matrix by Power method.

Theory: 9

Experiments using SCILAB:

1. Finding the real roots of algebraic and transcendental equations using Newton Raphson method.
2. Finding the largest Eigenvalue by power method.
3. Solving system of linear equations using Gauss Seidel Method.

Laboratory: 6

UNIT V	NUMERICAL DIFFERENTIATION AND INTEGRATION	15

Finite differences – Forward and Backward differences – Interpolation – Newton's forward and backward interpolation formulae - Lagrange's interpolation for unequal intervals - Numerical Differentiation - Newton's and Lagrange's formulae - Numerical integration using Trapezoidal and Simpson's 1/3 rules – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

Theory: 9

Experiments using SCILAB:

1. Finding approximately the missing value using Lagrange interpolation.
2. Evaluating line integrals by trapezoidal rule.
3. Evaluating line integrals by Simpson's rule.

Laboratory: 6

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Determine Laplace transform and inverse transform of simple functions.

CO2: Determine Z- transform and inverse transform of simple functions.

CO3: Solve ordinary differential equations using Laplace transform and difference equations using Z-Transform.

CO4: Compute the solutions of algebraic, transcendental and the system of equations.

CO5: Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

TEXT BOOKS:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES:

1. Erwin. Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Jain R.K. and Iyengar S. R. K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
4. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
5. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

LIST OF EQUIPMENTS:

1. SCILAB - Open source

22CS201	DATA STRUCTURES (Common to CSE / IT / ADS)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To understand the concepts of List ADT.
- To learn linear data structures – stacks and queues ADTs.
- To understand and apply Tree data structures.
- To understand and apply Graph structures.
- To analyze sorting, searching and hashing algorithms.

UNIT I	LINEAR DATA STRUCTURES – LIST	15

Algorithm analysis - running time calculations - Abstract Data Types (ADTs) – List ADT – array- based implementation – linked list implementation – singly linked lists - circularly linked lists - doubly-linked lists – applications of lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

List of Exercises:

- Array implementation of List ADTs.
- Linked list implementation of List ADTs.

UNIT II	LINEAR DATA STRUCTURES – STACKS, QUEUES	15

Stack ADT – Stack Model - Implementations: Array and Linked list - Applications - Balancing symbols - Evaluating arithmetic expressions - Conversion of Infix to postfix expression - Queue ADT – Queue Model - Implementations: Array and Linked list - applications of queues - Priority Queues – Binary Heap – Applications of Priority Queues.

List of Exercises:

- Array implementation of Stack and Queue ADTs.
- Linked list implementation of Stack and Queue ADTs.
- Applications of List – Polynomial manipulations
- Applications of Stack – Infix to postfix conversion and expression evaluation.

UNIT III	NON LINEAR DATA STRUCTURES – TREES	15

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT– AVL Tree.

List of Exercises:

- Implementation of Binary Trees and operations of Binary Trees.
- Implementation of Binary Search Trees.
- Implementation of Heaps using Priority Queues.

UNIT IV	NON LINEAR DATA STRUCTURES - GRAPHS	15

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Applications of graphs – BiConnectivity – Euler circuits.

List of Exercises:

- Graph representation and Traversal algorithms.

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	15

Searching- Linear Search - Binary Search - Sorting - Bubble sort - Selection sort - Insertion sort – Hashing - Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

List of Exercises:

- Implement searching and sorting algorithms.

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Implement abstract data types for list.

CO2: Solve real world problems using appropriate linear data structures.

CO3: Apply appropriate tree data structures in problem solving.
CO4: Implement appropriate Graph representations and solve real-world applications.
CO5: Implement various searching and sorting algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson Education, 2014.
2. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", Silicon paper publications, 2004.

REFERENCES:

1. Rajesh K. Shukla, "Data Structures using C and C++", Wiley India Publications, 2009.
2. Narasimha Karumanchi, "Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles", CareerMonk Publications, 2020.
3. Jean-Paul Tremblay and Paul Sorenson, "An Introduction to Data Structures with Application", McGraw-Hill, 2017.
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in Java", Third Edition, Pearson Education, 2012.
5. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
6. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, "Fundamentals of Data Structures in C++", Second Edition, Silicon Press, 2007.
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501578165051392105 84/overview

LIST OF EQUIPMENTS:

Systems with Linux/Ubuntu Operating System with gnu C++ compiler

22PH201	PHYSICS FOR COMPUTER SCIENCE AND INFORMATION TECHNOLOGY (Common to All Branches)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Learn the fundamental concepts of Physics and apply this knowledge to scientific, engineering and technological problems.
- Make the students enrich basic knowledge in electronics and quantum concepts and apply the same in computing fields.

UNIT I	LASER AND FIBRE OPTICS	15

Population of energy levels – Einstein's A and B coefficients derivation - Resonant cavity - Optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction- Engineering applications of lasers in data storage (qualitative).

Fibre optics: Principle and propagation of light through optical fibre - V-number - Types of optical fibres (Material, refractive index and mode) - Losses in optical fibre - Fibre optic communication - Fibre optic sensors (pressure and displacement).

(Theory -9)

List of Experiments:

1. Determination of divergence of laser beam
2. Determination of acceptance angle and numerical aperture of an optical fibre

(Laboratory -6)

UNIT II	ELECTRON THEORIES OF MATERIALS	15

Classical free electron theory - Expressions for electrical conductivity and thermal conductivity - Wiedemann-Franz law - Success and failures of CFT- Effect of temperature on Fermi function- Density of energy states and average energy of electron at 0 K - Energy bands in solids.

(Theory -9)

List of Experiments

1. Determination of thermal conductivity of a bad conductor by Lee's disc method
2. Measurement of the internal resistance using potentiometer

(Laboratory -6)

UNIT III	SEMICONDUCTOR PHYSICS	15

Intrinsic Semiconductors – E-kdiagram-Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors- Band gap determination-Extrinsic semiconductors - Carrier concentration in n-type and p-type semiconductors -Electrical conductivity of intrinsic and extrinsic semiconductors -Variation of Fermi level with temperature and impurity concentration - Hall effect and its applications.

(Theory -9)

List of Experiments

1. Bandgap determination of intrinsic semiconductor.
2. Determination of wavelength of semiconductor laser

(Laboratory -6)

UNIT IV	INTRODUCTION TO NANO DEVICES AND QUANTUM COMPUTING	15

Introduction to nanomaterial -Electron density in a bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structures - Band gap of nanomaterial.

Quantum computing: Quantum states - classical bits - quantum bits or qubits - CNOT gate - multiple qubits - Bloch sphere - quantum gates - advantages of quantum computing over classical computing.

(Theory - 9)

List of Experiments

1. Synthesis of nanoparticles by sol-gel method

2. Determination of particle size using laser source

(Laboratory - 6)

UNIT V	MAGNETIC AND SUPERCONDUCTING MATERIALS	15

Introduction- Bohr magneton -magnetic dipole moment - origin of magnetic moments - types of magnetic materials-Ferromagnetism: Domain Theory - antiferromagnetism - ferrimagnetism - magnetic principle in computer data storage - Magnetic hard disc (GMR sensor) - Introduction to spintronics.

Superconducting materials – properties, types of superconductors, applications – SQUID and MAGLEV trains - *superconducting qubits in quantum computing.*

(Theory -9)

List of Experiments

1. Determination of hysteresis loss using B-H loop
2. Determination of magnetic susceptibility of a paramagnetic liquid using Quincke's apparatus

(Laboratory -6)

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Discuss the basic principles of working of laser and their applications in fibre optic communication

CO2: Summarize the classical and quantum electron theories and energy band structures

CO3: Describe the conductivity in intrinsic and extrinsic semiconductors and importance of Hall effect measurements

CO4: Associate the properties of nanoscale materials and their applications in quantum computing

CO5: Interpret the properties of magnetic and superconducting materials and their applications in computer data storage

TEXT BOOKS:

1. **S.O. Kasap**,Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition) 2020.
2. **Jasprit Singh**, Semiconductor Devices: Basic Principles, Wiley (Indian Edition) 2007.
3. **Parag K Lala**, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition) 2020.

REFERENCES:

1. **R.P. Feynman**, The Feynman Lectures on Physics - Vol. II, The New Millennium Edition, 2012.
2. **M.A.Wahab**, Solid State Physics, 3rd Edition, Narosa Publishing House Pvt. Ltd., 2015.
3. **B.Rogers, J. Adams and S.Pennathur**,Nanotechnology: Understanding Small System, CRC Press, 2014.
4. **C.P. Williams,** Explorations in Quantum Computing, Springer-Verlag London, 2011.
5. **Wilson J.D. and Hernandez C.A.,** Physics Laboratory Experiments, Houghton Mifflin Company, New York 2005.
6. **Department of Physics,** Physics laboratory manual, R.M.K. Group of Institutions, 2021.

LIST OF EQUIPMENTS:

1.	Semiconductor Laser	6Nos.
2.	Determination of optical fibre parameters	6Nos.
3.	Lee's disc apparatus	6Nos.
4.	Potentiometer	6 Nos.

5.	Bandgap determination set up	6Nos.
6.	Sol-gel synthesis	2Nos.
7.	B-H loop set-up	5Nos.
8.	Quincke’s apparatus	2Nos.

2HS101	PROFESSIONAL COMMUNICATION (Common to All Branches)	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- Strengthen basic reading and writing skills.
- Comprehend listening contexts competently.
- Inculcate reading habit and develop effective reading skills.
- Improve active and passive vocabulary.
- Acquire speech clarity with right pronunciation.
- Develop vocabulary of a general kind and enhance grammatical accuracy.
- Imbibe Content and Language Integrated Learning (CLIL).

UNIT I FORMAL AND INFORMAL COMMUNICATION **12**

Listening: Short Texts, Short Formal and Informal Conversations
Speaking: Self Introduction, Exchanging Personal Information
Reading: Practice in Skimming, Scanning and Predicting, Reading Comprehension
Writing: Free Writing, Hints Development
Grammar: Parts of Speech, Prepositions.
Vocabulary: Compound Nouns, Technical Words.

(Theory 6)

1. Familiarization of Vowel Sounds-Monophthongs, Diphthongs and Consonant Sounds
2. Listening to Formal Conversations in British and American Accents
3. Guided Writing

(Laboratory 6)

UNIT II GRAMMAR AND LANGUAGE DEVELOPMENT **12**

Listening: Telephonic Conversations.
Speaking: Sharing information of a personal kind - Greetings – Taking leave.
Reading: Short comprehension passages - Pre-reading and Post-reading (multiple choice questions short questions / open and close ended questions)
Writing: Instructions, Recommendations, Checklists
Grammar: Tenses, Framing 'Wh' & 'Yes' or 'No' questions
Vocabulary: Numerical Adjectives, Collocations

. (Theory 6)

1. Communication Etiquettes
2. Self -Introduction using SWOT Analysis

(Laboratory 6)

UNIT III BASIC TECHNICAL WRITING AND STUDY SKILLS **12**

Listening: Listening to longer texts and filling up the tables
Speaking: Asking about routine actions and expressing opinions
Reading: Short texts (Cloze Test)
Writing: Formal letters, E-mail writing, Interpretation of Charts and Graphs
Grammar: Cause and Effect expressions**,** Conditional Clauses
Vocabulary: Often misspelled and confusing words

(Theory 6)

Mechanics of Reading Skills
News Reading–Cloze Tests

(Laboratory 6)

UNIT IV GROUP DISCUSSION AND JOB APPLICATIONS **12**

Listening: Listening to recorded dialogues of conversations and completing exercises based on them
Speaking: Discussion on Social issues.
Reading: Reading text from magazines
Writing: Purpose Expressions, Letter of Application, Minutes of Meeting.
Grammar: Modal Verbs, Subject-Verb agreement
Vocabulary : Sequence Words

(Theory 6)

1. Group Presentation, Group Discussion: Do's and Don'ts of GroupDiscussion
2. Discussions on failure and success in interviews of famous personalities Spotting Errors

(Laboratory 6)

UNIT V	ART OF REPORTING	12

Listening: Listening to TED talks
Speaking: Debate & Presentations
Reading: Biographies
Writing: Definitions (Single line & Extended), Report Writing (Industrial visit, Accident and Feasibility reports)
Grammar: Reported speech
Vocabulary : Verbal Analogies (Theory 6)

1. Writing based on listening to academic lectures and discussions
2. Leadership skills, Negotiation skills
3. Mechanics of Report Writing

(Laboratory 6)

LIST OF PROJECTS

1. Create a podcast on a topic that will be interesting to college students
2. Read and Review (Movie/Book/Technical Article)
3. Presentation on Social Issues
4. Submit a report on "Global English: A study"

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Comprehend conversations and short talks delivered in English
CO2: Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques
CO3: Read articles of a general kind in magazines and newspapers efficiently
CO4: Write short general essays, personal letters and E-mails in English CO5: Develop vocabulary of a general kind by enriching reading skills

TEXT BOOKS:

1. **Kumar, Suresh E, & Sreehari, P.** *Communicative English*. Orient Black Swan, 2007.
2. **Richards, Jack C.** Interchange Students' Book-2 New Delhi: CUP,2015.

REFERENCES:

1. **Bailey, Stephen.** Academic Writing: *A practical guide for students*. New York:Rutledge,2011.
2. **Dhanavel, S P.** English and Soft Skills, Volume Two, Orient Black Swan.
3. **Elbow, Peter.** *Writing Without Teachers*. London: Oxford University Press, 1973.
4. **Larsen, Kristine.** *Stephen Hawking*: *A Biography*, Greenwood: Publishing Group, 2005.
5. **Redston, Chris & Gillies Cunningham.** Face2Face (Pre- intermediate Students'Book &Workbook) Cambridge University Press, New Delhi: 2005.
6. Lewis, Norman. Word Power Made Easy, Latest Edition: Penguin Random House India: 2015

WEB REFERENCES:

1. Basics of Business Communication
   https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012688768083632128308_shared/overview
2. communicating to Succeed
   https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012686653619175424640_shared/overview
3. Business English

https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683227498151936279_shared/overview
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013267708367904768573/overview (lab support)

4. Business Writing
   https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012689477601009664 33_shared/overview
5. Email Etiquettes

https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013294623865561088176 82_shared/overview

6. Email Writing Skills
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268954363013529666_shared/overview

7. Time Management
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012985921210736640721_shared/overview

8. Understanding Body Language
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012979737651445760246 89_shared/overview

9. ONLINE RESOURCES:
https://infyspringboard.onwingspan.com/web/en/page/home

22CS202	JAVA PROGRAMMING (Common to CSE / ADS)	L 3	T 0	P 2	C 4

OBJECTIVES:

The Course will enable learners to:

- To explain object oriented programming concepts and fundamentals of Java
- To apply the principles of packages, interfaces and exceptions
- To develop a Java application with I/O streams, threads and generic programming
- To build applications using strings and collections.
- To apply the JDBC concepts

UNIT I	JAVA FUNDAMENTALS	15

An Overview of Java - Data Types, Variables, and Arrays – Operators - Control Statements – Class Fundamentals – Declaring objects – Methods – Constructors – this keyword – Overloading methods - Overloading constructors - Access Control – Static – Final

List of Exercises:

1. Develop a Java application to generate Electricity bill. You must use one super class called EB Bill and must have two sub classes namely Domestic Bill and Commercial Bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff

If the type of the EB connection is domestic, calculate the amount to be paid as follows: First 100 units - Rs. 1 per unit

101-200 units - Rs. 2.50 per unit 201 -500 units - Rs. 4 per unit

> 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows: First 100 units - Rs. 2 per unit

101-200 units - Rs. 4.50 per unit 201 -500 units - Rs. 6 per unit

> 501 units - Rs. 7 per unit

2. Arrays Manipulations: (Use Methods for implementing these in a Class)

a. Find kth smallest element in an unsorted array

b. Find the sub array with given sum

c. Matrix manipulations – Addition, Subtraction, Multiplication

d. Remove duplicate elements in an Array

e. Accept an integer value N and print the Nth digit in the integer sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and so on till infinity.

Example: The 11th digit in the sequence 12345678910111213…. is 0.

UNIT II	INHERITANCE, INTERFACES AND EXCEPTION HANDLING	15

Inheritance: Inheritance basics, Using super, Method Overriding, Using Abstract Classes, Using final with Inheritance - Package and Interfaces: Packages, Packages and member access, Importing Packages, Interfaces, Static Methods in an Interface – Exception Handling: Exception- Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions.

List of Exercises:

1. Develop a Java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
2. Develop a Java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
3. Design a Java interface for ADT Stack. Implement this interface using array and built-in classes. Provide necessary exception handling in both the implementations.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of

the classes extends the class Shape. Each one of the classes contains the methods print Area () that prints the area of the given shape and Numberofsides() that prints the number of sides of the given shape.

5. Write a Java program to apply built-in and user defined exceptions.

UNIT III	MULTITHREADING, I/O AND GENERIC PROGRAMMING	15

Multithreaded Programming: Creating a Thread, Thread Priorities, Synchronization, Interthread Communication – I/O: I/O Basics, Reading Console Input, Writing Console Output, Reading and Writing Files – Generics: Introduction, Generic class, Bounded Types, Generic Methods, Generic Interfaces, Generic Restrictions.

List of Exercises:

1.Write a Java program to read and copy the content of one file to other by handling all file related exceptions.

UNIT IV	STRING HANDLING AND COLLECTIONS	15

Lambda Expressions - String Handling – Collections: The Collection Interfaces, The Collection Classes – Iterator – Map - Regular Expression Processing.

List of Exercises:

1.String Manipulation:

a. Reversing a set of words and count the frequency of each letter in the string.
b. Pattern Recognition - Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
c. Remove all the occurrences of string S2 in string S1 and print the remaining.
d. Find the longest repeating sequence in a string
e. Print the number of unique string values that can be formed by rearranging the letters in the string S.

2. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
3. Collections:

a. Write a program to perform string operations using ArrayList. Write functions for the following

i. Append - add at end
ii. Insert – add at particular index
iii. Search
iv. List all string starts with given letter

b. Find the frequency of words in a given text.

UNIT V	JDBC CONNECTIVITY	15

JDBC – DataSource, Configurations, Connection, Connection Pools, Driver Types, ResultSet, Prepared Statement, Named Parameter, Embedded SQL (Insert, Update, Delete, Join, union etc), ResultSet Navigation, Connection Close and Clean up.

List of Exercises:

- Mini Project (using JDBC)

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the object oriented programming concepts and fundamentals of Java.
CO2: Develop Java programs with the packages, interfaces and exceptions.
CO3: Build Java applications with I/O streams, threads andgenerics programming.
CO4: Apply strings and collections in developing applications.
CO5: Implement the concepts of JDBC.

TEXT BOOKS:

1. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw Hill Education, 2019.

REFERENCES:

1. Cay S. Horstmann, Gary Cornell, “Core Java Volume – I Fundamentals”, 11th Edition, Prentice Hall, 2019.
2. Paul Deitel, Harvey Deitel, Java SE 8 for programmers, 3rd Edition, Pearson, 2015.

3. Steven Holzner, Java 2 Black book, Dream tech press, 2011.
4. Timothy Budd, Understanding Object-oriented programming with Java, Third Edition, Pearson Education, 2008.
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview

LIST OF EQUIPMENTS:

1. Java and Eclipse / NetBeans IDE or Equivalent

22CS203	DATABASE MANAGEMENT SYSTEM (Common to CSE / ADS)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To understand the basic concepts of Data modeling and Database Systems.
- To understand SQL and effective relational database design concepts.
- To learn relational algebra, calculus and normalization.
- To know the fundamental concepts of transaction processing, concurrency control techniques, recovery procedure and data storage techniques.
- To understand query processing, efficient data querying and advanced databases.

UNIT I	DATABASE CONCEPTS	15

Concept of Database and Overview of DBMS - Characteristics of databases - Data Models, Schemas and Instances - Three-Schema Architecture - Database Languages and Interfaces - Introductions to data models types - ER Model- ER Diagrams - Enhanced ER Model - reducing ER to table Applications: ER model of University Database Application – Relational Database Design by ER- and EER-to-Relational Mapping.

List of Exercises:

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements

UNIT II	STRUCTURED QUERY LANGUAGE	15

SQL Data Definition and Data Types – Constraints – Queries – INSERT, UPDATE, and DELETE in SQL - Views - Integrity Procedures, Functions, Cursor and Triggers - Embedded SQL - Dynamic SQL.

List of Exercises:

1. Database Querying – Simple queries, Nested queries, Sub queries and Joins
2. Views, Sequences, Synonyms
3. Database Programming: Implicit and Explicit Cursors

UNIT III	RELATIONAL ALGEBRA, CALCULUS AND NORMALIZATION	15

Relational Algebra – Operations - Domain Relational Calculus- Tuple Relational Calculus - Fundamental operations.

Relational Database Design - Functional Dependency – Normalization (1NF, 2NF 3NF and BCNF) – Multivalued Dependency and 4NF – Joint Dependencies and 5NF - De-normalization.

List of Exercises:

1. Procedures and Functions
2. Triggers

UNIT IV	TRANSACTIONS, CONCURRENCY CONTROL AND DATA STORAGE	15

Transaction Concepts – ACID Properties – Schedules based on Recoverability, Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Transaction Recovery – Concepts – Deferred Update – Immediate Update.

Organization of Records in Files – Unordered, Ordered – Hashing Techniques – RAID – Ordered Indexes – Multilevel Indexes - B+ tree Index Files – B tree Index Files.

List of Exercises:

1. Exception Handling
2. Database Design using ER modeling, normalization and Implementation for any application
3. Database Connectivity with Front End Tools

UNIT V	QUERY OPTIMIZATION AND ADVANCED DATABASES	15

Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics.

Distributed Database Concepts – Design – Concurrency Control and Recovery – NOSQL Systems – Document-Based NOSQL Systems and MongoDB.

List of Exercises:

1. Case Study using real life database applications anyone from the following list
a) Inventory Management for a EMart Grocery Shop
b) Society Financial Management
c) Cop Friendly App – Eseva
d) Property Management – eMall
e) Star Small and Medium Banking and Finance
● Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
● Apply Normalization rules in designing the tables in scope.
● Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.
● Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
● Ability to showcase ACID Properties with sample queries with appropriate settings

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Map ER model to Relational model to perform database design effectively.
CO2: Implement SQL and effective relational database design concepts.
CO3: Apply relational algebra, calculus and normalization techniques in database design.
CO4: Understand the concepts of transaction processing, concurrency control, recovery procedure and data storage techniques.
CO5: Apply query optimization techniques and understand advanced databases.

TEXT BOOKS:

1. Elmasri R. and S. Navathe, "Fundamentals of Database Systems", Pearson Education, 7th Edition, 2016.
2. Abraham Silberschatz, Henry F.Korth, "Database System Concepts", Tata McGraw Hill , 7th Edition, 2021.

REFERENCES:

1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.Raghu Ramakrishnan, Gehrke "Database Management Systems", MCGraw Hill, 3rd Edition 2014.
2. Plunkett T., B. Macdonald, "Oracle Big Data Hand Book" , McGraw Hill, First Edition, 2013
3. Gupta G K , "Database Management Systems" , Tata McGraw Hill Education Private Limited, New Delhi, 2011.
4. C. J. Date, A.Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2015.
5. Maqsood Alam, Aalok Muley, Chaitanya Kadaru, Ashok Joshi, Oracle NoSQL Database: Real-Time Big Data Management for the Enterprise, McGraw Hill Professional, 2013.
6. Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2015.
7. Database Management System Part – 1
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview
8. Database Management System Part – 2
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012767300562919424 1_shared/overview
9. Online Resources:
https://infyspringboard.onwingspan.com/web/en/page/home

LIST OF EQUIPMENTS:

1. MySql and Eclipse / NetBeans IDE or Equivalent

22GE211	PRODUCT DEVELOPMENT LAB - 2 (Common to All Branches)	L	T	P	C
		0	0	2	1

The students may be grouped into a batch of strength 3 or 4 to work under a project supervisor. The student batches should study the device/system/component and will do literature review to develop prototype idea. Further at the end of the semester they will make a final presentation to exhibit the conceptual design skills and the process to develop a product.

OBJECTIVES:

The Course will enable learners to:

- Use the innovative design methodology to articulate the product concepts.
- Summarize the requisite Engineering Principles for transforming concepts into products.
- Conduct basic tests to extract the qualitative and quantitative performance factors.

List of Exercise/Experiments

1. Study of Basic Engineering Design Concepts.
2. Conduct a literature survey on the implementation of the design concepts.
3. Prepare the design concepts for an identified literature gap.
4. Present the Product Idea Presentation – Phase II.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the working and capacity of various engineering systems.
CO2: Infer the outcomes in the product development process.
CO3: Perform basic engineering and material characterization tests.
CO4: Demonstrate the ability to provide conceptual design strategies for a product.
CO5: Implement the Science, Engineering, Technology and Mathematics (STEM) for product design.

LIST OF EQUIPMENTS:

22CH104	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY (Common to All Branches)	L	T	P	C
		2	0	0	MC

OBJECTIVES:

The Course will enable learners to:

- To gain knowledge of the environment and various natural resources.
- To identify the Scientific and Technological solutions to pollution issues and waste management.
- To understand the significance of the conservation of biodiversity.
- To recognize the needs and benefits of sustainability and its management.
- To comprehend the effects of human population on the environment.

UNIT I	NATURAL RESOURCES	7

Definition, scope and importance of environment – need for public awareness. Introduction to natural resources - Types - Forest resources: Use and over-exploitation, deforestation and its impacts, Food resources: effects of modern agriculture, organic farming, Renewable energy sources - Solar, Wind, Geothermal, Tidal, OTE and Biomass.

Field activity -Tree plantation

UNIT II	POLLUTION AND WASTE MANAGEMENT	7

Pollution - Definition –causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Nuclear hazards - nuclear accidents and holocaust -Role of an individual in prevention of pollution –Case studies.

Waste management- Municipal solid wastes, e- waste, plastic waste.

Field study – Solid waste management of the institution

UNIT III	BIODIVERSITY AND ITS CONSERVATION	6

Biodiversity: types – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species, extinct, rare, vulnerable species of India – conservation of biodiversity: In-situ and ex-situ method.

Field study – Biodiversity of the institution

UNIT IV	SUSTAINABILITY AND MANAGEMENT	5

Sustainability-concept, needs and challenges-Circular economy -Sustainable Development Goals-Concept ofCarbon footprint, Environmental Impact Assessment, Clean Development Mechanism, solutions.

Field study – Carbon footprint of the institution

UNIT V	HUMAN POPULATION	5

Introduction - Population growth, variation among nations,population explosion, Environment and human health – endemic/epidemic/pandemic– Role of information technology in environment and human health.

Case Study – Pandemics of 21st century

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Investigate and use conservational practices to protect natural resources.

CO2: Identify the causes of pollutants and illustrate suitable methods for pollution abatement.

CO3: Adapt the values of biodiversity and its conservation methods.

CO4: Recognize suitable sustainable development practices and apply it in day-to-day life.

CO5: Assess the impacts of human population and suggest suitable solutions.

TEXT BOOKS:

1. Anubha Kaushik and C.P. Kaushik, “Perspectives in environmental studies”,New Age International Publishers,2nd edition, 2021.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2017.

3. Gilbert M.Masters, Introduction to Environmental Engineering and Science, 3rd edition, Pearson Education, 2014.
4. Erach Bharuch, Textbook of Environmental Studies for Undergraduate Courses, Third Edition, Universities Press(I) Pvt. Ltd., Hyderabad, 2021.

REFERENCES:

1. William P.Cunningham & Mary Ann Cunningham Environmental Science: A Global Concern, McGraw Hill, 14th edition, 2017.
2. Rajagopalan, R, Environmental Studies-From Crisis to Cure, Oxford University Press, 2015.
3. G. Tyler Miller and Scott E. Spoolman, ―Environmental Science, Cengage Learning India Pvt, Ltd., Delhi, 2014.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2012.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006 and subsequent amendments, 2022

22GE201	HERITAGE OF TAMILS (Common to All Branches)	L	T	P	C
		1	0	0	1

OBJECTIVES:

The course is designed to

- Recognize Tamil literature and its significance in Tamil culture.
- Introduce the Tamils' rich artistic and cultural legacy.
- Familiarize the different types of folk and martial arts that are unique to Tamil Nadu.
- Acquaint the concept of Thinai in Tamil literature and culture.
- Comprehend the significance of Tamil in developing Indian culture.

UNIT I	LANGUAGE AND LITERATURE	3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry – Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making -- Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III	FOLK AND MARTIAL ARTS	3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV	THINAI CONCEPT OF TAMILS	3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 15 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: State the role of Tamil literature in shaping Tamil Cultural roots.
CO2: Express the cultural and religious significance of Tamil art and sculptures.
CO3: Identify and describe the techniques of folk and martial arts.
CO4: Classify the role of Thinai concept in Tamil culture and literature.
CO5: Compare the idea of cultural and intellectual contributions of Tamils.

TEXT-CUM-REFERENCE BOOKS:

3. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
4. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
5. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
6. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
7. Social Life of Tamils (Dr.K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

8. Social Life of the Tamils - The Classical Period (Dr.S .Singaravelu) (Published by: International Institute of Tamil Studies.
9. Historical Heritage of the Tamils (Dr. S. V. Subaramanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
10. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
11. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
13. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
14. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book

SEMESTER III

		L	T	P	C
22GE302	**UNIVERSAL HUMAN VALUES II: UNDERSTANDINGHARMONY (Common to III Semester CSE, , ADS and IV Semester ECE Branches)**	3	2	0	4

OBJECTIVES:

The objective of the course is fourfold:

- Development of a holistic perspective based on self-exploration about Themselves(humanbeing), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family,society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

.

UNIT I	**Course Introduction - Need, Basic guidelines, Content and Process for Value Education**	**6+6**

. Purpose and motivation for the course, recapitulation from Universal Human Values-I-Self-Exploration–Its content and process-Natural Acceptance and Experiential Validation-as the process for self-exploration - Continuous Happiness and Prosperity-A look at basic Human Aspirations.

Right understanding, Relationship and Physical Facility-The basic requirements for fulfillment ofaspirations of every human being with correct priority-Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario.

Methods to fulfill the human aspirations: Understanding and living in harmony at various levels.

Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT II	**Understanding Harmony in the Human Being– Harmony in Myself!**	**6+6**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -the needs of Self and Body: happiness and physical facility.

Recognizing the body as an instrument of 'I'- its characteristics and activities -Appreciating the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning ofProsperity in detail-Programs to ensure Sanyam and Health.

Practice sessions to discuss the role others have played in making material goods available to everyone – Identifying those from one's own life. Practice sessions to differentiate between prosperity and accumulation. Discussions on health and dealing with diseases

UNIT III	**Understanding harmony in the family and society- Harmony in human-human relationship**	**6+6**

Understanding values in human beings and human relationships; meaning of Justice -nine

universal values in relationships- program for their fulfillment to ensure mutual happiness-Trust and Respect as the foundational values of relationships.

Comprehending the meaning of Trust and Respect - difference between intention and competence - difference between respect and differentiation - the other salient values in relationships. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, Fearlessness (trust) and co-existence as comprehensive Human Goals - visualizing a universal harmonious order in society-Undivided society, Universal order-from family to world family.

Practice sessions to reflect on relationships in family, hostel and institutes extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discussions with scenarios. Eliciting examples from student's lives

UNIT IV	**Understanding Harmony in the Nature and Existence-Whole existence as coexistence**	**6+6**

Understanding the harmony in nature, its inter-connectedness - mutual fulfillment among the fourorders of nature- recyclability and self-regulation in nature.

Recognizing Existence as Co-existence of mutually interacting units in all- pervasive space - holistic perception of harmony at all levels of existence.

Practice sessions to discuss human being as cause of imbalance in nature- pollution, depletion ofresources and role of technology etc.

UNIT V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**	**6+6**

Natural acceptance of human values - definitiveness of Ethical Human Conduct - basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Competence in professional ethics: Ability to utilize the professional competence for augmentinguniversal human order - Ability to identify the scope and characteristics of people friendly and eco-friendly production systems - Ability to identify and develop appropriate technologies and management patterns for above production systems - case studies of typical holistic technologies,management models and production systems.

Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

Sum up.

Practice sessions / exercises: Case studies to discuss the conduct as an engineer or scientist etc.

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students :

.CO1: Would become more aware of themselves, and their surroundings (family, society, nature).

CO2: Would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: Would have better critical ability.

CO4: Would become sensitive to their commitment towards what they have understood (humanvalues, human relationship, and human society).

CO5: Would be able to apply what they have learnt to their own self in different day-to-daysettings in real life, at least a beginning would be made in this direction.

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, *Human Values and Professional Ethics*, Excel Books,New Delhi, Second Edition 2019.

REFERENCES:

1. Nagaraj A, Jeevan Vidya: Ek Parichaya Jeevan Vidya Prakashan, Amarkantak, 1999.

2. E.F Schumacher, *Small is Beautiful*, Vintage classics, London, 1993

3. A. N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, Third Edition 2020.

4. Maulana Abdul Kalam Azad, India Wins Freedom, Oriental blackswan private limited, Hyderabad, 2020.

5. Mahatma Gandhi, *Hind Swaraj or Indian Home Rule*, Maheswari Publications, Delhi 2020

6. Romain Rolland, *The life of Vivekananda and the universal gospel*, Publication house of Ramakrishna Math, Kolkata, Thirty second edition 2018.

7. Romain Rolland, *Mahatma Gandhi: The man who become one with the universal being*,Srishti Publishers & Distributors, New Delhi, Sixth Edition 2013.

8. Dennis P Heaton, *The story of stuff*. (2010): 553-556.

9. Mohandas Karamchand Gandhi, *The story of my experiments with truth: An auto biography*,Om Books International, 2018.

10. Cecile Andrews, *Slow is beautiful: new visions of community, leisure, and joie de vivre*, Newsociety publishers, 2006

11. Joseph Cornelius Kumarappa, *The economy of permanence. CP*, All India Village IndustriesAssn., 1946.

22MA301	DISCRETE MATHEMATICS (Common to CSE, IT, AD) **(Theory Course)**	L	T	P	C
		3	2	0	4

OBJECTIVES:

The course is designed to:

- Describe the arguments using connectives and rules of inference.
- Introduce the basic concept of counting and generating functions.
- Define the graphs and it's models.
- Understand the concept of group theory, lattices and Boolean algebra.

UNIT I	LOGIC AND PROOFS	15

Propositional logic - Propositional equivalences - Predicates and quantifiers - Nested quantifiers - Rules of inference - Introduction to proofs - Proof methods and strategy.

UNIT II	COMBINATORICS	15

Mathematical induction - Strong induction and well ordering The basics of counting - The pigeonhole principle - Permutations and combinations - Recurrence relations - Solving linear recurrence relations - Generating functions - Inclusion and exclusion principle and its applications.

UNIT III	GRAPHS	15

Graphs and graph models - Graph terminology and special types of graphs - Matrix representation of graphs and graph isomorphism - Connectivity - Euler and Hamilton paths.

UNIT IV	ALGEBRAIC STRUCTURES	15

Algebraic systems - Semi groups and monoids - Groups - Subgroups - Homomorphism's - Normal subgroup and cosets - Lagrange's theorem - Definitions and examples of Rings and Fields.

UNIT V	LATTICES AND BOOLEAN ALGEBRA	15

Partial ordering - Posets - Lattices as posets - Properties of lattices - Lattices as algebraic systems - Sub lattices - Direct product and homomorphism - Some special lattices - Boolean algebra.

TOTAL: 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Validate the arguments using connectives and rule of inference.
CO2: Solve linear recurrence relations.
CO3: Determine Euler's path and Hamilton paths.
CO4: Identify algebraic structures of groups, rings, and fields.
CO5: Interpret lattices as algebraic structures.

TEXTBOOKS:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 8th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2021.
2. Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2017.

REFERENCES:

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2014.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

22CS302	COMPUTER ORGANIZATION AND ARCHITECTURE (Common to CSE and ADS)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Describe the basic principles and operations of digital computers.
- Design arithmetic and logic unit for various fixed and floating point operations
- Construct pipeline architectures for RISC processors.
- Explain various memory systems & I/O interfacings
- Discuss parallel processor and multi-processor architectures

UNIT I	COMPUTER FUNDAMENTALS	9

Computer Types - Functional Units — Basic Operational Concepts — Number Representation and Arithmetic Operations - Performance Measurement — Instruction Set Architecture - Memory Locations and Addresses - Instructions and Instruction Sequencing - Addressing Modes.

UNIT II	COMPUTER ARITHMETIC	9

Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Unsigned Numbers - Multiplication of Signed Numbers - Fast Multiplication - Integer Division - Floating-Point Numbers and Operations.

UNIT III	BASIC PROCESSING UNIT AND PIPELINING	9

Basic Processing Unit: Concepts - Instruction Execution - Hardware Components - Instruction Fetch and Execution Steps -Control Signals - Hardwired Control.

Pipelining: Basic Concept - Pipeline Organization- Pipelining Issues - Data Dependencies - Memory Delays - Branch Delays - Resource Limitations - Performance Evaluation -Superscalar Operation.

UNIT IV	I/O AND MEMORY	9

Input/Output Organization: Bus Structure - Bus Operation - Arbitration - The Memory System: Basic Concepts - Semiconductor RAM Memories - Read-only Memories - Direct Memory Access - Memory Hierarchy - Cache Memories - Performance Considerations - Virtual Memory - Memory Management Requirements - Secondary Storage.

UNIT V	PARALLEL PROCESSING AND MULTICORE COMPUTERS	9

Parallel Processing: Use of Multiple Processors - Symmetric Multiprocessors - Multithreading and Chip Multiprocessors - Clusters - Nonuniform Memory Access Computers Vector Computation - Multicore Organization.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Explain the basic principles and operations of digital computers.
CO2: Design Arithmetic and Logic Unit to perform fixed and floating-point operations
CO3: Develop pipeline architectures for RISC Processors.
CO4: Summarize Various Memory systems & I/O interfacings.
CO5: Recognize Parallel Processor and Multi Processor Architectures

TEXT BOOKS:

1.Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Tata McGraw Hill, Sixth edition, 2012.

2.David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.

REFERENCES:

1.John P.Hayes, Computer Architecture and Organization, Third Edition, TataMcGraw Hill, 2012.

2.David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface, 6th edition, Morgan Kaufmann, 2021.

3.John L. Hennessy and David A. Patterson, Computer Architecture – A Quantitate Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition,2012.

22CS305	ADVANCED JAVA PROGRAMMING	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Gain a comprehensive understanding of the Java Collections Framework and its various interfaces and implementations.
- Learn the details of Java I/O streams and utility classes for managing dates, numbers, and currencies.
- Develop a thorough understanding of the Stream API introduced in Java 8 and its various operations.
- Explore advanced object serialization and string tokenizing techniques, including pattern matching with regular expressions.
- Understand advanced Stream API features and gain proficiency in using regular expressions for text processing.

UNIT I	COLLECTIONS FRAMEWORK AND UTILITY CLASSES	9+6

Introduction to Collections Framework - Collection Interface- Methods in Collection Interface - Iterable and Iterator Interfaces - List Interface- ArrayList - LinkedList - Set Interface - HashSet- LinkedHashSet - TreeSet - Map Interface - HashMap - LinkedHashMap- TreeMap - Queue Interface -PriorityQueue - Deque Interface - Utility Classes.

List of Experiments

1. Write a program that measures the time taken for insertion, deletion, and search operations on ArrayList, LinkedList, HashSet, and TreeSet for varying sizes of input data.
2. Implement a custom data structure that combines features of a list and a set.
3. Write a Java program to create a HashMap where the keys are strings, and the values are integers Add five key-value pairs to the map. Print all the keys and values in the map. Remove an entry by key. Update the value associated with a specific key. Check if the map contains a specific key and a specific value.

UNIT II	I/O OPERATIONS, SERIALIZATION, AND DATE HANDLING	9+6

Date – Calendar – Comparable interface – Observer Interface – Streams - Types of Streams - The Byte-stream I/O hierarchy - Character Stream Hierarchy – Random Access File class – the java.io. Console Class – Serialization – Dates - Numbers, and Currency - Working with Dates - Numbers and Currencies.

List of Experiments

1. Create a class representing a complex object with nested data structures. Serialize the object to a file, then deserialize it back and verify that the object remains intact.
2. Write a program that formats dates and currencies according to different locales.
3. Implement a java program that allows users to open a text file, navigate through it using random access, insert, delete, and modify text at specific positions within the file.

UNIT III	STREAM API AND FUNCTIONAL PROGRAMMING PARADIGMS	9+6

Overview of Stream API - Importance of Stream API in Java 8 and Beyond – Functional Programming Concepts - Creating Streams - Stream Interface Methods - Stream Operations - Intermediate Filtering (filter)-Mapping (map, flatMap)-Sorting (sorted)-

Distinct (distinct) - Limit and Skip (limit, skip) - Terminal Operations -Collecting Results (collect) - Reducing and Summarizing (reduce, summaryStatistics)-Iterating (forEach) - Matching and Finding (anyMatch, allMatch, noneMatch, findFirst, findAny) -Counting (count).

List of Experiments

1. Write a program that performs stream operations like filtering, mapping, and reducing.
2. Create an infinite stream generator that generates prime numbers. Implement methods to check for primality and generate the next prime number.
3. Write a program that reads a text file containing sentences. Tokenize each sentence into words, filter out stopwords, and print the remaining words.

UNIT IV	ADVANCED STRING PROCESSING, OBJECT SERIALIZATION, AND I/O TECHNIQUES	9+6

String Tokenizer – Parsing - Tokenizing and Formatting - Locating Data via Pattern Matching, Tokenizing - Object Serialization - Serializable Interface - Writing and Reading Serializable Objects -Transient Keyword- SerialVersionUID - Advanced I/O - Piped Streams (PipedInputStream and PipedOutputStream) – SequenceInputStream - PushbackInputStream and PushbackReader.

List of Experiments

1. Write a program that reads a text file and tokenizes it into sentences using the StringTokenizer class.
2. Create a class hierarchy representing different types of objects (e.g., Person, Employee). Serialize instances of these classes to a file using object serialization.
3. Implement a program that uses advanced I/O techniques like PipedInputStream, PipedOutputStream, SequenceInputStream, and PushbackInputStream.

UNIT V	ADVANCED STREAM FEATURES AND REGULAR EXPRESSIONS	9+6

Importance and Use Cases of Advanced Stream Features - Creating Custom Streams - Stream Generators (Stream.generate, Stream.iterate) - Infinite Streams - Using Spliterators – Advanced Stream Operations - FlatMapping - Chaining Stream Operations - Stream Peeking (peek) - Advanced Filtering Techniques - Introduction to Regular Expressions - Character Classes - Quantifiers - Pattern Matching - Groups and Capturing - Regex in Java - java.util.regex Package Pattern Class - Matcher Class - String Manipulation with Regex - Splitting Strings - Replacing Text (replaceAll, replaceFirst) - Replacing with Backreferences.

List of Experiments

1. Implement custom stream generators using Stream.generate and Stream.iterate methods.
2. Write a program that demonstrates advanced stream operations like flatMapping, chaining stream operations, and peeking.
3. Develop a program that utilizes regular expressions to perform string manipulation tasks such as splitting strings, replacing text, and extracting specific patterns.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Utilize the Java Collections Framework to solve complex data structure problems.

CO2: Demonstrate proficiency in Java I/O operations and manage data efficiently.

CO3: Learn to utilize the Stream API for complex data processing by applying functional

programming techniques.

CO4: Understand and implement advanced object serialization techniques.

CO5: Effectively use regular expressions for advanced text processing tasks.

CO6: Build simple applications using advanced java programming concepts.

TEXT BOOK:

1. Cay S. Horstmann, "Core Java Volume I--Fundamentals," 12th Edition, 2019.
2. Joshua Bloch, "Effective Java," 3rd Edition, 2018.
3. Raoul-Gabriel Urma, "Java 8 in Action: Lambdas, Streams, and Functional-Style Programming," 1st Edition, 2014.
4. Herbert Schildt, "Java: The Complete Reference," 11th Edition, 2018.
5. Alan Mycroft and Martin Odersky, "Programming in Scala," 4th Edition, 2020.

REFERENCES:

1. Bruce Eckel, "Thinking in Java," 4th Edition, 2006.
2. Herbert Schildt, "Java: A Beginner's Guide," 8th Edition, 2019.
3. Richard Warburton, "Java 8 Lambdas: Pragmatic Functional Programming," 1st Edition, 2014.

LIST OF EQUIPMENTS:

JDK/Eclipse

22CS306	DESIGN AND ANALYSIS OF ALGORITHMS (Common to CSE and ADS)	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- Critically analyse the efficiency of alternative algorithmic solutions for the same problem
- Illustrate brute force and divide and conquer design techniques.
- Explain dynamic programming for solving various problems.
- Apply greedy technique and iterative improvement technique to solve optimization problems
- Examine the limitations of algorithmic power and handling it in different problems.

UNIT I	INTRODUCTION	6+6

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving –Fundamentals of the Analysis of Algorithmic Efficiency – Asymptotic Notations and their properties. Analysis Framework – Mathematical analysis for Recursive and Non-recursive algorithms

List of Exercise/Experiments:

1. Perform the recursive algorithm analysis.
2. Perform the non-recursive algorithm analysis.

UNIT II	BRUTE FORCE AND DIVIDE AND CONQUER	6+6

Brute Force - String Matching - Exhaustive Search - Knapsack Problem - Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort - Multiplication of Large Integers – Closest-Pair and Convex Hull Problems - Transform and Conquer Method: Heap Sort

List of Exercise/Experiments:

1. Write a program to search an element using binary search
2. Write a program to sort the elements using merge sort and find time complexity.
3. Write a program to sort the elements using quick sort and find time complexity.
4. Write a program to sort the elements using heap sort

UNIT III	DYNAMIC PROGRAMMING	6+6

Dynamic programming – Principle of optimality – Floyd‘s algorithm – Multi stage graph - Optimal Binary Search Trees - Longest common subsequence - Matrix-chain multiplication – Travelling Salesperson Problem – Knapsack Problem and Memory functions.

List of Exercise/Experiments:

1. Solve Floyd’s algorithm
2. Write a program to find optimal binary search tree for a given list of keys.
3. Solve the multi-stage graph to find shortest path using backward and forward approach
4. Write a program to find the longest common subsequence

UNIT IV	GREEDY TECHNIQUE AND ITERATIVE IMPROVEMENT	6+6

Greedy Technique – Prim‘s algorithm and Kruskal’s Algorithm – Huffman Trees. The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs - The Stable marriage Problem

List of Exercise/Experiments:

1. Write a program to find minimum spanning tree using Prim’s algorithm
2. Implement Kruskal’s algorithm to find minimum spanning tree
3. Write a program to solve maximum flow problem

UNIT V	BACKTRACKING AND BRANCH AND BOUND	6+6

P, NP NP- Complete and NP Hard Problems. Backtracking – N-Queen problem - Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem - Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem

List of Exercise/Experiments:

1. Write a program to implement sum of subset problem.
2. Write a program to solve N-Queen problem
3. Solve the assignment problem using branch and bound technique
4. Solve knapsack problem using branch and bound technique

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Solve mathematically the efficiency of recursive and non-recursive algorithms

CO2: Design and Analyse the efficiency of divide and conquer and transform and conquer algorithmic techniques

CO3: Implement and analyse the problems using dynamic programming

CO4: Solve the problems using and greedy technique and iterative improvement technique for optimization

CO5: Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound technique.

TEXT BOOKS:

Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.

Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.

REFERENCES:

Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.

S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.

http://nptel.ac.in/

LIST OF EQUIPMENTS:

Standalone PC with C/C++/Java

22AI301	ARTIFICIAL INTELLIGENCE (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the various Intelligent agents and search strategies in AI.
- To learn about different problem-solving strategies using heuristic function.
- To learn about knowledge-based agents and first order logics.
- To understand knowledge representation and planning.
- To know about the expert system.

UNIT I	ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS	9+6

Introduction to AI – Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies.

Lab Programs:

1. Implement basic search strategies – 8-Puzzle, 8 - Queens problem.
2. Implement Breadth First Search & Depth first Search Algorithm
3. Implement Water Jug problem.
4. Solve Tic-Tac-Toe problem.

UNIT II	PROBLEM SOLVING	9+6

Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP

Lab Programs:

1. Implement A* and memory bounded A* algorithms.
2. Implement Minimax algorithm & Alpha-Beta pruning for game playing.
3. Constraint Satisfaction Problem
4. Mini Project – Chess. Sudoku.

UNIT III	LOGICAL AGENTS	9+6

Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic

First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining – Resolution.

Lab Programs:

1. Implement Unification algorithm for the given logic.
2. Implement forward chaining and backward chaining using Python.

UNIT IV	KNOWLEDGE REPRESENTATION AND PLANNING	9+6

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information

Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – non-deterministic domains – Time, schedule, and resources – Analysis

Lab Programs:

1. Implementation of object detection.
2. Implement classical planning algorithms.

UNIT V	LEARNING AND EXPERT SYSTEMS	9+6

Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.

Expert Systems: Functions – Main structure – if-then rules for representing knowledge – developing the shell – Dealing with uncertainty

Lab Programs:

1. Develop an Expert system.

2. Mini-Project – Develop Machine Learning based classification Models.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Illustrate the structure of agents and to implement various Intelligent agents.
CO2: Apply search strategies in problem solving and game playing using heuristic function.
CO3: Implement logical agents and first-order logic problems.
CO4: Apply problem-solving strategies with knowledge representation mechanism for solving hard problems.
CO5: Demonstrate the basics of expert systems and to develop models using machine learning techniques.

TEXT BOOKS:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
4. Bratko, Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems,1st Edition by Patterson, Pearson, India, 2015.
6. NPTEL Courses:
    a. An Introduction to Artificial Intelligence - https://onlinecourses.nptel.ac.in/noc23_cs05/preview
    b. Artificial Intelligence: Knowledge Representation And Reasoning - https://onlinecourses.nptel.ac.in/noc23_cs09/preview

22AI302	DATA SCIENCE USING PYTHON (Lab Integrated)	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- To learn the fundamentals of Data Science.
- To experiment and implement python libraries for data science Learn the tools and packages in Python for Data Science.
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization libraries in Python

UNIT I	INTRODUCTION	6+6

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.

List of Exercise/Experiments:

1. Download, install and explore the features of R/Python for data analytics
    - Installing Anaconda
    - Basic Operations in Jupiter Notebook
    - Basic Data Handling

UNIT II	PYTHON LIBRARIES FOR DATA SCIENCE	6+6

Introduction to Numpy - Multidimensional Ndarrays – Indexing – Properties – Constants – Data Visualization: Ndarray Creation – Matplotlib - Introduction to Pandas – Series – Dataframes – Visualizing the Data in Dataframes - Pandas Objects – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – Joins-Pivot Tables - String operations – Working with time series – High performance Pandas.

List of Exercise/Experiments:

1. Working with Numpy arrays - Creation of numpy array using the tuple, Determine the size, shape and dimension of the array, Manipulation with array Attributes, Creation of Sub array, Perform the reshaping of the array along the row vector and column vector, Create Two arrays and perform the concatenation among the arrays.
2. Working with Pandas data frames - Series, DataFrame , and Index, Implement the Data Selection Operations, Data indexing operations like: loc, iloc, and ix, operations of handling the missing data like None, Nan, Manipulate on the operation of Null Vaues (is null(), not null(), dropna(), fillna()).
3. Perform the Statistics operation for the data (the sum, product, median, minimum and maximum, quantiles, arg min, arg max etc.).
4. Use any data set compute the mean ,standard deviation, Percentile.

UNIT III	CLASSIFICATION	6+6

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.

Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.

List of Exercise/Experiments:

1. Apply Decision Tree algorithms on any data set.
2. Apply SVM on any data set
3. Implement K-Nearest-Neighbor Classifiers

UNIT IV	CLUSTERING AND OUTLIER DETECTION	6+6

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches

– Clustering and Classification-Based Approaches.

List of Exercise/Experiments:

1. Apply K-means algorithms for any data set.
2. Perform Outlier Analysis on any data set.

UNIT V	**DATA VISUALIZATION**	**6+6**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

List of Exercise/Experiments:

1. Basic plots using Matplotlib.
2. Implementation of Scatter Plot.
3. Construction of Histogram, bar plot, Subplots, Line Plots.
4. Implement the three dimensional potting.
5. Visualize a dataset with Seaborn.

TOTAL:30+30 = 60 PERIODS

OUTCOMES:

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

CO1: Explain the fundamentals of data science
CO2: Experiment python libraries for data science
CO3: Apply and implement basic classification algorithms
CO4: Implement clustering and outlier detection approaches
CO5: Present and interpret data using visualization tools in Python

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit 1)
2. Ashwin Pajankar, Aditya Joshi, Hands-on Machine Learning with Python: Implement Neural Network Solutions with Scikit-learn and PyTorch, Apress, 2022.
3. Jake VanderPlas, “Python Data Science Handbook – Essential tools for working with data”, O’Reilly, 2017.

REFERENCES:

1. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012.
3. Samir Madhavan, Mastering Python for Data Science, Packt Publishing, 2015
4. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts,
5. Techniques and Applications", 1st Edition, Springer, 2017
6. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential
7. Concepts", 3rd Edition, O'Reilly, 2017
8. Hector Guerrero, “Excel Data Analysis: Modelling and Simulation”, Springer International Publishing, 2nd Edition, 2019
9. NPTEL Courses:
    a. Data Science for Engineers - https://onlinecourses.nptel.ac.in/noc23_cs17/preview
    b. Python for Data Science - https://onlinecourses.nptel.ac.in/noc23_cs21/preview

22GE301	TAMILS AND TECHNOLOGY (Common to All Branches)	L	T	P	C
		1	0	0	1

OBJECTIVES:

The course is designed to

- Recognize the historical significance of weaving and pottery technologies in ancient Tamil civilization.
- Highlight the concepts of design and construction technology during the Sangam age.
- Provide an overview of manufacturing technology and its role in Tamil society.
- Illustrate the agricultural and irrigation techniques employed in ancient Tamil society.
- Promote scientific Tamil and Tamil computing.

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Identify the role of weaving and ceramic technology in ancient Tamil Culture.
CO2: Assess the design and construction technology ideas in the current Tamil society.
CO3: Identify the different types of manufacturing technology used in Tamil society and their significance.
CO4: Classify agricultural and irrigation technologies in ancient Tamil society and its current relevance.
CO5: Discuss the fundamentals of scientific Tamil and Tamil computing.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S .Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subaramanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book

22CS311	APTITUDE AND CODING SKILLS – I (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Develop vocabulary for effective communication and reading skills.
- Build the logical reasoning and quantitative skills.
- Develop error correction and debugging skills in programming.

List of Exercises:

1. **English – Phase I**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. **Logical Reasoning – Phase I**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. **Quantitative Ability - Phase I**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. **Automata Fix – Phase I**

Logical, Compilation and Code reuse

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Develop vocabulary for effective communication and reading skills.
CO2: Build the logical reasoning and quantitative skills.
CO3: Develop error correction and debugging skills in programming.

22CS313	PRODUCT DEVELOPMENT LAB – 3 (Design and Analysis Phase) (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- To provide an adequate understanding of project/product concepts and creative design process.
- Create a methodology to develop solutions to complex systems.

The students can form a team of 3 or 4 to work on the approved topic by the faculty in-charge. All approved product/process topics should have the following stages as listed under activities. The faculty in-charge conducts a periodic review to endorse the work process and during the review, the faculty shall provide suggestions/ideas to improvise the project towards completion. An interim report (consisting of literature, photographs, proof of the work done, etc..) for all listed activities should be submitted by the team during periodic review for evaluation. A final project report is required at the end of the semester for evaluation.

LIST OF ACTIVITIES:

1. Develop the design stage for a product from the concept.
    - Researching it in-depth.
    - Ideating possible solutions.
    - Selecting a promising solution.
    - Make a mock-up model
    - Comprehend the design features of the mock-up model.
2. Evaluate the pros-cons of the mock-up (& with the existing product).
3. Generate the Design for Manufacturing and Assembly (DFMA) process route for the product with necessary interdisciplinary collaborations.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1 Enhance their skills in design concepts, rules and procedures.
CO2 Develop their cognitive strategy to think, organize, learn and behave.
CO3 Demonstrate the ability to provide conceptual design strategies for a product.
CO4 Describe the procedure for designing a Mock-up model.
CO5 Recognize and apply appropriate interdisciplinary and integrative strategies for solving complex problems

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No	Equipment Name	Quantity
1	CNC Router	1 No
2	3D Printer	1 No
3	3D Scanner	1 No
4	Laser cutting Machine	1 No
5	Centre lathe	2 Nos
6	Arc welding transformer with cables and holders	2 Nos

7	Plumbing tools	2 Sets
8	Carpentry tools	2 Sets
9	Multimeter	10 Nos
10	Drilling Machine	1 No
11	Solder Stations	5 Sets
12	Desoldering Machine	1 No
13	PCB Milling Machine	1 No
14	Variable Power Supply	1 No
15	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	10 Sets
16	Personal Desktop Computers	30 Nos
17	3D Modelling software – Creo/ AutoCAD/ etc.,	30 Licence

SEMESTER IV

22MA401	**PROBABILITY AND STATISTICS** (Common to CSE and ADS) **(Theory Course with Laboratory Component)**	**L**	**T**	**P**	**C**
		3	0	2	4

OBJECTIVES:

The course is designed to:

- Provide the necessary basic concepts of random variables and to introduce some standard distributions.
- Test the hypothesis for small and large samples.
- Introduce the concepts of Analysis of Variances.
- Understand the concept of statistical quality control.

UNIT I	**ONE-DIMENSIONAL RANDOM VARIABLES**	**15**

Basic probability definitions- Independent events- Conditional probability (revisit) - Random variable - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

List of Exercise/Experiments using R Programming:

1. Finding conditional probability.
2. Finding mean, variance and standard deviation.

UNIT II	**TWO-DIMENSIONAL RANDOM VARIABLES**	**15**

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and linear regression - Transformation of random variables.

List of Exercise/Experiments using R Programming:

1. Finding marginal density functions for discrete random variables.
2. Calculating correlation and regression.

UNIT III	**TESTING OF HYPOTHESIS**	**15**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t and F distributions for mean and variance - Chi-square test- Contingency table (test for independent) - Goodness of fit.

List of Exercise/Experiments using R Programming:

1. Testing of hypothesis for given data using Z - test.
2. Testing of hypothesis for given data using t - test.

UNIT IV	**DESIGN OF EXPERIMENTS**	**15**

One way and Two-way classifications - Completely randomized design - Randomized blockdesign - Latin square design.

List of Exercise/Experiments R Programming:

1. Perform one-way ANOVA test for the given data.
2. Perform two-way ANOVA test for the given data.

UNIT V	**STATISTICAL QUALITY CONTROL**	**15**

Control charts for measurements ($\bar{X}$ and R charts) - Control charts for attributes (p, c and npcharts) - Tolerance limits.

List of Exercise/Experiments using R Programming:

1. Interpret the results for $\bar{X}$-Chart for variable data.
2. Interpret the results for R-Chart for variable data.

TOTAL:75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Calculate the statistical measures of standard distributions.

CO2: Compute the correlation & regression for two dimensional random variables.

CO3: Apply the concept of testing the hypothesis.

CO4: Implement the concept of analysis of variance for various experimental designs.

CO5: Demonstrate the control charts for variables and attributes**.**

TEXTBOOKS:

1. R.A. Johnson, I. Miller and J. Freund, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. J.S. Milton and J.C. Arnold, "Introduction to Probability and Statistics", Tata McGrawHill, 4th Edition, 2017.

REFERENCES:

1. J.L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2016.
2. S.M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6th Edition, Elsevier, 2020.
3. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
4. R.E.Walpole, R.H.Myers, S.L. Myers and K.Ye, "Probability and Statistics for Engineers and Scientists". Pearson Education, Asia, 9th Edition, 2012.

22CS304	OPERATING SYSTEM (Common to CSE and ADS)	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- Explain the basic concepts of operating systems and process.
- Discuss threads and analyse various CPU scheduling algorithms.
- Describe the concept of process synchronization and deadlocks.
- Analyse various memory management schemes.
- Describe I/O management and file systems.

UNIT I	INTRODUCTION TO OPERATING SYSTEMS AND PROCESSES	6+6

Introduction: Computer system organization - architecture – Resource management - Protection and Security – Virtualization - Operating System Structures: Services - User and Operating-System Interface - System Calls - System Services - Design and Implementation - Building and Booting an Operating System – Processes: Process Concept - Process Scheduling - Operations on Processes – Inter process Communication - IPC in Shared-Memory Systems - IPC in Message-Passing Systems

List of Exercise/Experiments:

1. Basic Unix file system commands such as ls, cd, mkdir, rmdir, cp, rm, mv, more, lpr, man, grep, sed, etc..
2. Programs using Shell Programming.
3. Implementation of Unix System Calls.
4. Implementation of IPC using message queue
   a. Get the input data (integer value) from a process called sender
   b. Use Message Queue to transfer this data from sender to receiver process
   c. The receiver does the prime number checking on the received data
   d. Communicate the verified/status result from receiver to sender process, this status should be displayed in the Sender process.

Note: Simultaneously execute two or more processes. Don't do it as a single process

UNIT II	THREADS AND CPU SCHEDULING	6+6

Threads & Concurrency: Overview - Multicore Programming - Multithreading Models - Thread Libraries - Implicit Threading - Threading Issues - CPU Scheduling: Basic Concepts – Scheduling Criteria - Scheduling Algorithms - Thread Scheduling - Multi-Processor Scheduling - Real-Time CPU Scheduling

List of Exercise/Experiments:

1. Write a program to implement the following actions using pthreads
   a. Create a thread in a program and called Parent thread, this parent thread creates another thread (Child thread) to print out the numbers from 1 to 20. The Parent thread waits till the child thread finishes
   b. Create a thread in the main program, this program passes the 'count' as arguments to that thread function and this created thread function has to print your name 'count' times.
2. Write C programs to implement the various CPU Scheduling Algorithms.

UNIT III	PROCESS SYNCHRONISATION AND DEADLOCKS	6+6

Process Synchronization: The critical-section problem – Peterson's Solution, Synchronization hardware, Mutex locks, Semaphores, monitors - Classic problems of synchronization: Bounded Buffer Problem - Reader's & Writer Problem, Dinning Philosopher Problem. Deadlock: System model - Deadlock characterization, Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection - Recovery from deadlock.

List of Exercise/Experiments:

1. Process Synchronization using Semaphores. A shared data has to be accessed by two categories of processes namely A and B. Satisfy the following constraints to access the data without any data loss.
   a. When a process A1 is accessing the database another process of the same category is permitted.
   b. When a process B1 is accessing the database neither process A1 nor another 74 process B2 is permitted.
   c. When a process A1 is accessing the database process B1 should not be allowed to access the database. Write appropriate code for both A and B satisfying all the above constraints using semaphores.

Note: The time-stamp for accessing is approximately 10 sec.

2. Bankers Algorithm for Deadlock Avoidance

UNIT IV	MEMORY MANAGEMENT	6+6

Memory Management: Contiguous Memory Allocation - Paging - Structure of the Page Table – Swapping - Virtual Memory: Demand Paging – Copy-on write – Page Replacement – Allocation of frames – Thrashing – Memory Compression

List of Exercise/Experiments:

1. Analysis and Simulation of Memory Allocation and Management Techniques
   i. First Fit ii. Best Fit iii. Worst Fit
2. Implementation of Page Replacement Techniques
   i. FIFO ii. LRU iii. Optimal page replacement

UNIT V	STORAGE MANAGEMENT	6+6

Mass Storage Structure: Overview of Mass Storage Structure- HDD scheduling – Swap Space Management, I/O systems: I/O Hardware, Application I/O interface, Kernel I/O Subsystem, File System Interface: File Concept – Access Methods – Directory Structure – Protection, File-System Implementation: File-System Structure- File-System Operations - Directory Implementation - Allocation Methods - Free-Space Management, - Case Study-Linux

List of Exercise/Experiments:

1. Simulation of File Allocation Techniques
   i. Sequential ii. Linked list iii. indexed
2. Implementation of File Organization Strategies
   i. Single level directory ii. Two level directory iii. Hierarchical level directory

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Implement the basic concepts of operating systems and process.
CO2: Analyse various CPU scheduling algorithms and thread mechanism.
CO3: Implement the concepts of process synchronization and deadlocks.
CO4: Design various memory management schemes to given situation.
CO5: Implement various I/O and file management techniques.

TEXTBOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts” II, 10th Edition, John Wiley and Sons Inc., 2018.
2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.

REFERENCES:

1. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.
2. Achyut S.Godbole, Atul Kahate, “Operating Systems”, McGraw Hill Education, 2016.

LIST OF EQUIPMENTS:

Standalone desktops with C/C++/Java/Equivalent compiler.

22CS401	DISTRIBUTED AND CLOUD COMPUTING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- ✓ To articulate the concepts and models underlying distributed computing
- ✓ To maintain consistency and perform efficient coordination in distributed systems through the use of logical clocks, global states, and snapshot recording algorithms.
- ✓ To learn different distributed mutual exclusion algorithms.
- ✓ To develop the ability to understand the cloud infrastructure and virtualization that help in the development of cloud.
- ✓ To explain the high-level automation and orchestration systems that manage the virtualized infrastructure.

UNIT I	INTRODUCTION	6 + 6

Definition - Relation to computer system components - Message-passing systems versus shared memory systems - Primitives for distributed communication - Synchronous versus asynchronous executions. A model of distributed computations: A distributed program - A model of distributed executions - Models of communication networks - Global state of a distributed system.

List of Exercise/Experiments:

1. Develop a distributed program that uses Java's messaging API (JMS) to communicate between nodes. Explore the different messaging paradigms (pub/sub, point-to-point) and evaluate their performance and scalability.
2. Develop a model of a distributed program using Java's concurrency and synchronization primitives.

UNIT II	LOGICAL TIME, GLOBAL STATE, AND SNAPSHOT ALGORITHMS	6 + 6

Logical time – Scalar Time – Vector Time - Efficient implementations of vector clocks – Virtual Time. Global state and snapshot recording algorithms: System model - Snapshot algorithms for FIFO channels and non-FIFO channels.

List of Exercise/Experiments:

1. Develop a program in Java that implements vector clocks to synchronize the order of events between nodes in a distributed system.
2. Implement a snapshot algorithm for recording the global state of the distributed system using vector clocks, for both FIFO and non-FIFO channels. Test the algorithm by recording snapshots at various points in the system's execution and analyzing the resulting global state.

UNIT III	DISTRIBUTED MUTUAL EXCLUSION ALGORITHMS	6 + 6

Introduction - Lamport’s algorithm - Ricart–Agrawala algorithm - Quorum-based mutual exclusion algorithms - Maekawa’s algorithm - Suzuki–Kasami’s broadcast algorithm.

List of Exercise/Experiments:

1. Implement Lamport's algorithm for mutual exclusion in a distributed system using Java's RMI API.
2. Develop a program in Java that implements Maekawa's algorithm for mutual exclusion in a distributed system.

3. Implement Suzuki-Kasami's broadcast algorithm in Java to achieve reliable message delivery in a distributed system.

UNIT IV	CLOUD INFRASTRUCTURE AND VIRTUALIZATION	6 + 6

Data Center Infrastructure and Equipment – Virtual Machines – Containers – Virtual Networks - Virtual Storage.

List of Exercise/Experiments:

1. Set up a virtualized data center using a hypervisor like VMware or VirtualBox and create multiple virtual machines (VMs) on it. Configure the VMs with different operating systems, resources, and network configurations, and test their connectivity and performance.
2. Deploy a containerized application on a virtual machine using Docker or Kubernetes.

UNIT V	AUTOMATION AND ORCHESTRATION	6 + 6

Automation - Orchestration: Automated Replication and Parallelism - The MapReduce Paradigm: The MapReduce Programming Paradigm – Splitting Input – Parallelism and Data size – Data access and Data Transmission – Apache Hadoop – Parts of Hadoop – HDFS Components – Block Replication and Fault Tolerance – HDFS and MapReduce - Microservices.

List of Exercise/Experiments:

1. Set up and configure a single-node Hadoop cluster.
2. Run the word count program in Hadoop.
3. Deploy a microservices architecture using a container orchestration tool like Kubernetes or Docker Swarm.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Articulate the main concepts and models underlying distributed computing.

CO2: Learn how to maintain consistency and perform efficient coordination in distributed systems through the use of logical clocks, global states, and snapshot recording algorithms.

CO3: Learn different distributed mutual exclusion algorithms

CO4: Develop the ability to understand the cloud infrastructure and virtualization that help in the development of cloud.

CO5: Explain the high-level automation and orchestration systems that manage the virtualized infrastructure.

TEXT BOOKS:

1. Ajay D. Kshemkalyani, Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2011. (Unit 1, 2, 3)
2. Douglass E. Comer, "The Cloud Computing Book: The future of computing explained", CRC Press, 2021. (Unit 4, 5)

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-on Approach", Universities Press Private Limited, 2014.
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2017.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4. Hagit Attiya, Jennifer Welch, "Distributed Computing: Fundamentals, Simulations and Advanced Topics", John Wiley & Sons, Inc., 2004.

LIST OF EQUIPMENTS:

Java, VMWare/VirtualBox, Hadoop, AWS/GCP/Azure/Any cloud platform,

Eclipse/Equivalent IDE.

22AI401	MACHINE LEARNING (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To discuss the basics of Machine Learning and model evaluation.
- To study dimensionality reduction techniques.
- To understand the various classification algorithms.
- To elaborate on unsupervised learning techniques.
- To discuss the basics of neural networks and various types of learning.

UNIT I	INTRODUCTION	9+6

Machine Learning – Types – Applications – Preparing to Model – Activities – Data – Exploring structure of Data – Data Quality and Remediation – Data Pre-processing – Modelling and Evaluation: Selecting a Model -Training a Model – Model representation and Interpretability – Evaluating Performance of a Model – Improving Performance.

Lab Programs:

1. Implementation of Candidate Elimination algorithm
2. Implementation of ML model evaluation techniques (R-Squared/Adjusted R-Squared/Mean Absolute Error/Mean Squared Error)
3. Implementation of ML model evaluation techniques (Confusion Matrix/F1 Score/AUC-ROC Curve)

UNIT II	FEATURE ENGINEERING AND DIMENSIONALITY REDUCTION	9+6

Feature Engineering – Feature Transformation – Feature Subset Selection - Principle Component Analysis – Feature Embedding – Factor Analysis – Singular value decomposition and Matrix Factorization – Multidimensional scaling – Linear Discriminant Analysis – Canonical Correlation Analysis – Isomap – Locally linear Embedding – Laplacian Eigenmaps.

Lab Programs:

1. Write python code to identify feature co-relations (PCA)
2. Interpret Canonical Covariates with Heatmap
3. Feature Engineering is the way of extracting features from data and transforming them into formats that are suitable for Machine Learning algorithms. Implement python code for Feature Selection/ Feature Transformation/ Feature Extraction.
4. Mini Project – Feature Subset Selection

UNIT III	SUPERVISED LEARNING	9+6

Linear Regression -Relation between two variables – Steps – Evaluation – Logistic Regression – Decision Tree – Algorithms – Construction – Classification using Decision Tree – Issues – Rule-based Classification – Pruning the Rule Set – Support Vector Machines – Linear SVM – Optimal Hyperplane – Radial Basis Functions – Naïve Bayes Classifier – Bayesian Belief Networks.

Lab Programs:

1. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select the appropriate data set for your experiment and draw graphs.
2. Implement and demonstrate the working of the decision tree-based ID3 algorithm
3. Build a Simple Support Vector Machines using a data set

UNIT IV	UNSUPERVISED LEARNING	9+6

Clustering – Types – Applications - Partitioning Methods – K-means Algorithm – K-Medoids – Hierarchical methods – Density based methods DBSCAN – Finding patterns using Association Rules – Hidden Markov Model.

Lab Programs:

1. Implement a k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions
2. Implement market basket analysis using association rules
3. Mini Project using Clustering analysis.

UNIT V	NEURAL NETWORKS AND TYPES OF LEARNING	9+6

Biological Neuron – Artificial Neuron – Types of Activation function – Implementations of ANN –Architectures of Neural Networks – Learning Process in ANN – Back propagation – Deep

Learning – Representation Learning – Active Learning – Instance based Learning – Association Rule Learning – Ensemble Learning Algorithm – Regularization Algorithm- Reinforcement Learning – Elements- Model-based- Temporal Difference Learning.

Lab Programs:

1. Build an ANN by implementing the Single-layer Perceptron. Test it using appropriate data sets.
2. Implement Multi-layer Perceptron and test the same using appropriate data sets.
3. Build a RBF Network to calculate the fitness function with five neurons.
4. Mini Project – Face recognition,

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Explain the basics of Machine Learning and model evaluation.
CO2: Study dimensionality reduction techniques.
CO3: Understand and implement various classification algorithms.
CO4: Understand and implement various unsupervised learning techniques.
CO5: Build Neural Networks and understand the different types of learning.

TEXT BOOKS:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson,2019. (Unit 1 – chap 1,2,3/ Unit 2 – Chap 4 / Unit 4 – 9 / Unit 5 – Chap 10, 11)
2. Ethem Alpaydin, "Introduction to Machine Learning, Adaptive Computation and Machine Learning Series", Third Edition, MIT Press, 2014. (Unit 2 – Chap 6 / Unit 4 – chap 8.2.3/ Unit 5 – Chap 18)

REFERENCES:

1. Anuradha Srinivasaraghavan,Vincy Joseph, "Machine Learning", First Edition, Wiley, 2019.(Unit 3 – Chap 7,8,9,10,11 / Unit 4 – 13, 11.4, 11.5,12)
2. Peter Harrington, "Machine Learning in Action", Manning Publications, 2012.
3. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition,
4. Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.
6. Christoph Molnar, "Interpretable Machine Learning - A Guide for Making Black Box Models Explainable", Creative Commons License, 2020.
7. NPTEL Courses:
    a. Introduction to Machine Learning - https://onlinecourses.nptel.ac.in/noc23_cs18/preview

22CS403	WEB DEVELOPMENT FRAMEWORKS (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Simplify website development using Spring boot as server-side technologies.
- Build single page applications using REACT as a reusable UI component technology as client-side technology.
- Assemble REACT as a front end technology and Node js as a server side technology to develop enterprise applications
- Develop a scalable and responsive web application
- Develop an industry ready application web enterprise feature

UNIT I	SPRING BOOT AND STRUTS	9+6

Spring Boot: Introducing Spring Boot, getting started with springboot, Common springboot taskManaging configuration, creating custom properties, executing code on Springboot application startup, Database access with Spring data, Securing spring boot application.

List of Exercise/Experiments:

1.Use Spring Boot to build a Web Application
2. Create REST Service for an Education Site.

UNIT II	JAVA REACT	9+6

React: Introduction to React, Pure React- The Virtual DOM, React Elements, React with JSX, Props, State, and the Component Tree, Enhancing Components - Flux.

List of Exercise/Experiments:

1. Build Search filter in React
2. Display a list in React
3. Create Simple Login form in React

UNIT III	NODE JS	9+6

Node JS: Introduction to Node JS, Setting up Node.js, Node.js Modules- Finding and loading CommonJS and JSON modules using require, Hybrid CommonJS/Node.js/ES6 module scenarios, npm - the Node.js package management system.

List of Exercise/Experiments:

1. Write a node.js program for making external http calls
2. Write a program in node.js to parse the given url.

UNIT IV	WEB FRAMEWORK (ANGULAR) – I	9+6

Introduction- Angular First App, Angular UI with Bootstrap CSS Authentication, Authentication Service, Unsubscribe, Logout and Route Guard Cleanup, Customer Service, Http Service, Token Interceptor, Multi Provider, Compile-time Configuration, Runtime Configuration, Error Handling.

List of Exercise/Experiments:

1. Create a Dropdown using Angular UI bootstrap
2. Modify existing components and generating new components using Angular.

UNIT V	WEB FRAMEWORK (ANGULAR)-II	9+6

Dependency injection in Angular, Reactive programming in Angular, Laying out pages with Flex Layout, Implementing component communications, Change detection and component lifecycle.

List of Exercise/Experiments:

Launching your app with Angular root module

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Write Web API/RESTful API application programming interface to communicate with Spring boot as a server-side technology.

CO2: Build single page applications using REACT as a reusable UI component technology as client-side technology

CO3: Build applications using Node Js as server-side technologies

CO4: Able to develop a web application using latest Angular Framework
CO5: Apply various Angular features including directives, components, and services.

TEXT BOOKS:

1. Somnath Musib, Spring Boot in Practice, Manning publication, June 2022 (https://www.manning.com/books/spring-boot-in-practice)
2. Alex Banks, Eve Porcello, "Learning React", May 2017, O'Reilly Media, Inc. ISBN: 9781491954621 (https://www.oreilly.com/library/view/learningreact/9781491954614/)
3. David Herron," Node.js Web Development - Fourth Edition",2018, Packt Publishing, ISBN: 9781788626859
4. Sukesh Marla, "A Journey to Angular Development Paperback ", BPB Publications. (https://in.bpbonline.com/products/a-journey-to-angulardevelopment?_pos=1&_sid=0a0a0e9fb&_ss=r)
5. Yakov Fain Anton Moiseev, "Angular Development with TypeScript", 2nd Edition. (https://www.manning.com/books/angular-development-with-typescript-secondedition).

REFERENCES:

1. Sue Spielman, The Struts Framework 1: A Practical guide for Java Programmers, 1st Edition. Elsevier 2002.
2. https://onlinecourses.nptel.ac.in/noc23_cs46/preview LIST OF EQUIPMENTS: VSCode, Angular JS, React JS, Node JS, Ruby, Django

22CS411	APTITUDE AND CODING SKILLS – II (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Develop advanced vocabulary for effective communication and reading skills.
- Build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

List of Exercises:

1. **English – Phase II**

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. **Logical Reasoning – Phase II**

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. **Quantitative Ability - Phase II**

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. **Automata Fix – Phase II**

Logical, Compilation and Code reuse

5. **Automata - Phase II**

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching

Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Develop advanced vocabulary for effective communication and reading skills.
CO2: Build an enhanced level of logical reasoning and quantitative skills.
CO3: Develop error correction and debugging skills in programming.
CO4: Apply data structures and algorithms in problem solving.

22CS412	MINI PROJECT AND DESIGN THINKING LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Introducing students to design thinking that enhances innovation activities in terms of value creation and sustainability in problem solving.
- Strengthen students' individual and collaborative capabilities to identify problems/ needs, develop sound hypotheses, collect, and analyze appropriate data, develop prototypes to collect meaningful feedback in a real-world environment.

LIST OF EXERCISES:

UNIT 1

Introduction: Design thinking overview- Design Process – Principles of Design Thinking –Problems Best suited for Design Thinking - Visualization tool – **Case Study:** Problem Identification **(6)**

UNIT 2

Empathize – Information Gathering – Analysis – Story Telling tool- Innovation- Ideation Finding and Evaluating Ideas Mind Mapping Tool

Case Study: Analysing the Identified Problem. **(6)**

UNIT 3

Designing Prototypes – Tasks in Prototyping –Understanding Different Prototypes- Developing different prototypes -Demonstration –Prototyping Tools

Case Study: Prototyping the solution. **(6)**

UNIT 4

Testing and Evaluation – Testing Prototypes – Evaluation – Improving solution – Strategic Opportunities –**Case Study:** Evaluating the solution. **(6)**

UNIT 5

Applications: HealthCare and Science – Education- Transportation - Finance – Technology. **(6)**

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the design thinking process and able to visualize the problem.
CO2: Analyse the problem using innovation tools
CO3: Design a prototype for an identified problem solution
CO4: Testing and evaluate strategies in improving the solution
CO5: Apply the innovation ideas to real-world applications.

22CS413	PRODUCT DEVELOPMENT LAB - 4 (Prototype Phase) (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Analyze the real-time problems in product development from an engineering perspective.
- Implement the DFMA process route to make and assemble the product.
- Test and qualify the product or a system with acquired knowledge.
- Identify the business opportunities for the developed product or process.

The student batch of PDD Lab 3 shall continue their product/ process design work under the guidance of the faculty incharge. All batches should cover the following stages of prototyping work as listed under activities. The faculty incharge shall conduct periodic reviews to endorse the work progress and during the review, the faculty shall provide suggestions/ideas to improvise the project towards completion. An interim report (consisting of BoM, Stages of Prototyping, photographs, proof of work done, etc..) for all listed activities should be submitted by the team during periodic review for evaluation. A final project report is required at the end of the semester and the evaluation is based on an oral presentation in front of the examiner panel constituted by the Head of the Department.

LIST OF ACTIVITIES:

1. Develop Engineering BoM for the approved industrial Mock-up from Phase III. Transform the Engineering BoM to develop a Prototype.
2. Devise / Plan an economically efficient manufacturing process to make the Prototype and testing.
3. Deliberation of the Product / Process outcome – Phase IV.
   Preparation and submission of a project report.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1 Identify the real-time problems through literature.

CO 2 Develop feasible solutions for the problems.

CO 3 Evaluate the methods to develop solutions to the problem.

CO 4 Analyze the business opportunities for a new product.

CO 5 Prepare a detailed report for the experimental dissemination.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No	Equipment Name	Quantity
1	CNC Router	1 No
2	3D Printer	1 No
3	3D Scanner	1 No
4	Laser cutting Machine	1 No

5	Centre lathe	2 Nos
6	Arc welding transformer with cables and holders	2 Nos
7	Plumbing tools	2 Sets
8	Carpentry tools	2 Sets
9	Multimeter	10 Nos
10	Drilling Machine	1 No
11	Solder Stations	5 Sets
12	Desoldering Machine	1 No
13	PCB Milling Machine	1 No
14	Variable Power Supply	1 No
15	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	10 Sets
16	Personal Desktop Computers	30 Nos
17	Numerical Simulation Tools	30 Licence
18	Test bench: Mech: Digital Micrometre/ Vernier/ Bore gauge/ etc EEE : (Based on the electrical components) ECE : (Based on the electronic components)	5 Nos

SEMESTER V

22AI501	DEEP LEARNING (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the basics of deep neural networks.
- To implement deep learning models.
- To elaborate CNN and RNN architectures of deep neural networks.
- To familiarize autoencoders in neural networks.
- To learn about the deep generative models.
- To apply Deep Learning to solve real-world problems.

UNIT I	DEEP NETWORKS	9+6

Challenges motivating deep learning - Deep feedforward networks - Learning XOR - Gradient based learning - Hidden Units – Architecture Design – Back Propagation – Regularization – Parameter Norm Penalties – Constrained Optimization – Under-Constrained Problems – Dataset Augmentation – Noise Robustness – Semi-Supervised Learning – Multi-Task Learning – Early Stopping – Parameter Tying and Sharing – Bagging and Other Ensemble methods – Dropout – Adversarial Training.

List of Exercises:

1. Implement a simple feed-forward neural network.
    a. Create a basic network
    b. Analyze performance by varying the batch size, number of hidden layers, learning rate.
    c. Create a confusion matrix to validate the performance of your model.
    d. Visualize a neural network.
2. Solve XOR problem using Multi Layer Perceptron.

UNIT II	OPTIMIZATION FOR TRAINING DEEP MODELS	9+6

Pure optimization – Challenges – Basic Algorithms – Parameter initialization Strategies – Algorithms with Adaptive Learning Rates – Approximate Second-Order methods – Optimization Strategies and Meta Algorithms.

List of Exercises:

1. Implement Stochastic Gradient Descent Algorithm.
2. Implement Gradient Descent with AdaGrad.

UNIT III	CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS	9+6

Convolution Operation – motivation – Pooling – Infinitely Strong prior – Variants – Structured Output – Data Types – Efficient Convolutional Algorithms – Random or Unsupervised features – Neuroscientific Basis - Deep Learning – Sequence Modelling - Computational Graphs - RNN - Bidirectional RNN – Encoder-Decoder - Sequence to Sequence RNN - Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units - Strategies for multiple time scales – LSTM and Gated RNNs - Optimization for Long Term Dependencies.

List of Exercises:

1. Implement a Recurrent Neural Networks (RNN) and process any sequential data such as characters, words or video frames.
2. Implement RNN with Long Short Term Networks (LTSM).

UNIT IV	AUTOENCODERS	9+6

Autoencoders: Undercomplete autoencoders - Regularized autoencoders – Power, Layer Size and Depth - Stochastic encoders and decoders – Denoising Autoencoders - Learning with autoencoders – contractive Autoencoders – Applications of autoencoders.

List of Exercises:

1. Implement different types of autoencoders.

UNIT V	DEEP GENERATIVE MODELS	9+6

Boltzmann Machine – Restricted Boltzmann Machine – Deep Belief Networks – Deep Boltzmann Machines - Boltzmann Machines for Real-Valued Data – Convolutional Boltzmann Machines - Boltzmann Machine for Structured or Sequential Outputs – Directed Generative Nets – Evaluating

Generative Models.

List of Exercises:

1. Solve a real world problem using CBM.

TOTAL: 45 + 30 = 75 PERIODS

OUTCOMES:

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

CO1: Demonstrate the basics of deep neural networks to solve real world problems**.**
CO2: Implement deep learning models.
CO3: Elaborate CNN and RNN architectures of deep neural networks.
CO4: Use autoencoders in neural networks.
CO5: Illustrate the various deep generative models.
CO6: Apply deep generative models to solve real world problems.

TEXT BOOKS:

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

REFERENCES:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.
2. Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
3. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.
4. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
5. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
6. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", John Wiley & Sons Inc., 2007.

22AI502	Data Exploration, Feature Engineering and Visualization	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To outline exploratory data analysis and the phases involved in data analysis.
- To discuss various statistical techniques for data analysis.
- To demonstrate the basics of feature engineering on different types of data.
- To perform data analysis and apply visualization techniques.
- To apply the methods of time series analysis.
- To formulate dashboards using different datasets by applying data engineering and feature extraction techniques.

UNIT I	EXPLORATORY DATA ANALYSIS	9+6

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA.

Visual Aids For EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Descriptive Statistics-types of kurtosis, quartiles, Grouping Datasets-data aggregation, group wise transformation.

List of Exercise/Experiments

1. Install the following Data Mining and data Analysis tool: Weka, KNIME, Tableau Public.
2. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.

UNIT II	FEATURE ENGINEERING	9+6

Text Data – Visual Data – Feature-based Time-Series Analysis – Data Streams – Feature Selection and Evaluation.

List of Exercise/Experiments

1. Implement document embeddings for fake news identification.
2. Implement feature based representations of time series
3. Implement feature selection algorithm for data streams

UNIT III	VISUALIZING DATA	9+6

The Seven Stages of Visualizing Data, Processing-load and displaying data – functions, sketching and scripting, Mapping - Location, Data, two sided data ranges, smooth interpolation of values over time - Visualization of numeric data and non-numeric data.

List of Exercise/Experiments

1. Perform text mining on a set of documents and visualize the most important words in a visualization such as word cloud.
2. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc..
3. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.

UNIT IV	TIME SERIES ANALYSIS	9+6

Overview of time series analysis - showing data as an area, drawing tabs, handling mouse input, Connections and Correlations – Preprocessing-introducing regular expression, sophisticated sorting, Scatterplot Maps-deployment issues.

List of Exercise/Experiments

1. Perform Time Series Analysis with datasets like Open Power System Data.
2. Build a time-series model on a given dataset and evaluate its accuracy.

UNIT V	TREES, HIERARCHIES, AND RECURSION	9+6

Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data.

List of Exercise/Experiments

1. Use a case study on a data set and apply the various visualization techniques and present an analysis report.
2. Mini-Project:- Create a Dashboard for a dataset with a visualization tool.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Outline exploratory data analysis and the phases involved in data analysis.
CO2: Demonstrate various statistical techniques for data analysis.
CO3: Present the basics of feature engineering on different types of data.
CO4: Perform data analysis and apply visualization techniques.
CO5: Apply the methods of time series analysis.
CO6: Develop dashboards using different datasets by applying data engineering and feature extraction techniques.

TEXT BOOKS:

1. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt Publishing , First Edition, March 2020.
2. Guozhu Dong, Huan Liu, "Feature Engineering for Machine Learning and Data Analytics", First Publication, CRC Press, First edition, 2018.
3. Ben Fry, “Visualizing Data”, O’reilly Publications, First Edition, 2007.

REFERENCES:

1. Danyel Fisher & Miriah Meyer, “Making Data Visual: A Practical Guide To Using Visualization For Insight”, O’reilly publications, 2018.
2. Claus O. Wilke, ”Fundamentals of Data Visualization”, O’reilly publications, 2019.
3. EMC Education Services, “Data Science and Big data analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2015.
4. Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press; 1st edition, 2014.
5. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

LIST OF EQUIPMENTS:

1. Systems with Python/R, Tableau Public / PowerBI

22CS511	ADVANCED APTITUDE AND CODING SKILLS - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

LIST OF EXERCISES:

1. English – Phase I Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase I Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification patternrecognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase I Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase I

Logical, Compilation and Code reuse

TOTAL: 30 PERIODS

OUTCOMES:

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

CO1: Develop vocabulary for effective communication and reading skills.

CO2: Build the logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

22AI512	INTERNSHIP AND CAREER READINESS COURSE	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- To outline the basics of Data Warehouse concepts.
- To write queries using SQL and NoSQL.
- To discuss the features of python.
- To understand the fundamentals of Cloud.
- To familiarize the basic algorithms in AI, ML and Prompt Engineering.

MODULE I	Data Warehouse Concepts, SQL, NoSQL

Data Warehouse concepts: Need for BI, Data Warehouse, Key terminologies related to DWH architecture: OLTP vs OLAP, ETL, Data Mart, Metadata, DWH Architecture, creating a DWH

Data Lakehouse: Data Lake to Data Swamp, SQL Relational Databases, Transactional Processing, Relational Database Workload Types, Architectural Challenges, Databricks Evolution

ETL: Extract Data Dump from source, Data format consistency, Data Quality rules, Truncate & Load, Load strategies, Load Approach, Transform, Mapping, Enriching, Joins, filter, Remove Duplicates, Aggregation, Load, Dimension, Facts, EDW Tables, Data Marts

Variety of ETL Tools: Apache Airflow, Datastage, Oracle Data Integrator, SSIS, Talend, Hadoop, AWS Glue, Azure Data Factory, Google Cloud Dataflow, Stitch, SAP, Hevo, Qlik, Airbyte

Informatica: Informatica Architecture, Informatica PowerCenter & Repository, Informatica PowerCenter Designer, Informatica PowerCenter workflow manager, Informatica PowerCenter workflow monitor, Run Mappings, Workflow creation & Deletion

SQL (Beginner): DQL, DDL, DML, Filtering and sorting Data, Grouping and Aggregating Data, Joins and Subqueries, Window Functions, Optimizing SQL queries, Automation.

SQL (Advanced): Store Procedure, Trigger, Views, Functions.

NoSQL: NoSQL Fundamentals and Comparison with SQL

Power BI: Connecting Data Sources and Data Bases, Data Modeling, Creating Calculated Fields in Power BI

MODULE II	Python, Cloud Fundamentals

Python (Beginner): Variables, Operators, functions, Libraries, Methods, Refactoring, Enum, Tuples, Dictionaries, sets, Map, filter, reduce, Class & objects, Exceptions, Overloading

Python (Advanced): Iterators, Modules, Packages, Generators, List, Comprehensions, Regular expressions, Serialization, Partial functions, closures, Decorators

AWS: Benefits of AWS, AWS Services - Computer, Storage, Database Service, Networking Service, Security Service, Management tool Service, Developer tool Service

Azure: Cloud Computing, Services in Azure - Compute, Containers, Databases, Identity, Security, Networking, Storage

GCP: Cloud Computing, Benefits of GCP, GCP services, AWS vs Azure vs GCP

Python with Deep Learning: Python Data Science Libraries, Numpy, Scipy, Pandas, Matplotlib, Scikit-Learn, Statsmodels, Pandas, Sorting, Concatenate, Preprocessing - Time Series Data, Visualization

Python with AI: Introduction, Demand of AI, What is AI, Types of AI, Why python for AI, Python Packages for AI

MODULE III	AI, ML, Prompt Engineering

Artificial Intelligence: Artificial intelligence and its types, AI Roadmap, Machine learning and its types, Linear regression Analysis, Classifications in Machine Learning

Machine Learning: AI vs ML, Classification vs regression, Supervised learning, Unsupervised learning, Training Model, Preparing Data, K-Nearest Neighbors, Naive Bayes, Logistic Regression, Support Vector Machine, Neural Networks, Tensorflow, K-Means Clustering, Principal Component Analysis, K-Means and PCA Implementations

Prompt Engineering: Introduction to AI, Linguistics, Language Models, Prompt Engineering Mindset, Zero shot and few shot prompts, AI hallucinations, Vectors/text embeddings.

Generative AI Fundamentals: Generative AI and its use cases, How do LLMS (Large Language Models) work, LLMs generates output for NLP task, LLM model decision criteria, Proprietary models, Fine tuned models, Mixing LLM flavors in workflow, Data privacy, Data security

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Apply the basics of Data Warehouse concepts.
CO2: Apply ETL Tools for Data processing.
CO3: Write queries using SQL and NoSQL.
CO4: Apply the features of python.
CO5: Elaborate the fundamentals of Cloud and various services.
CO6: Demonstrate the basic algorithms in AI, ML and summarize the basics of Prompt Engineering.

REFERENCES:

4. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
5. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012
6. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017
7. Elmasri R. and S. Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition, 2016.
8. Brett Powell , Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence, Packt Publications, 2018.
9. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt publishing, March 2020.
10. Ethem Alpaydin, “Introduction to Machine Learning, Adaptive Computation and Machine Learning Series”, Third Edition, MIT Press, 2015.
11. Nathan Hunter, The Art of Prompt Engineering with Chatgpt: A Hands-On Guide: 3 (Learn AI Tools the Fun Way!), Shroff/Hunter Publishers, 2023
12. Joseph Babcock and Raghav Bali, Generative AI with Python and TensorFlow 2, Packt Publications, 2021.

SEMESTER VI

22AI602	AUTOMATA THEORY AND COMPILER DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamental concepts of automata theory.
- To understand deterministic and non-deterministic finite automata.
- To elaborate on Regular Expressions and Grammars.
- To introduce Push down Automata and Turing Machines.
- To introduce the major concepts of language translation and compiler design.
- To elaborate the code optimization and code generation in compiler design.

UNIT I	INTRODUCTION TO AUTOMATA THEORY	9

Introduction to Finite Automata: Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems.
Nondeterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions.
Deterministic Finite Automata: Definition of DFA, How A DFA Process Strings, The language of DFA, Conversion of NFA with €-transitions to NFA without €-transitions. Conversion of NFA to DFA.

UNIT II	REGULAR EXPRESSIONS AND CONTEXT FREE GRAMMARS	9

Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions.
Pumping Lemma for Regular Languages: Statement of the pumping lemma, Applications of the Pumping Lemma.
Context-Free Grammars: Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.

UNIT III	PDA AND TURING MACHINES	9

Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA and CFG's, Acceptance by final state
Turing Machines: Introduction to Turing Machine, Formal Description, Instantaneous description, The language of a Turing machine .

UNIT IV	LEXICAL AND SYNTAX ANALYSIS	9

Introduction: The structure of a compiler,
Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex,
Syntax Analysis: Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom- Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers, Parser Generators YACC.

UNIT V	CODE GENERATION AND OPTIMIZATION	9

Code generation and optimization: Issues in the design of code generator, a simple code generator, Introduction to code optimization, Basic blocks & flow graphs, DAG representation of basic blocks, Peephole optimization, the principle sources of optimization.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Construct deterministic and non-deterministic finite automata.
CO2: Design context free grammars for formal languages using regular expressions.
CO3: Use PDA and Turing Machines for recognizing context-free languages.
CO4: Design a lexical analyzer.
CO5: Design syntax analyzer.
CO6: Design a simple code generator and apply different code optimizations.

TEXT BOOKS:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education, 2008.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles, Techniques and Tools", Second Edition, Pearson, 2013.

REFERENCES:

1. K.L.P Mishra and Chandrashekaran, Theory of Computer Science – Automata languages and computation, 3rd Edition, PHI, 2007.
2. Elain Rich, "Automata, Computability and complexity", 1st Edition, Pearson Education, 2018.
3. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publishers, 6th Edition, 2016.
4. K Muneeswaran, "Compiler Design", Oxford University Press, 2013.
5. John C Martin, Introduction to Languages and The Theory of Computation, TMH, 4th Edition, 2010.

22CS602	OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To explain software engineering principles and activities involved in building large software programs.
- To describe the process of requirements gathering, analysis and unified modelling
- To illustrate the object oriented design process.
- To analyse various traditional and object oriented testing methods
- To apply estimation techniques, schedule project activities and compute pricing.

UNIT I	PRODUCT AND PROCESS	9+6

The Nature of Software – Defining the Discipline – The Software Process – Process models – Prescriptive Process Models – Product and Process – Agility and Process – What is an Agile Process? - Scrum – Other Agile Frameworks – Kanban – DevOps

List of Exercise/Experiments:

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.

UNIT II	REQUIREMENTS AND UNIFIED MODELING	9+6

Requirements Engineering – Establishing the Groundwork: Nonfunctional Requirements – Requirements Gathering – Developing Use Cases – Negotiating and Validating Requirements.

Unified Modeling Language – Introduction – Static and Dynamic Models – Modelling – Introduction to the UML – UML Diagrams – UML Class Diagrams – Use-Case Diagram – UML Dynamic Modelling.

List of Exercise/Experiments:

1. Identify use cases and develop the Use Case model.
2. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.

UNIT III	OBJECT ORIENTED ANALYSIS AND DESIGN	9+6

Object oriented Analysis process – Business object Analysis – Use-case driven OOA – Business process modelling – Use case model. Design Concepts – Design Process – Design Concepts – Design Model: Design Principles and Design Elements. Architectural Design – Designing class-based components - Conducting Component Level Design – User Interface Analysis and Design – Pattern-Based Software Design.

List of Exercise/Experiments:

3. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
4. Draw relevant State Chart and Activity Diagrams for the same system

UNIT IV	SOFTWARE TESTING	9+6

Component Level: A Strategic Approach to Software Testing – White-Box Testing – Black Box Testing - Object Oriented Testing Integration Level: Integration Testing – AI and Regression Testing – Integration Testing in the OO Context Specialized Testing for Mobility: Web application Testing – Web Testing Strategies – Security Testing – Performance Testing – Real time Testing – Testing AI Systems – Testing Virtual

Environments.

List of Exercise/Experiments:

5. Implement the system as per the detailed design
6. Test the software system for all the scenarios identified as per the usecase diagram

UNIT V	**SOFTWARE PROJECT MANAGAMENT**	**9+6**

Software Metrics and Analytics: Software Measurement – Product Metrics. Creating a Viable Software Plan: The Project Planning Process – Software Scope and Feasibility – Decomposition and Estimation Techniques – Project Scheduling. Risk Management: Reactive Versus Proactive Risk Strategies – Risk Identification – Risk Projection – The RMMM Plan.

Software Process Improvement: The SPI Process – The CMMI

List of Exercise/Experiments:

7. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
8. Implement the modified system and test it for various scenarios

SUGGESTED DOMAINS FOR MINI-PROJECT:

1. Passport automation system.
2. Book bank
3. Exam registration
4. Stock maintenance system.
5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. E-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

TOTAL: 45 + 30= 75 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understanding Software and Software Processes

CO2: Analyze and **gather** software requirements.

CO3: Use UML to **create** static and dynamic models

CO4: Design software components using object-oriented principles.

CO5: Apply various software testing strategies.

CO6: Develop software projects effectively.

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering: A Practitioner‘s Approach” , McGraw Hill International Edition, Nineth Edition, 2020.
2. Ali Bahrami, “Object Oriented Systems Development”, McGraw Hill International Edition,2017.

REFERENCES:

1. Micheal Blalh and James Rumbaugh, Object Oriented Modeling and Design with UML, 2nd edition Pearson 2013.
2. Ian Sommerville, “Software Engineering”, Tenth Edition, Pearson Education, 2016.
3. Ivar Jacobson, Harold Bud Lawson, Pan-Wei Ng, Paul E. McMahon, Michael Goedicke, “The Essentials of Modern Software Engineering”, Morgan & Claypool Publishers, 2019.
4. Booch, G, Jacobson I, Rumbaugh J, “The Unified Modeling Language User Guide”, Addison Wesley, 2008.
5. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, 3rd edition, Addison Wesley, 2003.

LIST OF EQUIPMENTS:

ArgoUML, Visual Paradigm

22AI601	REINFORCEMENT LEARNING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To outline the concepts of Reinforcement Learning
- To solve problems using Monte Carlo Decision Process and Dynamic Programming.
- To implement problems using temporal difference learning.
- To apply functional approximation in reinforcement learning.
- To implement Deep Reinforcement Learning.
- To solve real-world problems using Reinforcement Learning.

UNIT I **INTRODUCTION TO REINFORCEMENT LEARNING** **9+6**

Introduction - Elements of RL, History of RL- Limitation and Scope - Examples – Multi-arm Bandits – k-armed Bandit Problem – Action-Value Methods – Incremental Implementation – Nonstationary Problem – Optimistic Initial Values – Upper Confidence Bound Action Selection – Gradient Bandit Algorithms – Contextual Bandits.

List of Exercises:

1. Implement a simple Tic-Tac-Toe game using reinforcement learning.
2. Implement a 10-armed Gradient bandit algorithm.

UNIT II **MONTE DECISION PROCESS AND DYNAMIC PROGRAMMING** **9+6**

Finite Markov Decision Processes - The Agent Environment interface - Goals and Rewards – Returns and Episodes – Episodic and Continuing Tasks – Policies and Value Functions – Optimality and Approximation - Dynamic Programming - Policy Evaluation - Policy Improvement, Iteration - Value Iteration - Asynchronous DP- Efficiency of DP - Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Off - policy Monte Carlo Prediction – Off-Policy Monte Carlo Controls.

List of Exercises:

1. Implement a game using dynamic programming in reinforcement learning.
2. Implement any real-world problem using Monte Carlo Algorithm.

UNIT III **TEMPORAL DIFFERENCE LEARNING** **9+6**

Temporal-Difference prediction – Advantages of TD Prediction Methods -Optimality of TD(0) – Sarsa: On-policy TD Control – Q Learning: Off-Policy TD Control – Expected Sarsa - n-step TD Prediction – n-step Sarsa - n-step Off-Policy Learning.

List of Exercises:

1. Implement SARSA.
2. Implement Q-learning.

UNIT IV **FUNCTION APPROXIMATION METHODS** **9+6**

On-Policy Prediction with Approximation: Value-function Approximation – The Prediction Objective – Stochastic-gradient and Semi-gradient Methods - Linear Methods – Feature Construction for Linear Methods - Eligibility Traces: The λ-return – TD(λ).

List of Exercises:

1. Solve a real world problem using Q-Learning with Linear Function Approximation.
2. Implement SARSA with Linear Function Approximation.

UNIT V **DEEP REINFORCEMENT LEARNING** **9+6**

Deep Q-Learning – Deep Q-Networks - Rainbow DQN – Policy Gradient Methods – Policy Approximation and its advantages – Policy Gradient Theorem – REINFORCE: Monte Carlo Policy Gradient - Actor-Critic Methods - Hierarchical RL – Multi-Agent RL.

List of Exercises:

1. Implement a game using Deep Reinforcement Learning.
2. Implement Deep Q-Learning in Python using Keras & OpenAI Gym for an agent that can play a game.

TOTAL: 45 +30 = 75 PERIODS

OUTCOMES:

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

CO1: Outline the concepts of Reinforcement Learning.
CO2: Solve problems using Dynamic Programming and Monte Carlo Decision Process.
CO3: Implement the concept of Temporal difference Learning (TML) to solve real world problems.
CO4: Apply functional approximation in reinforcement learning.
CO5: Implement Deep Reinforcement Learning to solve real world problems.
CO6: Solve real-world problems using Reinforcement Learning

TEXT BOOKS:

1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press, Second Edition, 2020.
2. Phil Winder, "Reinforcement Learning: Industrial Applications of Intelligent Agents". Oreilly, 2021.

REFERENCES:

1.Nimish Sanghi, "Deep Reinforcement Learning with Python with PyTorch, TensorFlow and OpenAI Gym", Apress, First Edition, 2021.
2.Maxim Lapan, "Deep Reinforcement Learning Hands-On", Packt, Second Edition, 2020.
3.Miguel Morales, "Deep Reinforcement Learning ", Miguel Morales, Manning Publication, 2020.
4.Kevin Murphy, "Machine Learning - A Probabilistic Perspective" , MIT press, 2012.
5.Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

LIST OF EQUIPMENTS:

Systems with Anaconda, Jupyter Notebook, Python, OpenAI Gym, TensorFlow, Keras, PyTorch

22CS611	ADVANCED APTITUDE AND CODING SKILLS - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

LIST OF EXERCISES:

1. English – Phase II Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase II Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase II Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase II

Logical, Compilation and Code reuse

5. Automata - Phase II

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Develop advanced vocabulary for effective communication and reading skills.

CO2: Build an enhanced level of logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

CO4: Apply data structures and algorithms in problem solving.

SEMESTER – VII

22AI701	BIG DATA ANALYTICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the fundamentals of Big Data analytics and framework to store and process the big data.
- To use Hadoop framework and Hadoop Distributed File system for big data processing.
- To use MongoDB for data manipulations.
- To apply data analysis using Hadoop ecosystem.
- To implement MapReduce programming model and to process the big data along with Hadoop technologies.
- To understand the advanced frame work for faster accessing and processing of Big Data.

UNIT I **INTRODUCTION TO BIG DATA PROCESSING** **9+6**

Need – Big Data: Classification – Characteristics – Types – Classification – Handling Techniques – Scalability and Parallel Processing – Data Architecture Design – Managing Data – Data Sources – Quality – Pre-processing – Storing in Cloud – Data Storage and Analysis – Applications.

List of Exercises:

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files

UNIT II **HADOOP FRAMEWORK** **9+6**

Introduction - Hadoop – Core Components – Features – Eco System Components – Streaming – Pipes - Hadoop Distributed File System (HDFS) - YARN - Map Reduce Framework and Programming Model – Map Tasks – Key-Value Pair – Grouping by Key – Partitioning – Combiners – Reduce Tasks – Processing Steps – Node Failures – Composing MapReduce for Calculations and Algorithms.

List of Exercises:

1. Develop a MapReduce program to calculate the frequency of a given word in a given file.
2. Implement of Matrix Multiplication with Hadoop Map Reduce.
3. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting file.

UNIT III **MONGODB** **9+6**

Introduction - Datatypes- Query Language, Cassendra – Features – Data Types – CRUD – Collections – Time to Live – Alter Commands – Import and Export – Querying System Table.

List of Exercise:

1. Installation and configuration of MongoDB.
2. Perform create, insert, drop, update, delete database operations in MongoDB.
3. Methods and indexing using MongoDB.

UNIT IV **DATA ANALYSIS WITH HIVE & PIG** **9+6**

Introduction - Hive Architecture-Data Types – File format – HQL (Hive Query Language) -RCFile Implementation - Pig: Overview - data types - Running Pig – Execution – Commands -Relational Operators - Eval Function - Complex Data Types

List of Exercises:

1. Create HIVE Database and Descriptive analytics-basic statistics, visualization using Hive.
2. Write queries to sort and aggregate the data in a table using HiveQL.
3. Installing and Configuring Apache PIG.
4. Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin.
5. Develop a program to Store and retrieve data in Pig.

UNIT V	LARGE-SCALE DATA PROCESSING	9+6

Spark – Spark SQL – Python with Spark – Data Analysis Operations – Programming with RDDs – Machine Learning with MLib – Data ETL Process – Analytics – Reporting – Visualization.

List of Exercises:

1. Develop a program to count word using Spark.
2. Develop an application to find the maximum temperature using Spark.

TOTAL: 45 + 30 = 75 PERIODS

OUTCOMES:

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

CO1: Apply the fundamentals of Big Data analytics and framework to store and process the big data.

CO2: Demonstrate the Hadoop framework Hadoop Distributed File System and MapReduce.

CO3: Apply MongoDB for data manipulations

CO4: Apply data analysis using Hadoop ecosystem.

CO5: Implement MapReduce programming model and to process the big data along with Hadoop technologies.

CO6: Illustrate advanced frameworks and tools for more efficient big data access and processing.

TEXT BOOKS:

3. Seema Acharya, Subhashini Chellappan, Big data and Analytics, Second Edition, 2019.
4. Raj Kamal, Preeti Saxena, Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning, First Edition, McGraw Hill Publications, 2019.

REFERENCES:

10. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., First Edition, 2016.
11. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Inc., Fourth Edition, 2015.
12. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.
13. Alan Gates, Programming Pig Dataflow Scripting with Hadoop, O'Reilly Media, Inc, 2011.
14. Mike Frampton, "Mastering Apache Spark", Packt Publishing 2015.
15. Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems", O'Relly 2012.
16. Mohammed Gulle, "Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis", Apress 2015.

LIST OF EQUIPMENTS:

2. Hadoop framework, Apache PIG and HIVE, MONGODB, Spark.

22AI702	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To learn the fundamentals of natural language processing
- To discuss word level analysis.
- To discuss the different language models.
- To understand the significance of syntactic and semantic analysis.
- To learn discourse algorithms and various lexical resources.

UNIT I **INTRODUCTION** **9+6**

Natural Language Processing - Ambiguities in NLP - Regular Expressions – Words – Corpora - Text Normalization, Minimum Edit Distance.

Lab Exercises:

1. NLTK basic Tasks.
    a. Tokenization
    b. Stemming
    c. Lemmatization
2. Identify the Patterns from given the given text document using Regular Expressions.

UNIT II **WORD LEVEL ANALYSIS** **9+6**

Morphological Analysis – Morphological Parsing - Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based - HMM - Transformation-based tagging.

Lab Exercises:

1. Implement POS tagging using Hidden Markov Models.
2. Write a program to compute unsmoothed unigram and bigrams.

UNIT III **LANGUAGE MODELS** **9+6**

Markov Chains – Hidden Markov Model – Forward Algorithm – Decoding: Viterbi Algorithm – Training HMMs – Maximum Entropy Models – Maximum Entropy Markov Models.

Lab Exercises:

1. Identify semantic relationships between words and sentences using different measures.
2. Implement Sequence Classification using Support Vector Machine model.
3. Implement Named Entity Recognition using ML Models.

UNIT IV **SYNTACTIC AND SEMANTIC ANALYSIS** **10+6**

Context-Free Grammars - Grammar rules - Treebanks - Normal Forms for grammar – Finite-state – CFG - Dependency Grammar – Parsing with CFG – Search – Ambiguity - Syntax-Driven Semantic analysis – Semantic Augmentations - Semantic attachments – Unification based approaches to Semantic Analysis – Semantic Attachments – Integrating Semantic Analysis to Early Parser – WordNet.

Lab Exercises:

1. Implement Word Embedding using Word2vec, FastText, Glove model
2. Implement Transformer models using Pytorch.

UNIT V **APPLICATIONS OF NLP** **8+6**

Information Extraction - Question Answering and Summarization – Dialogue and Conversational Agent - Machine Translation.

Lab Exercises:

1. Implement Chatbot.
2. Implement Neural Machine Translation using Encoder –Decoder model.

TOTAL: 30 + 45 = 75 PERIODS

OUTCOMES:

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

CO1: Elaborate the fundamentals of natural language processing.
CO2: Perform word level analysis in NLP.
CO3: Implement different ML models for NLP.
CO4: Analyze the syntax and semantics using various methods.
CO5: Develop skills in analyzing text at the word level.
CO6: Apply NLP to solve real-world problems.

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, Second Edition, 2019.

REFERENCES:

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, O'Reilly Media, 2009.
2. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
3. Richard M Reese, "Natural Language Processing with Java", O'Reilly Media, 2015.
4. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
5. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

22AI711	MLOPS	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To design and implement a Machine Learning Project.
- To perform data engineering and ML model engineering and develop a model.
- To perform model testing and validation.
- To deploy a ML model using CI/CD pipeline.

LIST OF EXERCISES:

1. Analyze messy customer purchase data (wrangling), compress for efficiency, and visualize buying trends to improve product recommendations.
2. Train a computer vision model to classify different types of flowers in images using transfer learning, evaluating with accuracy and confusion matrix.
3. Build a text classifier to distinguish between product reviews and customer support tickets using a pre-trained NLP library, evaluating with F1-score.
4. Build a recommendation system using collaborative filtering to suggest movies to users based on their watch history and ratings provided by similar viewers.
5. Train an image classifier (cifar-10) using a CNN with MLflow to optimize hyperparameters (learning rate, epochs) for maximizing accuracy.
6. Deploy a simple web application in a Docker container on Kubernetes, collecting user interactions with Filebeat and visualizing them in Kibana dashboards.
7. Build a CI/CD pipeline in Github Actions to automate training and deployment of a machine learning model (e.g., image classifier) using Jenkins, including model profiling with a profiler tool to identify performance bottlenecks.
8. Deploy two versions of a web application (A/B test) with Google Optimize, using a Canary pattern for initial risk assessment and measuring conversion rates for each version.
9. Deploy a sample web application (e.g., flask app) to a cloud platform (AWS), monitor application health metrics (CPU, memory) with Cloudwatch, and visualize them in Grafana Cloud dashboards.

TOTAL: 30 PERIODS

OUTCOMES:

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

CO1: Design and implement a Machine Learning Project.
CO2: Apply data engineering and ML model engineering and develop a model.
CO3: Apply model testing and validation.
CO4: Build and Deploy a ML model using CI/CD pipeline.

LIST OF EQUIPMENTS:

Systems with Anaconda, Jupyter Notebook, Python,

PROFESSIONAL ELECTIVES

ELECTIVE VERTICALS

VERTICAL I- ADVANCED ANALYTICS

22AI901	Business Intelligence and Analytics	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- To understand the business intelligence (BI) methodology and concepts.
- To learn about descriptive, inferential statistics and data warehousing operations.
- To analyze wide range of applications of data mining.
- To analyze the various prescriptive analytics methods.
- To develop and deploy Business Analytic Models.

UNIT I	OVERVIEW OF BUSINESS INTELLIGENCE	6+6

Evolution of Computerized Decision Support to Analytics- A Framework for Business Intelligence - Analytics Overview - Analytics Examples- Introduction to Big Data Analytics- Overview of the Analytics Ecosystem.

List of Exercise/Experiments

1. Perform Customer Segmentation, Classification using customer data of a certain organization. Analyze the data from the standpoint of paying capacity and purchasing pattern similarities among the company's clients.
2. Build a data model by taking an available data for a certain company and create a series of analysis and visualizations on various metrics related to the products of that company.

UNIT II	DESCRIPTIVE ANALYTICS	6+6

The Nature of Data- Data Preprocessing- Statistical Modeling for Business Analytics- Regression Modeling for Inferential Statistics- Business Reporting- Data Visualization- Types of charts and graphs- Visual Analytics- Information Dashboards- Business Intelligence and Data Warehousing- Data Warehousing Process - Data Warehousing architecture - Data Integration and the Extraction, Transformation, and Load (ETL) Processes- Data Warehouse Development.

List of Exercise/Experiments

1. Consider Groceries dataset for Market Basket Analysis and investigate customer's historical transactions. Focus on descriptive analytics of customer's purchase behavior, revealing interesting combinations of products that are frequently bought together, and creating valuable suggestions for the company.
2. Given Life Expectancy (WHO) dataset that provides information on both life expectancy and GDP per capita by year for different countries and regions, Explore and visualize the data using appropriate plots, and develop meaningful insights.

UNIT III	PREDICTIVE ANALYTICS	6+6

Data Mining Concepts – Data Mining Process – Data Mining Methods - Text Analytics and Text Mining – NLP – Applications – Process – Sentiment Analysis – Web Mining – Search Engines – Web Analytics – Social Analytics.

List of Exercise/Experiments

1. Perform Customer Review Sentiment Analysis with text data extracted from customer reviews of a certain company and explore it using specialized statistical and linguistic tools to identify positive, negative, and neutral experiences and their strength and subjectivity.

2. Using Microsoft Stock Data/Amazon Stock Data or INTEL Stock Data, Explore the company's historical stock performance and find insights about the future.

UNIT IV	PRESCRIPTIVE ANALYTICS	6+6

Model-based Decision Making – Structure of Mathematical Models for Decision Support – Certainty, Uncertainty and Risk – Decision Modelling – Multiple Goals, Sensitivity Analysis, WhatIf Analysis and Goal Seeking – Decision Analysis – Introduction to Simulation – Location-based Analytics for Organizations – Impacts of Analytics in Organization. Case study: prepare a detailed report on applications of analytics in different industries.

List of Exercise/Experiments

1. Perform Retail Price Optimization using dataset of price data for a retail company containing information such as product names, historical prices, product categories and characteristics, volume of sales, and time and geographic notations. Calculate the optimal selling prices for the products to create efficient, data-driven recommendations for the company.
2. Perform Credit Card Fraud Detection using online transactions dataset and analyze it for suspicious operations using statistical methods.

UNIT V	BUSINESS ANALYTICS MODEL	6+6

Overview of Business Analytics Model – Deployment of BA Model – Business Analytics at the Strategy Level – Link between Strategy and Deployment – Strategy and BA – Priority – Development and Deployment- Case Study: Specification of Requirements, Technical support - Establishing Business Processes – New Business Processes – Optimizing Existing Business Processes.

List of Exercise/Experiments

1. Consider Sales Product Dataset and analyze sales data from various aspects. Extract key performance indicators (KPIs) that will enable you to make data-driven decisions and improve company's business.
2. Perform Customer Churn Prediction and analyze a company's data to identify customers who are likely to churn based on a variety of factors, such as the number of calls to customer service and the total charge for calls.

TOTAL:30+30 = 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the business intelligence (BI) methodology and concepts.
CO2: Learn about descriptive, inferential statistics and data warehousing operations.
CO3: Analyze wide range of applications of data mining.
CO4: Analyze the various prescriptive analytics methods.
CO5: Develop and deploy Business Analytic Models.
CO6: Perform various analysis on different business models.

TEXT BOOKS:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence, Analytics, and Data Science: A Managerial Perspective", Pearson, 4th Edition, 2018.
2. Jesper Thorlund & Gert H.N. Laursen, "Business Analytics for Managers: Taking Business Intelligence beyond Reporting, Wiley, 2010.

REFERENCES:

1. Shmueli, Patel, and Bruce: Wiley, Data Mining for Business Intelligence, Concepts, Techniques and Applications, Wiley, 2010
2. R.N.Prasad and Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley, 2016.

LIST OF EQUIPMENTS:

1. Jupyter Notebook / Tableau / Power BI

22AI902	SOCIAL NETWORK ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To outline the components of the social network.
- To elaborate the modeling and visualization of the social network.
- To classify descriptive and inferential methods.
- To discuss about the evolution of the social network.
- To illustrate the applications in real time systems.

UNIT I	INTRODUCTION	9

Basics of Social Network Analysis: Introduction- The Social network and Representation -Types of Networks-Network parts and Level of Analysis-Networks as Social Structure and Institution- Theoretical Assumptions-Causality in Social Network Studies- A Brief History of Social Network Analysis-Mathematical Foundations: Graphs-Paths and components-Adjacency matrices-Ways and modes-Matrix products-Sources of network data-Types of nodes and types of ties- Data Collection: Network questions-Question formats-Interviewee burden-Data collection and reliability-Archival data collection-Data from electronic sources.

UNIT II	MODELING AND VISUALIZATION	9

Data Management: Data import-Cleaning network data- Data transformation-Normalization-Cognitive social structure data-Matching attributes and networks-Converting attributes to matrices-Data export,- Multivariate Techniques Used in Network Analysis: Multidimensional scaling-Correspondence analysis-Hierarchical clustering,- Visualization: Layout-Embedding node attributes-Node filtering-Ego networks-Embedding tie characteristics-Visualizing network change-Exporting visualizations-Closing comments.

UNIT III	DESCRIPTIVE AND INFERENTIAL METHODS	9

Descriptive Methods in Social Network Analysis: Graph and Matrix-Social Network Representation – Density – Centrality, Centralization and Prestige- Cliques – Multidimensional Scaling(MDS) and Dendogram – Structural Equivalence -Two mode Networks and Bipartite Matrix-Inferential Methods in Social Network Analysis: Permutation and QAP (Quadratic Assignment Procedure) Correlation-P* or Exponential Random Graph Model(ERGM).

UNIT IV	EVOLUTION	9

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT V	APPLICATIONS	9

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Outline the internal components and terminology of the social network.
CO2: Illustrate the fundamental exploratory multivariate techniques and visualizing network data.
CO3: Discuss most common descriptive and inferential statistical tools available.
CO4: Discuss about the evolution of the social network.

CO5: Illustrate the real time applications of social network analysis.
CO6: Apply the methods in Social Network Analysis to solve real world problems.

TEXT BOOKS:

1. Song Yang , Franziska B. Keller, "Social Network Analysis Methods and Examples", SAGE Publications Inc. 2017.
2. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, "Analyzing Social Networks", Second Edition, 2017.

REFERENCES:

1. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014 .
2. Przemyslaw Kazienko, Nitesh Chawla, "Applications of Social Media and Social Network Analysis", Springer,2015.
3. Ajith Abraham, Aboul Ella Hassanien, Vaclav Snasel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012.
4. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1st edition, 2011.
5. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2012.

22AI903	TEXT AND SPEECH ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the tools and techniques for performing text and speech analytics in diverse contexts.
- To understand the tools and technologies involved in developing text and speech applications.
- To demonstrate the use of computing for building applications in text and speech processing.
- To use information Retrieval Techniques to build and evaluate text processing systems.
- To apply advanced speech recognition methodologies in practical applications.

UNIT I	TEXT PROCESSING	9

Speech and Language Processing - Regular Expression - Text normalization – Edit Distance - Lemmatization – Stemming – N-gram Language Models - Vector Semantics and Embeddings.

UNIT II	TEXT CLASSIFICATION	9

Text Classification Tasks – Language Model – Neural Language Models – RNNs as Language Models – Transformers and Large Language Models.

UNIT III	QUESTION ANSWERING AND DIALOGUE SYSTEMS	9

Information Retrieval – Dense Vectors – Neural IR for Question Answering – Evaluating Retrieval-based Question Answering – Frame-based Dialogue Systems – Dialogue Acts and Dialogue State – Chatbots – Dialogue System Design.

UNIT IV	TEXT TO SPEECH SYNTHESIS	9

Automatic Speech Recognition Task – Feature Extraction for ASR: Log Mel Spectrum – Speech Recognition Architecture – CTC - ASR Evaluation: Word Error Rate – TTS – Speech Tasks.

UNIT V	SPEECH RECOGNITION	9

LPC for speech recognition - Hidden Markov Model (HMM) - Training procedure for HMM- subword unit model based on HMM - Language models for large vocabulary speech recognition - Overall recognition system based on subword units - Context dependent subword units- Semantic post processor for speech recognition.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Apply the fundamental techniques in text processing for various NLP tasks.
CO2: Implement advanced language models and improve text classification accuracy.
CO3: Designing text processing systems using state-of-the-art techniques.
CO4: Design, implement, and evaluate ASR and TTS systems.
CO5: Apply advanced speech recognition methodologies in practical applications.
CO6: Use information Retrieval Techniques to build and evaluate text processing systems.

TEXT BOOKS:

1. Jurafsky, D. and J. H. Martin, Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition Pearson Publication, Third Edition, 2022.
2. Lawrence Rabiner, Biing-Hwang Juang and B.Yegnanarayana, “Fundamentals of Speech Recognition”, Pearson Education, 2009.

REFERENCES:

1. John Atkinson-Abutridy, Text Analytics: An Introduction to the Science and Applications of Unstructured Information Analysis, CRC Press, 2022.
2. Jim Schwoebel, NeuroLex, Introduction to Voice Computing in Python, 2018
3. Lawrence R. Rabiner, Ronald W. Schafe, Theory and Applications of Digital Speech Processing, First Edition, Pearson, 2010.

4. Srinivasa-Desikan, Bhargav. Natural Language Processing and Computational Linguistics: A practical guide to text analysis with Python, Gensim, spaCy, and Keras. Packt Publishing Ltd, 2018.

22AI904	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To understand the basics of image processing techniques for computer vision and video analysis.
- To illustrate the techniques used for image pre-processing.
- To discuss the various image Segmentation techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the motion analysis techniques for video analytics.

UNIT I	INTRODUCTION	9

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II	IMAGE PRE-PROCESSING	9

Pixel brightness transformations - Geometric transformations - 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 - Detection of corners (interest points) - Detection of maximally stable extremal regions - Image restoration.

UNIT III	SEGMENTATION	9

Thresholding - Edge-based segmentation - Region-based segmentation – Matching - Evaluation issues in segmentation - Mean shift segmentation - Active contour models.

UNIT IV	OBJECT RECOGNITION	9

Knowledge representation - Statistical pattern recognition - Neural nets - Syntactic pattern recognition - Recognition as graph matching - Optimization techniques in recognition - Fuzzy systems - Boosting in pattern recognition - Random forests - Image understanding control strategies.

UNIT V	MOTION ANALYSIS	9

Differential motion analysis methods - Optical flow - Analysis based on correspondence of interest points - Detection of specific motion patterns - Video tracking - Motion models to aid tracking.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the basics of image processing techniques for computer vision and video analysis.
CO2: Illustrate the techniques used for image pre-processing.
CO3: Analyze the various image Segmentation techniques.
CO4: Understand the various Object recognition mechanisms.
CO5: Elaborate on the motion analysis techniques for video analytics.
CO6: Apply image processing techniques in real-world applications.

TEXT BOOKS:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.

REFERENCES:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited, 2011.
2. Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
4. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press,2012.

22AI905	STREAM PROCESSING AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To outline the framework for real time stream processing.
- To learn various algorithms for data streaming.
- To identify frequent item sets by mining from data streams.
- To introduce approaches to evaluate stream learning algorithms.
- To use tools for distributed data flow management.
- To design solutions to stream processing problems.

UNIT I	INTRODUCTION TO DATA STREAMS	9

Data Stream Models – Bounds of Random variables – Poisson Process – Maintaining Simple Statistics from Data Streams – Sliding Window and computing statistics over sliding windows – Data Synopsis – Sampling – Histograms – Wavelets – DFT - Change Detection: Tracking Drifting Concepts - Monitoring the Learning Process.

UNIT II	STREAMING ALGORITHMS	9

Clustering Examples: Basic Concepts - Partitioning Clustering – Hierarchical Clustering - Micro Clustering – Grid Clustering - Clustering Variables - The Very Fast Decision Tree Algorithm (VFDT) - The Base Algorithm, Analysis of the VFDT Algorithm, Extensions to the Basic Algorithm: Processing Continuous Attributes, Functional Tree Leaves, Concept Drift.

UNIT III	FREQUENT PATTERN MINING	9

Introduction – Heavy Hitters - Mining Frequent Itemsets from Data Streams - Landmark Windows - Mining Recent Frequent Itemsets - Frequent Itemsets at Multiple Time Granularities - Sequence Pattern Mining - Reservoir Sampling for Sequential Pattern Mining over data stream.

UNIT IV	EVALUATING STREAMING ALGORITHMS	9

Learning from Data Streams - Evaluation Issues - Design of Evaluation Experiments - Evaluation Metrics - Comparative Assessment - Evaluation Methodology in Non-Stationary Environments.

UNIT V	DATA FLOW MANAGEMENT	9

Distributed Data Flows – Apache Kafka – Apace Flume - Processing Streaming Data – Storing Streaming Data – Delivering Streaming Metrics.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Outline the framework for real time stream processing.
CO2: Elaborate various algorithms for data streaming.
CO3: Illustrate frequent item sets by mining from data streams.
CO4: Apply the metrics and procedures to evaluate a model.
CO5: Use tools for distributed data flow management.
CO6: Develop solutions for real-world problems using streaming data.

TEXT BOOKS:

1. Joao Gama, “Knowledge Discovery from Data Streams”, CRC Press, 2010.
2. Byron Ellis, Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data, First Edition, WILEY Big Data Series, 2014.

REFERENCES:

1. Andrew Psaltis, Streaming Data: Paul Lewis, First Edition, Manning Publication, 2017.
2. Bugra Gedik, Deepak S. Turaga, Henrique C. M. Andrade, Fundamentals of Stream Processing: Application Design, Systems, and Analytics, Cambridge University Press, 2014.
3. Charu C. Aggarwal, “Data Streams: Models and Algorithms”, Kluwer Academic Publishers, 2007.

4. David Luckham, “The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems”, Addison Wesley, 2002.

22AI906	COGNITIVE SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand cognitive computing.
- To know about design principles and NLP for Cognitive systems.
- To distinguish between Big Data and Cognitive computing.
- To discuss implications of cognitive computing in business.
- To develop applications of cognitive computing.

UNIT I	FOUNDATIONS OF COGNITIVE SCIENCE	9

Foundation of Cognitive Computing: cognitive computing as a new generation- the uses of cognitive systems- system cognitive- gaining insights from data- Artificial Intelligence as the foundation of cognitive computing- understanding cognition.

UNIT II	DESIGN PRINCIPLES FOR COGNITIVE SYSTEMS AND NLP IN COGNITIVE SYSTEMS	9

Components of a cognitive system- building the corpus- bringing data into cognitive system- machine learning- hypotheses generation and scoring- presentation and visualization services.
Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system- semantic web- Applying Natural language technologies to Business problems.

UNIT III	BIG DATA Vs COGNITIVE COMPUTING	9

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data- defining big data- architectural foundation- analytical data warehouses- Hadoop- data in motion and streaming data- integration of big data with traditional data.

UNIT IV	THE BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING	9

Preparing for change- advantages of new disruptive models- knowledge meaning to business- difference with a cognitive systems approach- meshing data together differently- using business knowledge to plan for the future- answering business questions in new ways- building business specific solutions- making cognitive computing a reality- cognitive application changing the market- IBM Watson as a cognitive system.

UNIT V	APPLICATIONS OF COGNITIVE COMPUTING	9

Build a cognitive health care application - Build a cognitive application on Smarter cities - Applicate Cognitive Computing principle in building a Government related application.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Elaborate the concepts of cognitive science and computing.
CO2: Design and Implementation of Cognitive Systems.
CO3: Apply NLP in cognitive systems.
CO4: Integrate Big Data and Cognitive computing.
CO5: Discuss implications of cognitive computing in business.
CO6: Develop various applications of cognitive computing.

TEXT BOOKS:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive computing and Big Data Analytics" , Wiley, 2015.

REFERENCES:

1. Vijay Raghvan, Venu Govindaraju, C.R. Rao, "Cognitive Computing: Theory and Applications", Elsevier publications, North Holland Publication, 1st Edition, 2016.

2. Mallick, Pradeep Kumar, Borah, Samarjeet, "Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.

VERTICAL II – APPLIED AI

22AI908	AI in BLOCK CHAIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge in Blockchain Technologies.
- To understand how block chain and AI can be used to innovate.
- To elaborate Cryptocurrencies and AI.
- To develop applications using blockchain.
- To understand the limitations and future scope of AI in Blockchain.

UNIT I	INTRODUCTION TO BLOCKCHAIN	9

Overview – Blockchain vs Distributed Ledger Technology vs Distributed Databases – Public vs private vs permissioned blockchains – Privacy in blockchains – Blockchain platforms - Hyperledger – Hashgraph, Corda – IOTA - Consensus Algorithms – Building DApps with blockchain tools.

UNIT II	BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE	9

Introduction to the AI landscape - AI and Blockchain driven Databases – Centralized vs Distributed data – Blockchain data – Big data for AI analysis – Global databases – Data Management in a DAO - Benefits of combining blockchain and AI – Aicumen Technologies -Combining blockchain and AI to humanize digital interactions.

UNIT III	CRYPTOCURRENCY AND AI	9

Bitcoins – Ethereum - Role of AI in cryptocurrency – cryptocurrency trading – Making price predictions with AI – Market making – future of cryptocurrencies.

UNIT IV	DEVELOPING BLOCKCHAIN PRODUCTS	9

Development Life Cycle of a DIApp – Designing a DIApp – Developing a DIApp – Testing – Deploying – Monitoring – Implementing DIApps.

UNIT V	LIMITATIONS AND FUTURE OF AI WITH BLOCKCHAIN	9

Technical Challenges – Business Model Challenges – Scandals and Public perception – Government Regulation – Privacy Challenges for Personal Records – Convergence of AI with Blockchain – Future – Enterprise.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Acquire knowledge in Blockchain Technologies.
CO2: Understand how block chain and AI can be used to innovate.
CO3: Elaborate Cryptocurrencies and AI.
CO4: Develop applications using blockchain.
CO5: Understand the limitations and future scope of AI in Blockchain.
CO6: Elaborate the various applications of AI in Blockchain.

TEXT BOOKS:

1. Ganesh Prasad Kumble, Anantha Krishnan, "Practical Artificial Intelligence and Blockchain: A guide to converging blockchain and AI to build smart applications for new economies", Packt Publications, 2020.
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015.

REFERENCES:

1. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017.

2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.

22AI909	COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection.
- To become familiar with feature based alignment and motion estimation.
- To develop skills on 3D reconstruction.
- To understand image based rendering and recognition.

UNIT I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II	FEATURE DETECTION, MATCHING AND SEGMENTATION	9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV	3D RECONSTRUCTION	9

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos

UNIT V	IMAGE-BASED RENDERING AND RECOGNITION	9

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Analyze and apply basic image processing techniques in practical applications.
CO2: Compare the concepts related to feature detection, matching and detection.
CO3: Implement feature-based alignment and motion estimation in real-world applications.
CO4: Create and Apply 3D Reconstruction techniques in diverse applications.
CO5: Perform image-based rendering and recognition.
CO6: Implement efficient solutions to image processing and computer vision problems.

TEXT BOOKS:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Person Education, Second Edition, 2015

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

22AI910	INTELLIGENT ROBOTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Intelligent Robots.
- To discuss the Autonomous capabilities and Software architecture.
- To elaborate the Reactive Functionality of intelligent Robots.
- To use the various sensors in building Intelligent Robots.
- To illustrate the Deliberative Functionality of intelligent Robots.

UNIT I	INTRODUCTION	9

Overview- Definition – Components -Three Modalities – Need for Intelligent Robots – History of AI Robotics – Industrial Manipulators – Mobile Robots – Drones – Cognitive Systems.

UNIT II	AUTOMATION AND AUTONOMY	9

Autonomous Capabilities – Bounded Rationality – Automation and Autonomy – Programming Style – Hardware Design – Types of Functional Failures – Autonomous Capabilities. Types of Software Architectures – Operational Architectures – Components of a Telesystem – Human Supervisory Control.

UNIT III	REACTIVE FUNCTIONALITY	9

Behaviours : Agency and Marr's Computational Theory – Animal Behaviours – Schema Theory. Perception: Action-Perception cycle – Functions. Behaviour Coordination – Function – Cooperating Methods – Competing Methods – Sequences.

UNIT IV	SENSORS AND SENSING	9

Locomotion: Mechanical, Biomimetic, Legged Locomotion – Action Selection – Sensors and Sensing Model – Choosing – Range Sensing: Stereo – Depth from X – Sonar or Ultrasonics.

UNIT V	DELIBERATIVE FUNCTIONALITY	9

Deliberation – Strips – Navigation – Spatial Memory – Types of Path Planning – Configuration Space – Metric Path Planning – Motion Planning – Localization – Feature based Localization – Iconic Localization – Static vs Dynamic Environments – Simultaneous Localization and Mapping - Terrain Identification and Mapping – Scale and Traversability - Exploration – Mutlirobot Systems and AI – Human-Robot Interaction and areas of AI.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basics of Intelligent Robots.
CO2: Design and implement Autonomous capabilities in Robotics systems.
CO3: Elaborate the Reactive Functionality of intelligent Robots.
CO4: Use the various sensors in building Intelligent Robots.
CO5: Illustrate the Deliberative Functionality of intelligent Robots.
CO6: Analyse the various applications of AI Robotics.

TEXT BOOKS:

1. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, Second Edition, 2019.

REFERENCES:

1. Francis X. Govers, "Artificial Intelligence for Robotics: Build Intelligent Robots that Perform Human Tasks Using AI Techniques", Packt Publishing, 2018.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics", MIT Press, 2005.
3. Yoon Seok Pyo, Han Cheol Cho, Ryu Woon Jung, and Tae Hoon Lim, "ROS Robot Programming", ROBOTIS Co., Ltd, 2017.

22AI911	GENERATIVE AI	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the basic concepts of Generative AI.
- Build Generative AI systems to generate outputs of different domains.
- Deploy Generative AI Models.
- Compare and use the various Large Language Models.
- Understand the basics of Prompt Engineering.

UNIT I	GENERATIVE AI CONCEPTS	9

Introduction to Generative AI – Deep Learning – Deep Neural Networks – Multi-Layer Perceptron – Convolutional Neural Network – Autoencoders - Variational Autoencoders – Latent Space.

UNIT II	GENERATIVE ADVERSARIAL NETWORKS	9

Deep Convolutional GAN (DCGAN) - Wasserstein GAN with Gradient Penalty (WGAN-GP) - Conditional GAN (CGAN) - Autoregressive Models - Long Short-Term Memory Network (LSTM).

UNIT III	FLOW MODELS	9

Normalizing Flows – RealNVP - Energy-Based Models - Denoising Diffusion Models (DDM).

UNIT IV	LARGE LANGUAGE MODELS	9

Overview of LLMs - Transformers – GPT – Types of LLMs – Key concepts – other Transformers – T5 – Generative Pre-Trained Models – Multi-modal Models – DALL.E 2

UNIT V	PROMPT ENGINEERING	9

Basics – In-Context Learning – In-Context Prompting – Techniques – Image Prompting – Prompt Hijacking – Challenges.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basic concepts of Generative AI.
CO2: Build Generative AI systems to generate outputs of different domains.
CO3: Deploy Generative AI Models.
CO4: Compare and use the various Large Language Models.
CO5: Understand the basics of Prompt Engineering.
CO6: Apply Generative AI to solve real world applications.

TEXT BOOKS:

1. David Foster, Generative Deep Learning, 2nd Edition, O'Reilly Media, 2023.
2. Amit Bahree, Generative AI in Action, Manning Publication, First Edition, 2023.

REFERENCES:

1. Numa Dhamani and Maggie Engler, Introduction to Generative AI, Manning Publication, First Edition, 2024.
2. Valentina Alto, Modern Generative AI with ChatGPT and OpenAI Models, Packt publications, 2024.

22CS925	GAME DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand game programming fundamentals.
- To learn about the processes, mechanics, issues in game design.
- To gain knowledge of the game design and Artificial intelligence.
- To understand the design and scripting languages of game programming.
- To know about networked games and analyse code for sample games.

UNIT I	INTRODUCTION	9

Evolution of video game programming-The Game Loop-Time and games-Game objects-2D rendering Foundations-Sprites-Scrolling-Tile maps-Vectors -Matrices.

UNIT II	3D GRAPHICS FOR GAMES	9

3D graphics-Basics-Coordinate-spaces-Lighting and Shading-visibility-Input Devices-Event based input system-Mobile Input-Basic sound-3D sound-Digital Signal Processing-Physics-Planes, Rays, and line segments-Collision geometry-Collision detection-Physics base movement-Physics middleware.

UNIT III	GAME DESIGN AND AI	9

Cameras-Types of cameras-Perspective projection-Camera implementation-Camera support algorithm- Real AI versus Game AI-Pathfinding-State based behaviours-Strategy and planning.

UNIT IV	USER INTERFACE AND SCRIPTING LANGUAGES	9

Menu system-HUD elements-Radar-other UI considerations-Scripting languages-Implementing a scripting language-Tokenization-Syntax Analysis-Code Execution or Generation-Data Formats-Case study UI mods in world of warcraft.

UNIT V	NETWORKED GAMES	9

Protocols-Network Topology-Server/Client-Peer-to-Peer-Cheating-Sample game -Side scroller for iOS, Tower defence for PC/Mac-Code Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the fundamentals of game programming.

CO2: Identify the processes, mechanics, issues in game design,
CO3: Analyse the game design and artificial intelligence.
CO4: Construct a basic game engine using UI and scripting languages.
CO5: Develop code for sample games.
CO6: Understand the 3D game design

TEXT BOOKS:

1. Sanjay Madhav, Game Programming Algorithms and Techniques:A platform -Agnostic Approach-Game Design,1st Edition, Addison-Wesley Professional,2013.
2. Jouni Smed, Harri Hakonen, Algorithms and Networking for Computer Games, 2nd Edition,Wiley Publications,2017.

REFERENCES:

1. Ernest Adams and Andrew Rollings, “Fundamentals of Game Design”, Prentice Hall 3rd Edition,2014.
2. JungHyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 1st Edition, 2011.

22CS921	INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners:

- To understand the basic technologies and protocols used in Industrial IoT.
- To illustrate the models and architectures of IIoT.
- To identify and apply different sensors for various IIoT applications.
- To explain the various protocols used in IIoT.
- To build solutions for real-world problems using IIoT.
- To solve real-world problems using IIoT analytics.

UNIT I	INTERNET OF THINGS (IoT)	9

Introduction – Networking – Cyber Physical Systems – Evolution of IoT – IoT Networking Components - Addressing Strategies – IoT Sensing and Actuation.

UNIT II	INDUSTRIAL IoT	9

Industry 4.0 – IIoT – Industrial Internet Systems – Industrial Sensing – Industrial Processes – Business Models and Reference Architecture.

UNIT III	SENSORS AND ACTUATORS	9

Sensors – Sensor Characteristics – Sensorial Deviations – Sensing Types - Considerations – Actuators – Actuator Types – Actuator Characteristics.

UNIT IV	PROTOCOLS	9

Processing topologies and types – Connectivity Technologies – IEEE 802.15.4 – Zigbee – RFID – LoRa – Wi-Fi – Communication Technologies – Constrained nodes – Networks – Infrastructure Protocols - IPV6 – Discovery Protocols – MQTT – MQTT-SN – SOAP - REST.

UNIT V	IIOT ANALYTICS AND APPLICATIONS	9

IIoT Analytics – Categorization – Use – Challenges – Mapping of analytics with IIRA Architecture – Deployment of Analytics – Health care applications in industries - Inventory Management and Quality Control – Plant Safety and Security.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Elaborate the basic technologies and protocols used in Industrial IoT.
CO2: Illustrate the models and architectures of IIoT.
CO3: Interpret and apply different sensors for various IIoT applications.
CO4: Explain the various protocols used in IIoT.
CO5: Build solutions for real-world problems using IIoT.
CO6: Solve real-world problems using IIoT analytics.

TEXT BOOKS:

1. S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT. Cambridge University Press, 2020.
2. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press, 2020.

REFERENCES:

1. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications,1st Edition, Wiley Publications, 2013.
2. Dieter Uckelmann , Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Industry 4.0: The Industrial Internet of Things, Springer-Verlag Berlin Heidelberg, 2011.

3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, CISCO Press, 2017.
5. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

VERTICAL III - AI AND CLOUD COMPUTING

22CS907	CLOUD FOUNDATIONS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- ✓ To describe the different ways a user can interact with Cloud.
- ✓ To discover the different compute options in Cloud and implement a variety of structured and unstructured storage models.
- ✓ To confer the different application managed service options in the cloud and outline how security in the cloud is administered in Cloud.
- ✓ To demonstrate how to build secure networks in the cloud and identify cloud automation and management tools.
- ✓ To determine a variety of managed big data services in the cloud.

UNIT I	INTRODUCTION TO CLOUD	6+6

Cloud Computing - Cloud Versus Traditional Architecture - IaaS, PaaS, and SaaS - Cloud Architecture - The GCP Console - Understanding projects - Billing in GCP - Install and configure Cloud SDK - Use Cloud Shell - APIs - Cloud Console Mobile App.

List of Exercise/Experiments:

1. Install and configure cloud SDK.
2. Connect to computing resources hosted on Cloud via Cloud Shell.

UNIT II	COMPUTE AND STORAGE	6+6

Compute options in the cloud - Exploring IaaS with Compute Engine - Configuring elastic apps with autoscaling - Exploring PaaS - Event driven programs - Containerizing and orchestrating apps - Storage options in the cloud - Structured and unstructured storage in the cloud - Unstructured storage using Cloud Storage - SQL managed services - NoSQL managed services.

List of Exercise/Experiments:

1. Create virtual machine instances of various machine types using the Cloud Console and the command line. Connect an NGINX web server to your virtual machine.
2. Create a small App Engine application that displays a short message.
3. Create, deploy, and test a cloud function using the Cloud Shell command line.
4. Deploy a containerized application.
5. Create a storage bucket, upload objects to it, create folders and subfolders in it, and make objects publicly accessible using the Cloud command line.

UNIT III	APIs AND SECURITY IN THE CLOUD	6+6

The purpose of APIs – API Services - Managed message services - Introduction to security in the cloud - The shared security model - Encryption options - Authentication and authorization with Cloud IAM - Identify Best Practices for Authorization using Cloud IAM.

List of Exercise/Experiments:

1. Deploy a sample API with any of the API service.
2. Publish messages with managed message service using the Python client library.
3. Create two users. Assign a role to a second user and remove assigned roles associated with Cloud IAM. Explore how granting and revoking permissions works from Cloud Project Owner and Viewer roles.

UNIT IV	NETWORKING, AUTOMATION AND MANGAEMENT TOOLS	6+6

Introduction to networking in the cloud - Defining a Virtual Private Cloud - Public and private IP address basics - Cloud network architecture - Routes and firewall rules in the cloud - Multiple VPC networks - Building hybrid clouds using VPNs - Different options for load balancing - Introduction to Infrastructure as Code - Terraform - Monitoring and management tools.

List of Exercise/Experiments:

1. Create several VPC networks and VM instances and test connectivity across networks.
2. Create two nginx web servers and control external HTTP access to the web servers using tagged firewall rules.
3. Configure a HTTP Load Balancer with global backends. Stress test the Load Balancer and denylist the stress test IP.
4. Create two managed instance groups in the same region. Then, configure and test an Internal Load Balancer with the instances groups as the backends.
5. Monitor a Compute Engine virtual machine (VM) instance with Cloud Monitoring by creating uptime check, alerting policy, dashboard and chart.

UNIT V	BIG DATA AND MACHINE LEARNING SERVICES	6+6

Introduction to big data managed services in the cloud - Leverage big data operations - Build Extract, Transform, and Load pipelines - Enterprise Data Warehouse Services - Introduction to machine learning in the cloud - Building bespoke machine learning models with AI Platform - Pre-trained machine learning APIs.

List of Exercise/Experiments:

1. Create a cluster, run a simple Apache Spark job in the cluster, then modify the number of workers in the cluster.
2. Create a streaming pipeline using one of the cloud service.
3. Set up your Python development environment, get the relevant SDK for Python, and run an example pipeline using the Cloud Console.
4. Use cloud-based data preparation tool to manipulate a dataset. Import datasets, correct mismatched data, transform data, and join data.

5. Utyilize a cloud-based data processing and analysis tool for data exploration and use a machine learning platform to train and deploy a custom TensorFlow Regressor model for predicting customer lifetime value.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Describe the different ways a user can interact with Cloud.

CO2: Discover the different compute options in Cloud and implement a variety of structured and unstructured storage models.

CO3: Discuss the different application managed service options in the cloud and outline how security in the cloud is administered in Cloud.

CO4: Demonstrate how to build secure networks in the cloud and identify cloud automation and management tools.

CO5: Discover a variety of managed big data services in the cloud.

REFERENCES:

1. https://cloud.google.com/docs
2. https://www.cloudskillsboost.google/paths/36
3. https://nptel.ac.in/courses/106105223
4. Anthony J. Sequeira, "AWS Certified Cloud Practitioner (CLF-C01) Cert Guide", First Edition, Pearson Education, 2020.
5. AWS Documentation (amazon.com)
6. AWS Skill Builder
7. AWS Academy Cloud Foundations Course - https://www.awsacademy.com/vforcesite/LMS_Login

LIST OF EQUIPMENTS:

GCP / CloudSkillBoost Platform/AWS Console /AWS Academy Learner Lab.

22CS909	VIRTUALIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- ✓ To explain the fundamental concepts of virtualization
- ✓ To analyze the role of hypervisors in hardware virtualization
- ✓ To apply the understanding of CPU, memory (MMU), and I/O virtualization techniques
- ✓ To assess security considerations of virtualized environments
- ✓ To discuss strategies for protecting VMs and data centers

UNIT I	INTRODUCTION	9

Virtualization - Virtual Machines - Hypervisors - Type-1 and Type-2 Hypervisors - Multiplexing and Emulation - Approaches to Virtualization and Paravirtualization - Benefits of Using Virtual Machines. Working with Virtual Machines.

UNIT II	HARDWARE VIRTUALIZATION	9

The Popek/Goldberg Theorem - Virtualization without Architectural Support: Full Virtualization - Paravirtualization - Designs Options for Type-1 Hypervisors. Hypervisors: Describing a Hypervisor - Role of Hypervisor - VMWare ESX - Citrix Hypervisor - Microsoft Hyper-V.

UNIT III	TYPES OF VIRTUALIZATIONS	10

CPU Virtualization with VT-x: Design requirements - The VT-x Architecture - KVM. MMU Virtualization: Extended Paging - Virtualizing Memory in KVM. I/O Virtualization: Benefits of I/O Interposition - Physical I/O - Virtual I/O Without Hardware Support- Virtual I/O with Hardware Support. Virtualization Support in ARM Processors.

UNIT IV	VIRTUALIZATION SECURITY	9

Fundamentals of Virtualization Security: Virtualization Architecture - Threats to a Virtualized Environment. Securing Hypervisors: Hypervisor Configuration and Security. Designing Virtual Networks for Security: Comparing Virtual and Physical Networks - Virtual Network Security Considerations - Configuring Virtual Switches for Security.

UNIT V	VIRTUALIZATION AND AVAILABILITY	8

Availability - Protecting a Virtual Machine - Protecting Multiple Virtual Machines - Protecting Datacenters - Deploying Applications in a Virtual Environment - Recent Trends in Virtualization.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basics of virtualization and its benefits.

CO2: Assess the significance of hypervisors in hardware virtualization, examining their roles and implications for system efficiency and performance

CO3: Utilize knowledge of virtualization technologies to solve practical problems and implement effective solutions

CO4: Analyze security threats and design secure virtual networks

CO5: Discuss strategies to improve availability in virtual environment and for protecting VMs and data centers

TEXTBOOKS:

1. Edouard Bugnion, Jason Nieh, Dan Tsafrir, “Hardware and Software Support for Virtualization”, Morgan & Claypool Publishers, 2017.
2. Matthew Portnoy, “Virtualization Essentials”, Third Edition, Sybex - John Wiley & Sons, 2023.
3. Dave Shackleford, “Virtualization Security: Protecting Virtualized Environments”, Sybex - John Wiley & Sons, 2012.

REFERENCES:

1. Nelson Ruest, Danielle Ruest, Virtualization, A beginners guide, 2009, McGrawHill.
2. Nadeau,Tim Cerng, Je Buller, Chuck Enstall, Richard Ruiz, Mastering Microsoft Virtualization, Wiley Publication, 2010.
3. William Von Hagen, Professional Xen Virtualization, Wiley Publication, 2008.

22CS910	DEVOPS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Bridge the gap between development and operations for faster, more reliable software releases.
- Automate software delivery with CI/CD pipelines.
- Package and deploy apps efficiently using Docker containers.
- Automate infrastructure with Infrastructure as Code (IaC).
- Monitor and troubleshoot applications in production.

UNIT I	INTRODUCTION TO DEVOPS	9

Software Development Methodologies - Operations Methodologies - Systems Methodologies - Development, Release, and Deployment Concepts - Infrastructure Concepts. What is DevOps? - DevOps importance and benefits -DevOps principles and practices - 7 C's of DevOps lifecycle for business agility - DevOps and continuous testing. How to choose right DevOps tools? - Challenges with DevOps implementation.

UNIT II	VERSION CONTROL WITH GIT	9

Introduction to Git version control system - Git commands for basic operations (clone, commit, push, pull) - Branching and merging strategies - Collaboration using Git workflows.

UNIT III	CONTINUOUS INTEGRATION AND DELIVERY (CI/CD)	9

Introduction to CI/CD pipelines - Benefits of CI/CD for faster deployments - Setting up a CI/CD pipeline with Jenkins - Automating builds, tests, and deployments.

UNIT IV	CONTAINERIZATION WITH DOCKER	9

Introduction to containerization and its benefits - Understanding Docker concepts: images, containers, registries - Building and managing Docker containers - Docker Compose for multi-container applications - Introduction to container orchestration with Docker Swarm or Kubernetes.

UNIT V	INFRASTRUCTURE AS CODE (IAC) AND MONITORING	9

Introduction to Infrastructure as Code (IaC) - Benefits of using IaC for repeatable infrastructure provisioning - Learning IaC with Terraform - Setting up infrastructure configurations with Terraform - Introduction to monitoring and logging tools for applications - Alerting and troubleshooting techniques.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the core principles and philosophies of DevOps.
CO2: Implement version control systems for code management and collaboration.
CO3: Automate software delivery pipelines using CI/CD tools.
CO4: Utilize containerization technologies for packaging and deploying applications.
CO5: Configure infrastructure as code (IaC) for repeatable deployments.
CO6: Monitor and maintain applications in a production environment.

TEXT BOOKS:

3. Deepak Gaikwad, Viral Thakkar, "DevOps Tools: from Practitioner's Point of View", Wiley, 2019.
4. Jennifer Davis, Ryn Daniels, "Effective DevOps", O'Reilly Media, 2016.

REFERENCES:

3. Gene Kim, Jez Humble, Patrick Debois, "The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations", IT Revolution Press, 2016.

4. Jez Humble, Gene Kim, "Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation", Addison-Wesley, 2010.
5. Yevgeniy Brikman, "Terraform: Up & Running: Writing Infrastructure as Code", O'Reilly Media, 2019.
6. Joseph Muli, "Beginning DevOps with Docker", Packt Publishing, 2018.

22CS911	DATA ENGINEERING IN CLOUD	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- ✓ To grasp the fundamentals of data engineering, emphasizing cloud-based data access.
- ✓ To construct robust and secure data pipelines using AWS services.
- ✓ To select and implement appropriate data storage solutions while prioritizing pipeline security.
- ✓ To utilize cloud tools for handling extensive data for machine learning purposes.
- ✓ To efficiently analyze, visualize, and automate data pipelines to streamline operations.

UNIT I	INTRODUCTION	8

Introduction to data Engineering - The Data Engineering Life Cycle - Data Engineering and Data Science - Data-Driven Organizations: Data-driven decisions - The data pipeline - The role of the data engineer in data-driven organizations - Modern data strategies - The Elements of Data: The five Vs of data – volume, velocity, variety, veracity, and value. Demo: Accessing and Analyzing Data by Using Amazon S3.

UNIT II	SECURE AND SCALABLE DATA PIPELINES	10

The evolution of data architectures - Modern data architecture on AWS - Modern data architecture pipeline: Ingestion and storage - Processing and consumption - Streaming analytics pipeline - Security of analytics workloads - Scaling - Creating a scalable infrastructure and components. ETL and ELT comparison - Data wrangling.

UNIT III	STORING AND ORGANIZING DATA	9

Comparing batch and stream ingestion - Batch ingestion processing - Purpose-built ingestion tools - AWS Glue for batch ingestion processing - Kinesis for stream processing - Scaling considerations for batch processing and stream processing - Storage in the modern data architecture - Data lake storage - Data warehouse storage - Purpose-built databases - Storage in support of the pipeline - Securing storage.

UNIT IV	PROCESSING BIG DATA AND DATA FOR ML	10

Big data processing concepts - Apache Hadoop - Apache Spark - Amazon EMR - Managing your Amazon EMR clusters - Apache Hudi - The ML lifecycle - Collecting data - Applying labels to training data with known targets - Preprocessing data - Feature engineering - Developing a model - Deploying a model - ML infrastructure on AWS - SageMaker - Amazon CodeWhisperer - AI/ML services on AWS.Monitor a Compute Engine virtual machine (VM) instance with Cloud Monitoring by creating uptime check, alerting policy, dashboard and chart.

UNIT V	DATA ANALYSIS AND VISUALIZATION	8

Introduction to big data managed services in the cloud - Leverage big data operations - Build Extract, Transform, and Load pipelines - Enterprise Data Warehouse Services - Introduction to machine learning in the cloud - Building bespoke machine learning models with AI Platform - Pre-trained machine learning APIs.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand data engineering, pipelines & access data in the cloud.

CO2: Build secure & scalable data pipelines using AWS services.

CO3: Choose the right data storage & secure your data pipelines.

CO4: Process big data for machine learning with cloud tools.

CO5: Analyze & visualize data and automate data pipelines.

TEXT BOOKS:

1. Martin Kleppman, "Data Engineering: Building Reliable Scalable Data Systems", O'Reilly Media, 2017.
2. Wes McKinney, "Python for Data Analysis", 2nd Edition, O'Reilly Media, 2017.
3. Martin Kleppman, "Designing Data-Intensive Applications", O'Reilly Media, 2017.

REFERENCES:

1. AWS Documentation (amazon.com)
2. AWS Skill Builder
3. AWS Academy Data Engineering Course - https://www.awsacademy.com/vforcesite/LMS_Login

22CS933	MACHINE LEARNING FOR NLP IN CLOUD	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Illustrate how to apply the ML pipeline to NLP.
- Implement text extraction to obtain data from web pages.
- Build a solution that uses AWS services to transcribe and translate text from multimedia.
- Build a solution using a combination of algorithms and Amazon Machine Learning (Amazon ML) services.
- Identify use cases to use generative AI and LLMs.
- Use LLMs with AWS generative AI services.

UNIT I	Introduction to NLP	8

NLP – Business Problems Solved by NLP – NLP Roles - NLP and ML – Common NLP tasks – Apply ML to NLP problem - Evolution of NLP architectures.

UNIT II	Processing Text for NLP	10

Text processing overview - Getting text - Extracting Text from Webpages and Images - Text preprocessing - Vectorizing text - Encoding and Vectorizing Text - Advanced processing - Storing and visualizing unstructured data – Implement Sentiment Analysis - Identifying the steps for text processing - Examining the algorithms for sentiment analysis.

UNIT III	Information Extraction	9

Information extraction overview - Types of information extraction - Implementing information extraction – Working with Entities - Topic Modeling - Identifying the approach - Implementing Topic Modeling with Amazon Comprehend, Neural Topic Model (NTM).

UNIT IV	Translating Languages	9

Working with language issues - Detecting and translating languages - Transcribing and vocalizing text with AWS services - Implementing a Multilingual Solution.

UNIT V	Generative AI	9

Generative AI - Amazon Bedrock Overview - Introducing foundations models and large language models - Transformer architecture - LLMs configuration parameters - Introducing prompt engineering - Use LLMs to Perform NLP Tasks - Adapting LLMs - Application Integration.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Apply the ML pipeline to NLP.
CO2: Implement text extraction to obtain data from webpages.
CO3: Build a solution that uses AWS services to transcribe and translate text from multimedia.
CO4: Build a solution using a combination of algorithms and Amazon Machine Learning (Amazon ML) services.
CO5: Identify use cases to use generative AI and LLMs.
CO6: Use LLMs with AWS generative AI services.

TEXT BOOKS:

1. Mona M, Premkumar Rangarajan, Natural Language Processing with AWS AI Services, Packt Publications, 2021

REFERENCES:

1. Saket S R Mengle, Maximo Gurmendez, Mastering Machine Learning on AWS: Advanced machine learning in Python using SageMaker, Apache Spark, and TensorFlow, Packt Publications, 2019.
2. AWS Documentation (amazon.com)
3. AWS Skill Builder
4. AWS Academy Machine Learning for Natural Language Processing Course - https://www.awsacademy.com/vforcesite/LMS_Login

22CS934	CLOUD SERVICES MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- ✓ Introduce Cloud Service Management terminology, definition & concepts
- ✓ Compare and contrast cloud service management with traditional IT servicemanagement
- ✓ Identify strategies to reduce risk and eliminate issues associated with adoption ofcloud services
- ✓ Select appropriate structures for designing, deploying and running cloud-basedservices in a business environment
- ✓ Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT II	CLOUD SERVICES STRATEGY	9

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, KeyDriver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT III	CLOUD SERVICE MANAGEMENT	9

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud ServiceCapacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT IV	CLOUD SERVICE ECONOMICS	9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User,Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT V	CLOUD SERVICE GOVERNANCE & VALUE	9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

VERTICAL IV – HIGH PERFORMANCE COMPUTING

22AI912	MULTI-CORE ARCHITECTURES AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms.
- To develop multi core programs.
- To design parallel solutions.

UNIT I	MULTI-CORE PROCESSORS	9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design

UNIT II	PARALLEL PROGRAM CHALLENGES	9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III	SHARED MEMORY PROGRAMMING WITH OpenMP	9

Compiling and running OpenMP programs,The Trapezoidal rule,The parallel for directive, scheduling loops- Producers and consumers .

UNIT IV	DISTRIBUTED MEMORY PROGRAMMING WITH MPI	9

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.

UNIT V	PARALLEL PROGRAM DEVELOPMENT	9

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Illustrate multicore architectures and identify their characteristics and challenges.
CO2: Identify the issues in programming Parallel Processors.
CO3: Write programs using OpenMP and MPI.
CO4: Design parallel programming solutions to common problems.
CO5: Compare and contrast programming for serial processors and programming for parallel processors.
CO6: Elaborate on various concepts of multi-core architectures.

TEXT BOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011.

REFERENCES:

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP‖", Tata McGraw Hill,2003.
2. Victor Alessandrini, "Shared Memory Application Programming Concepts and Strategies in Multicore Application Programming, ", 1st Edition, Morgan Kaufmann, 2015.
3. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", CRC Press, 2015.

22AI913	GPU COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To understand the basics of GPU Architectures and CUDA Programming.
- To learn synchronization using CUDA.
- To discuss memories and its impact on performance.
- To understand the various parallel algorithms on GPU.
- To learn the basics of OPENCL.

UNIT I	GPU ARCHITECTURES AND CUDA PROGRAMMING	9

Heterogeneous Parallel Computing – Architecture of a modern GPU – Parallel Programming languages and models – GPU Computing – Introduction to Data Parallelism and CUDA C: Data Parallelism – CUDA Program Structure – A vector additional Kernel – Device Global Memory and Data Transfer – Kernel functions and Threading.

UNIT II	MULTI-DIMENSIONAL DATA & SYNCHRONIZATION	9

CUDA Thread Organization - Mapping Threads to Multi-Dimensional Data – Synchronization and Transparent Scalability – Assigning resources to Blocks – Querying Device Properties – Thread Scheduling and Latency Tolerance.

UNIT III	CUDA MEMORIES & PERFORMANCE	9

CUDA Memories – Memory Access Efficiency – CUDA Device Memory Types – Reducing global Memory Traffic – Performance Considerations - Warps and Thread Execution – Global Memory Bandwidth – Dynamic Partitioning of Execution Resources – Instruction Mix and Thread Granularity.

UNIT IV	ALGORITHMS ON GPU	9

Parallel Patterns: Convolution – Prefix Sum – Sparse Matrix – Vector Multiplication.

UNIT V	OPENCL BASICS	9

Introduction – OpenCL Platform Model – Execution Model – Programming model – Memory Model – OpenCL Runtime.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the basics of GPU Architectures and implement simple CUDA Programs.
CO2: Discuss synchronization using CUDA.
CO3: Elaborate CUDA memories and its impact on performance.
CO4: Design various parallel algorithms on GPU.
CO5: Solve simple problems using parallel algorithms.
CO6: Apply OpenCL to solve programs and improve performance.

TEXT BOOKS:

1. David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors – A hands-on Approach, Morgan Kaufmann, Second Edition, 2013.
2. Benedict Gaster,Lee Howes, David R. Kaeli , “Heterogeneous Computing with OpenCL”, Third Edition, Morgan Kaufman, 2012.

REFERENCES:

1. David Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous Computing with OpenCL 2.0”, Third Edition, Morgan Kaufman, 2015.
2. John L.Hennessy and David A. Patterson, “Computer Architecture - A Quantitative Approach”, Sixth Edition, Morgan Kaufman, 2017.
3. NPTEL Courses:
   a. GPU Architectures And Programming - https://onlinecourses.nptel.ac.in/noc23_cs61/preview

22CS924	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To analyse the behaviour of basic quantum algorithms
- To discuss simple quantum algorithms and information channels in the quantum circuit model
- To apply the Quantum Algorithms in Superdense coding and quantum Teleportation
- To analyse the Algorithms with Superpolynomial Speed-up
- To illustrate a simple quantum error-correcting code

UNIT I	FOUNDATION	9

Overview of traditional computing – Church-Turing thesis – circuit model of computation – reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem – functions of operators – tensor products – Schmidt decomposition theorem

UNIT II	QUBITS AND QUANTUM MODEL OF COMPUTATION	9

State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits

UNIT III	QUANTUM ALGORITHMS – I	9

Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch-Jozsa algorithm – Simon's algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation

UNIT IV	QUANTUM ALGORITHMS – II	9

Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability 101

UNIT V	QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION	9

Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyse the behaviour of basic quantum algorithms
- Discuss simple quantum algorithms and information channels in the quantum circuit model

- Apply the Quantum Algorithms in Superdense coding and quantum Teleportation
- Analyse the Algorithms with Superpolynomial Speed-up
- Illustrate a simple quantum error-correcting code

REFERENCES:

1. P. Kaye, R. Laflamme, and M. Mosca, “An introduction to Quantum Computing”, Oxford University Press, 2007. (Unit 1 to 5)
2. E. Rieffel and W. Polak “Quantum Computing A Gentle Introduction”, The MIT Press Cambridge, 2011.
3. Jack D. Hidary “Quantum Computing: An Applied Approach” Springer, 2019.
4. V. Sahni, “Quantum Computing”, Tata McGraw-Hill Publishing Company, 2007.
5. Michael A. Nielsen and Issac L. Chuang, “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010

22AI914	SCALABLE MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Discuss the basics of how distributed computing is applied in scaling up machine learning process.
- Use scalable machine learning frameworks for parallel learning.
- Apply parallel Machine Learning Algorithms that can scale up.
- Distinguish traditional ML algorithms and Scalable ML algorithms.
- Discuss alternative learning for scalability.
- Solve Large-scale real-world problems using GPUs and Multi-core systems.

UNIT I	INTRODUCTION	9

Scaling Up – Reasons – Key Concepts – Platforms – Distributed Machine Learning – Stages of ML Workflow – Tools and Technologies in ML Pipeline – Distributed Computing Models – Distributed Systems Architecture – Ensemble Models – Challenges.

UNIT II	FRAMEWORKS FOR SCALLING UP	9

Apache Spark Architecture – PySpark – MapReduce for Massively Parallel Learning – Uniformly Fine-Grained Data-Parallel Computing – GP-GPU.

UNIT III	LEARNING ALGORITHMS	9

PSVM: Parallel Support Vector Machines with Incomplete Cholesky Factorization - PSVM Algorithm - Massive SVM Parallelization Using Hardware Accelerators - SMO Algorithm - Large-Scale Learning to Rank Using Boosted Decision Trees – LambdaMART - Large-Scale Spectral Clustering with MapReduce and MPI.

UNIT IV	ALTERNATIVE LEARNING	9

Parallel Online Learning - Limits Due to Bandwidth and Latency - Parallelization Strategies - Delayed Update Analysis - Parallel Learning Algorithms - Global Update Rules - Distributed Transfer Learning via Cooperative Matrix Factorization - Distributed Coalitional Learning - Extension of DisCo to Classification Tasks - Parallel Large-Scale Feature Selection.

UNIT V	APPLICATIONS	9

Large-Scale Learning for Vision with GPUs - Standard Pipeline – GPUs – Approach - Feature Learning with Deep Belief Networks - Mining Tree-Structured Data on Multicore Systems - Multicore Challenge - Memory Optimizations - Adaptive Parallelization - Empirical Evaluation.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Discuss the basics of how distributed computing is applied in scaling up machine learning process.
CO2: Use scalable machine learning frameworks for parallel learning.
CO3: Apply parallel Machine Learning Algorithms that can scale up.
CO4: Distinguish traditional ML algorithms and Scalable ML algorithms.
CO5: Discuss alternative learning for scalability.
CO6: Solve Large-scale real-world problems using GPUs and Multi-core systems.

TEXT BOOKS:

1. Ron Bekkerman, Mikhail Bilenko and John Langford, Scaling Up Machine Learning: Parallel and Distributed Approaches, Cambridge University Press, 2012.
2. Adi Polak, Scaling Machine Learning with Spark, O'Reilly Media, 2023.

REFERENCES:

1. J. Joshua Thomas, S. Harini, V. Pattabiraman, Scalable and Distributed Machine Learning and Deep Learning Patterns (Advances in Computational Intelligence and Robotics), IGI Global, 2023.

2. Bastiaan Sjardin, Luca Massaron, Alberto Boschetti, Large Scale Machine Learning with Python, Packt Publications, 2016.

22AI915	OPTIMIZATION METHODS IN MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of different Submodular functions and Associated Ployhedra.
- To discuss Submodularity and its Applications.
- To analyze the various methods of Non-Smooth Convex Optimizations.
- To analyze the various Separable Optimization Problems.
- To discuss the various Submodular minimization methods and optimizations.

UNIT I	INTRODUCTION	9

Introduction – Definition – Submodularity – Associated Polyhedra – Polymatroids – Lovasz Extension – Definition – Greedy Algorithm – Links between submodularity and convexity.
Properties of Associated Polyhedra: Support functions – Facial Structure – Positive and Symmetric submodular Polyhedra.

UNIT II	SUBMODULARITY	9

Convex and Concave closures of set functions – Structured Sparsity – Convex Relaxation of Combinatorial Penalty – l_q relaxations of submodular penalties – Shaping level sets – Examples and Applications of Submodularity – Cardinality based functions – Cut functions – Set Covers – Flows – Entropies – Spectral functions of submatrices – Best Subset Selection – Matroids.

UNIT III	NON-SMOOTH CONVEX OPTIMIZATION	9

Projected Subgradient descent – Ellipsoid Method – Kelly's Method – Analytic Centre Cutting planes – Mirror descent/conditional gradient – Bundle and Simplicial Methods – Proximal Methods – Simplex algorithm for Linear Programming – Active Set Method for Quadratic Programming – Active Set Algorithms for Least-squares Problems.

UNIT IV	SEPARABLE OPTIMIZATION PROBLEMS	9

Analysis: Optimality conditions for base polyhedral – Equivalence with submodular function Minimization – Quadratic Optimization Problems – Separable problems on other polyhedra.
Algorithms: Divide-and Conquer algorithm for proximal problems – Iterative algorithms – Exact minimization-Approximate minimization.

UNIT V	SUBMODULAR MINIMIZATION AND OPTIMIZATION	9

Minimizers of Submodular Functions – Combinatorial Algorithms – Minimizing Symmetric posimodular functions – Ellipsoid method – Simplex method for Submodular function minimization – Analytic centre cutting planes -Minimum norm point algorithm – Approximate minimization through convex optimization – Special Structure. Maximization with cardinality constraints – Submodular function minimization.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basics of different Submodular functions and Associated Ployhedra.
CO2: Discuss Submodularity and its Applications.
CO3: Analyze the various methods of Non-Smooth Convex Optimizations.
CO4: Analyze the various Separable Optimization Problems.
CO5: Discuss the various Submodular minimization methods and optimizations.
CO6: Apply various optimization methods to solve real-world problem in machine learning.

TEXT BOOKS:

1. Francis Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc., 2013.

REFERENCES:

1. A. Beck, "First-Order Methods in Optimization", MOS-SIAM Series on Optimization, 2017.

2. S. Bubeck, “Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization”, 2015.
3. Stephen Boyd, Lieven Vandenberghe, Convex Optimization, Cambridge University Press, Seventh Edition, 2009.
4. Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, Optimization for Machine Learning, The MIT Press, 2012.

HONOURS VERTICAL – COMPUTATIONAL INTELLIGENCE

22AI921	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To learn the basic concepts of Soft Computing.
- To understand artificial neural networks.
- To elaborate fuzzy systems.
- To illustrate Genetic Algorithms.
- To discuss the various Hybrid algorithms and various Swarm Intelligence algorithms.

UNIT I	INTRODUCTION	9

Neural Networks - Application Scope of Neural Networks - Fuzzy Logic - Genetic Algorithm - Hybrid Systems - Soft Computing - Artificial Neural Network - Evolution of Neural Networks - Basic Models of ANN – Weights – Bias – Threshold – Learning Rate – Momentum Factor – Vigilance Parameter- McCulloch–Pitts Neuron - Linear Separability - Hebb Network.

UNIT II	ARTIFICIAL NEURAL NETWORKS	9

Perceptron Networks - Adaptive Linear Neuron - Multiple Adaptive Linear Neurons - Back-Propagation Network - Radial Basis Function Network - Pattern Association – Auto associative and Hetero associative Memory Networks - Bidirectional Associative Memory (BAM) - Hopfield Networks - Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps.

UNIT III	FUZZY SYSTEMS	9

Fuzzy Logic - Classical Sets (Crisp Sets) - Fuzzy Sets – Fuzzy Relation - Features of the Membership Functions - Fuzzification - Methods of Membership Value Assignments - Defuzzification - Lambda-Cuts for Fuzzy Sets (Alpha-Cuts) - Lambda-Cuts for Fuzzy Relations - Defuzzification Methods – Fuzzy Reasoning – Fuzzy Inference Systems.

UNIT IV	GENETIC ALGORITHMS	9

Biological Background - Traditional Optimization and Search Techniques- Genetic Algorithm and Search Space- - Simple GA - General Genetic Algorithm - Operators - Stopping Condition - Constraints - Problem Solving - The Schema Theorem- Classification - Holland Classifier Systems- Genetic Programming - Advantages and Limitations- Applications.

UNIT V	HYBRID SOFT COMPUTING AND SWARM INTELLIGENCE ALGORITHMS	9

Neuro-Fuzzy Hybrid Systems - Genetic Neuro-Hybrid Systems - Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP – Swarm Intelligence Algorithms - Ant Colony Optimization – Artificial Bee Colony – Particle Swarm Optimization – Firefly Algorithm.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Elaborate the basic concepts of Soft Computing.
CO2: Discuss Artificial neural networks and its applications.
CO3: Apply Fuzzy logic to solve different applications.
CO4: Solving problems using Genetic algorithms.
CO5: Discuss various algorithms in Soft computing with its applications and limitations.
CO6: Use various algorithms in Soft computing to solve real-world problems.

TEXT BOOKS:

1. S. N. Sivanandam , S. N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2019.
2. Adam Slovik, “Swarm Intelligence Algorithms: Modification and Applications”, Taylor & Francis, First Edition, 2020.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. Kwang H. Lee, First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. N.P. Padhy, S. P. Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
4. S. Rajasekaran, G. A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.
5. NPTEL Courses:
    a. Introduction To Soft Computing - https://onlinecourses.nptel.ac.in/noc23_cs40/preview

22AI922	APPLIED AI and ML	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand and apply statistical methods to analyze and interpret data.
- Analyze and cluster genomic data using appropriate algorithms.
- Implement linear regression models to predict outcomes.
- Evaluate and improve model performance in binary classification tasks.
- Implement and train neural networks for various tasks.

UNIT I	FOUNDATION OF DATA SCIENCE	9

Python for Data Science- NumPy & Pandas - Data Cleaning and Preparation- Statistics for Data Science- Types of Data- Levels of Measurement-Descriptive Statistics-Probability theory -Inferential Statistics-Advanced Visualization Techniques.

Case Study: Cardio Good Fitness Data Analysis

Projects:1. Food Hub Analysis
2. FIFO World Cup Analysis
3. Mobile Internet Usage Analysis

UNIT II	MAKING SENSE OF UNSTRUCTURED DATA	9

Introduction to Supervised & Unsupervised Learning- Handling Imbalanced Datasets-K-Means Clustering algorithm, Dimensionality Reduction techniques (PCA, t-SNE)-Visualizing High Dimensional Data-Comparsion of t-SNE with PCA-Combining PCA with t-SNE.

Case Study: Genomic Data Clustering

Project: Fantasy Sports Clustering Analysis

UNIT III	REGRESSION AND PREDICTION	9

Introduction to Linear Regression-OLS Method-Cost function and Optimization-Gradient Descent Algorithm-Multiple Linear Regression-Elastic Net, Model Evaluation Techniques in solving Real World Regression Problems.

Case Studies: 1. Hospital LOS Prediction
2.Big Mart Sales Prediction

Project: Super Kart Sales Prediction

UNIT IV	CLASSIFICATION AND HYPOTHESIS TESTING	9

Concepts of Classification algorithms- Model Performance- Application of Binary Classification-Multi class classification-Multi label classification-Challenges in solving real world classification problems.

Case Studies: 1.HR Employee Attrition Prediction
2. KC Roasters Coffee Quality Prediction

Projects: 1. Travel Package Purchase Prediction
2. Potential Customers Prediction

UNIT V	DEEP LEARNING	9

Implementation of Neural Networks-Data Quality & Quantity-Data Augmentation- Hyper parameter tuning-Computational Challenges -Transformer Networks-Transfer learning -solving real world Neural Network based Problems.

Case Study: 1. Audio MNLST Digit Recognition,
2.Street View Housing Number Digit Recognition

Project: Food Image Classification

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Apply statistical techniques to interpret data and make data-driven decisions.

CO2: Utilize dimensionality reduction techniques such as PCA and t-SNE to simplify complex datasets.

CO3: Apply regression techniques to real-world problems.

CO4: Perform hypothesis testing to validate assumptions and make inferences from data.

CO5: Apply deep learning techniques to solve practical problems.

CO6: Implement the concepts of AI and ML to solve various applications.

TEXT BOOKS:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019.
2. Ethem Alpaydin, Introduction to Machine Learning, Adaptive Computation and Machine Learning Series, Third Edition, MIT Press, 2014.
3. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio Aaron Courville, MIT Press, 2017.
5. Neural Networks and Deep Learning, Michael Nielsen, Determination Press, 2015.

REFERENCES:

1. Anuradha Srinivasaraghavan, Vincy Joseph, Machine Learning, First Edition, Wiley, 2019.
2. Peter Harrington, “Machine Learning in Action”, Manning Publications, 2012.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
4. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
5. Christoph Molnar, “Interpretable Machine Learning - A Guide for Making Black Box Models Explainable”, Creative Commons License, 2020.
6. Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, Packt Publisher, 2017.
7. Deep Learning with Keras, Antonio Gulli, SujitPal , Packt Publishers, 2017.
8. Deep Learning with Python", Francois Chollet, Manning Publications, 2017
9. https://olympus.mygreatlearning.com/courses

22AI927	RECOMMENDER SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To understand the foundations of the recommender system.
- To learn about collaborative filtering.
- To discuss content-based recommendation systems.
- To elaborate on the evaluation paradigms for a recommendation system.
- To make students design and implement a recommender system.

UNIT I	INTRODUCTION TO RECOMMENDER SYSTEMS	9

Introduction - Basic Models of Recommender Systems - Domain-Specific Challenges in Recommender Systems - Cold-Start Problem – Attack-Resistant Recommender Systems – Group – Multi-Criteria – Active-Learning – Privacy - Application Domains.

UNIT II	COLLABORATIVE FILTERING	9

Neighborhood-Based Collaborative Filtering - Key Properties - Predicting Ratings – Clustering - Dimensionality Reduction - A Regression Modeling - Graph Models – Model-based Collaborative Filtering - Decision and Regression Trees - Rule-Based Collaborative Filtering - Naive Bayes Collaborative Filtering – Latent Factor Models.

UNIT III	CONTENT-BASED RECOMMENDATION	9

Basic 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.

UNIT IV	DESIGN EVALUATION	9

Evaluating Paradigms – General Goals of Evaluation Design-Design Issues in Offline Recommender Evaluation-Accuracy Metrics in Offline Evaluation-Limitations of Evaluation Measures.

UNIT V	TYPES OF RECOMMENDATION SYSTEMS	9

Content-based Recommender Systems – Basic Components – Constraint-based Recommender Systems – Context-sensitive Recommender Systems – Social and Trust-Centric Recommender Systems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Elaborate the foundations of the recommender system.
CO2: Use collaborative filtering to design recommendation systems.
CO3: Discuss content-based recommendation systems.
CO4: Elaborate on the evaluation paradigms for a recommendation system.
CO5: Use appropriate type of recommendation systems to solve real-world problems.
CO6: Design, implement and evaluate a recommendation algorithm.

TEXT BOOKS:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Jannach D., Zanker M., FelFering A., Friedrich G., Recommender Systems: An Introduction, Cambridge University Press, First Edition, 2011.

REFERENCES:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.
2. Ricci, F., Rokach, L. and Shapira, B., Introduction to recommender systems handbook. In Recommender systems handbook, Springer, 2011.
3. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer, First Edition, 2013.

22AI928	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Knowledge Engineering.
- To discuss reasoning under uncertainty.
- To design and develop ontologies.
- To apply reasoning with ontologies and rules.
- To understand learning and rule learning.

UNIT I	INTRODUCTION	9

Knowledge, Representation and Reasoning - Need for Logic – First order logic – Syntax – Semantics – Pragmatics- Implicit and Explicit Belief - Expressing Knowledge - Resolution – Propositional case - Horn Logic – Horn clauses - Procedural Control of Reasoning.

UNIT II	REASONING UNDER UNCERTAINTY	9

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering – Evidence-based reasoning task: Intelligent Analysis.

UNIT III	ONTOLOGIES – DESIGN AND DEVELOPMENT	9

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching.
Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT IV	REASONIING WITH ONTOLOGIES AND RULES	9

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge - Rules in Production Systems - Object-Oriented Representation - Structured Descriptions.

UNIT V	LEARNING AND RULE LEARNING	9

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Inductive concept learning from Examples – Learning with an Incomplete Representation Language – Formal definition of Generalization.
Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Elaborate the basics of Knowledge Representation and Knowledge Engineering.
CO2: Develop reasoning under uncertainty.
CO3: Design and develop ontologies.
CO4: Implement ontology-based reasoning systems.
CO5: Understand learning and rule learning.
CO6: Integrating knowledge representation and reasoning in intelligent systems.

TEXT BOOKS:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016.

REFERENCES:

1. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
2. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
3. King, Knowledge Management and Organizational Learning , Springer, 2009.
4. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

HONOURS VERTICAL – INTELLIGENT HEALTHCARE

22AI923	AI AND ML FOR HEALTHCARE	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To gain a deep insight into the key concepts of AI and Big data for healthcare.
- To familiarize the principles of drug discovery and molecular modeling.
- To learn the various techniques of machine intelligence for Cancer prediction.
- To explore the recent trends in medical imaging.
- To understand the Remote patient monitoring and AI assisted surgery techniques.

UNIT I	CURRENT HEALTHCARE, BIG DATA, AND MACHINE LEARNING	6+6

Current healthcare practice- Value-based treatments and healthcare services- Increasing data volumes in healthcare – Analytics of healthcare data – The new age of healthcare- Precision medicine- Artificial intelligence and medical visualization- Intelligent personal health records-
Robotics and artificial intelligence-powered devices- Ambient assisted living- Success factors for artificial intelligence in healthcare

List of Lab Exercises:

1. Perform Diagnostic Analytics for a medical data set
2. Perform Prescriptive Analytics for a medical data set

UNIT II	DRUG DISCOVERY AND MOLECULAR MODELING	6+6

Introduction - The scope of artificial intelligence in drug discovery- Types of machine learning in artificial intelligence- Molecular modeling and databases in AI for drug molecules- ML methods in molecular modeling- Drug characterization- Drug design for neuroreceptors using ANN techniques- Use of deep learning in drug design

List of Lab Exercises:

1. Perform drug discovery Analytics using pharmaceutical data set
2. Perform Molecular Modeling Analytics using Molecular Modeling DataBase

UNIT III	CANCER DIAGNOSTICS AND TREATMENT DECISIONS	6+6

Background- AI, ML, and deep learning in cancer- Determine cancer susceptibility- Enhanced cancer diagnosis and staging- Predict cancer treatment response- Predict cancer recurrence and survival- Personalized cancer pharmacotherapy

List of Lab Exercises:

1. Perform Cancer Detection Analytics using a medical data set.
2. Perform Cancer Treatment Decision Analytics using a medical data set.

UNIT IV	ARTIFICIAL INTELLIGENCE FOR MEDICAL IMAGING	6+6

Introduction – AI in radiology/medical imaging – overcoming the hurdles - X-rays and AI in medical imaging - Ultrasound and AI in medical imaging- Application of AI in medical imaging - The development of AI in medical devices - Limitations of AI in medical devices - The future frontiers of AI in medical devices

List of Lab Exercises:

1. Perform Xray Image Analysis using a medical data set.
2. Perform Ultrasound Analysis using a medical data set.

UNIT V	REMOTE PATIENT MONITORING USING AI	6+6

Introduction - Deploying patient monitoring - The role of AI in remote patient monitoring - Diabetes prediction and monitoring using AI - Cardiac monitoring using AI - Neural applications and remote patient monitoring - Artificial intelligence assisted surgery- Preoperative – Intraoperative - Postoperative

List of Lab Exercises:

1. Develop a IOT based Remote Patient Monitoring system Project

TOTAL: 30+30=60 PERIODS

OUTCOMES:

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

CO1: Elaborate the key concepts of AI and Big data for healthcare.
CO2: Illustrate the principles of drug discovery and molecular modeling.
CO3: Implement various techniques of machine intelligence for Healthcare applications.
CO4: Identify the recent trends in medical imaging.
CO5: Understand the Remote patient monitoring system.
CO6: Apply various algorithms of AI and ML to solve Healthcare problems.

TEXT BOOKS:

1. Adam Bohr, Kaveh Memarzadeh, Artificial Intelligence in Healthcare, Academic Press is an imprint of Elsevier, 2020.

REFERENCES:

1. Arjun Panesar ,Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, APress, 2019.
2. Rangaraj M. Rangayyan, Biomedical Image Analysis, 2004.
3. Ranjay Krishna, "Computer Vision: Foundations and Applications", Standford University, 2017.
4. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer 2011.
5. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 3rd Edition, Wiley, 2018.

LIST OF EQUIPMENTS:

Systems with Anaconda, Jupyter Notebook, Python

22AI924	MEDICAL IMAGE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To understand the health data formats, health care policy and standards
- To learn the significance and need of machine learning for healthcare.
- To learn to measure healthcare quality
- To learn to build healthcare predictive models
- To learn to apply healthcare analytics for critical care applications

UNIT I	HEALTHCARE FOUNDATIONS	9

Introduction to Healthcare Analytics – Foundation, History and Examples - Healthcare Industry Basics – Healthcare Financing-Healthcare Policy – Patient data – Standardised Clinical Codesets

UNIT II	MACHINE LEARNING FOUNDATIONS	9

Model framework for medical decision making - Tree Like reasoning, Probabilistic reasoning and Bayes Theorem- Criterion tables and Weighted sum approach- Pattern association and neural network - Machine Learning Pipeline – Exploring and visualizing data – Feature Selection – Training model parameter – Evaluating model performance.

UNIT III	HEALTHCARE QUALITY	9

Measuring Healthcare Quality – healthcare measures – HVBP program – HRR program – HAC program – ESRD quality incentive program – SNFVBP – HHVBP – MIPS

UNIT IV	HEALTHCARE PREDICTIVE MODELS	9

Predictive analytics in healthcare – modeling task – obtaining dataset – importing dataset – data splitting – demographic, triage, financial variables – vital signs – codes – medication information – final preprocessing steps – building the models – using the models to predict – improving the models.

UNIT V	CASE STUDIES	9

Congestive heart failure – Breast cancer prediction – Readmission prediction – Healthcare and emerging technologies

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Elaborate the health data formats, health care policy and standards.
CO2: Analyse the significance and need of machine learning for healthcare.
CO3: Appraise the various techniques to measure healthcare quality.
CO4: Build healthcare predictive models.
CO5: Apply healthcare analytics for critical care applications.
CO6: Build analytics models for healthcare applications.

TEXTBOOKS:

1. Vikas Kumar, "Health Care Analytics Made Simple", Packt Publishing, 2018.
2. Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.

REFERENCES:

1. Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
2. Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016.
3. Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in HealthCare", Springer, 2020.

22AI925	CLINICAL DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Discuss standards to generate clinical data from electronic medical records.
- Elaborate various Modelling methods on Clinical Data.
- Illustrate methods to perform clinical data analysis using various data analysis techniques.
- Interpret clinical data analysis to support decision making.
- Apply statistics to improve the quality of decision making.
- Develop applications using Clinical Data.

UNIT I	INTRODUCTION	9

Data Sources – Electronic Medical Records – Laboratory Information Management Systems - GDPR – Data Types – Data Standards – Big Clinical Data – Data Landscape – Standardizing Clinical Data.

UNIT II	CLINICAL DATA TO MODELS	9

Preparing Data for Predictive Modelling – Designs for Model Development – Sample size – Missing Data – Time-Domain Processing – Frequency-Domain Processing – Prediction Modelling Methodology.

UNIT III	CLINICAL DATA ANALYSIS	9

Clinical Trials – Classifications – Discrete Data Analysis – Failure-time Data Analysis – Quantitative Data Analysis – Multiplicity Analysis.

UNIT IV	MEDICAL STATISTICS	9

Prove Prior Hypothesis – Improve the quality of research – Testing Randomness – Quality criteria.

UNIT V	APPLICATIONS	9

Clinical Decision Support System – Types – Challenges - Best Knowledge & Continuous Improvement of Knowledge and CDSS Methods – Mobile CDSS – Care Process – Operational Excellence – Process Mining - Sociotechnical Systems & Leadership - Value-Based Health Care Supported by Data Science.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Generate clinical data from electronic medical records.
CO2: Employ various Modelling methods on Clinical Data.
CO3: Perform clinical data analysis using various data analysis techniques.
CO4: Interpret clinical data to support decision making.
CO5: Apply statistics to improve the quality of decision making.
CO6: Develop applications using Clinical Data.

TEXT BOOKS:

1. Pieter Kubben, Michel Dumontier, Andre Dekker, Fundamentals of Clinical Data Science, Springer, 2019.
2. Ton J. Cleophas, Aeilko H. Zwinderman, Understanding Clinical Data Analysis: Learning Statistical Principles from Published Clinical Research, Springer, 2016.

REFERENCES:

1. Aeilko H. Zwinderman, Ton J. Cleophas, Machine Learning in Medicine - A Complete Overview, Springer, 2021.

22AI926	DEEP LEARNING IN GENOMICS AND LIFE SCIENCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Represent molecules and proteins as features for building machine learning models.
- Emphasize how to extract interpretable, biological insights from deep learning models.
- Illustrate the applications of deep learning in genomics.
- Analyze different models for Genomic applications.
- Employ various deep learning tools for genomics.
- Apply GANs for improving the models.

UNIT I	MACHINE LEARNING IN GENOMICS	9

Machine Learning for Genomics - Biopython – Genomics Data Analysis – Genome – Genome sequencing – Sanger sequencing of nucleic acids – Evolution of next generation sequencing – Analysis – steps – Calculating GC content – nucleotide content- Dinucleotide content – Modelling – Motif finder.
Case Study: Sequence Analysis of Covid-19

UNIT II	BIOPHYSICAL MACHINE LEARNING	9

Molecule - Molecular Bonds - Molecular Graphs - Molecular Conformations - Chirality of Molecules - Featurizing a Molecule - Graph Convolutions - Protein Structures - Protein Sequences - Biophysical Featurizations - Grid Featurization - Atomic Featurization.
Case Study: Analyzing the PDBBind Dataset.

UNIT III	DEEP LEARNING FOR GENOMIC APPLICATIONS	9

DNNs for Genomics – workflow for Genomics – Protein structure predictions – Regulatory genomics – Gene regulatory Networks – Single-cell RNA sequencing – Deep learning libraries for genomics.
Case Study: Disease prediction

UNIT IV	CNN AND RNN FOR GENOMICS	9

Transfer Learning – CNNs for Genomics – Applications – Deep Bind – DeepInsight – DeepChrome – DeepVariant – Applications and use cases of RNNs in Genomics – DeepNano – ProLanGo – DanQ – Autoencoders for genomics – Gene Expression.
Case Study: Predicting Gene expression from TCGA pan-cancer RNA-S using denoising autoencoders.

UNIT V	MODEL IMPROVEMENT	9

GANs for Improving Models – Difference between Discriminative and Generative Models – Challenges – synthetic data – Applications – Analysis of ScRNA-Seq data – Generation of DNA.
Case Study: Personalized Medicine

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Represent molecules and proteins as features for building machine learning models.
CO2: Extract interpretable, biological insights from deep learning models.
CO3: Illustrate the applications of deep learning in genomics.
CO4: Analyze different models for Genomic applications.
CO5: Employ various deep learning tools for genomics.
CO6: Apply GANs for improving the models.

TEXT BOOKS:

1. Upendra Kumar Devisetty, Deep Learning for Genomics: Data-driven approaches for genomics applications in life sciences and biotechnology, packt Publications, 2022.
2. Bharath Ramsundar, Peter Eastman, Patrick Walters, Vijay Pande, Deep Learning for the Life Sciences: Applying Deep Learning to Genomics, Microscopy, Drug Discovery & More, O'Reilly, 2019.

REFERENCES:

1. Sanjiban Sekhar Roy, Y.-H. Taguchi, Handbook of Machine Learning Applications for Genomics, Springer, 2022.
2. Shailza Singh, Machine Learning and Systems Biology in Genomics and Health, Springer, 2022.

OPEN ELECTIVE (Offered to Other Departments by ADS)

22AI001	AI in BLOCK CHAIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge in Blockchain Technologies.
- To understand how block chain and AI can be used to innovate.
- To elaborate Cryptocurrencies and AI.
- To develop applications using blockchain.
- To understand the limitations and future scope of AI in Blockchain.

UNIT I	INTRODUCTION TO BLOCKCHAIN	9

Overview – Blockchain vs Distributed Ledger Technology vs Distributed Databases – Public vs private vs permissioned blockchains – Privacy in blockchains – Blockchain platforms - Hyperledger – Hashgraph, Corda – IOTA - Consensus Algorithms – Building DApps with blockchain tools.

UNIT II	BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE	9

Introduction to the AI landscape - AI and Blockchain driven Databases – Centralized vs Distributed data – Blockchain data – Big data for AI analysis – Global databases – Data Management in a DAO - Benefits of combining blockchain and AI – Aicumen Technologies -Combining blockchain and AI to humanize digital interactions.

UNIT III	CRYPTOCURRENCY AND AI	9

Bitcoins – Ethereum - Role of AI in cryptocurrency – cryptocurrency trading – Making price predictions with AI – Market making – future of cryptocurrencies.

UNIT IV	DEVELOPING BLOCKCHAIN PRODUCTS	9

Development Life Cycle of a DIApp – Designing a DIApp – Developing a DIApp – Testing – Deploying – Monitoring – Implementing DIApps.

UNIT V	LIMITATIONS AND FUTURE OF AI WITH BLOCKCHAIN	9

Technical Challenges – Business Model Challenges – Scandals and Public perception – Government Regulation – Privacy Challenges for Personal Records – Convergence of AI with Blockchain – Future – Enterprise.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Acquire knowledge in Blockchain Technologies.
CO2: Understand how block chain and AI can be used to innovate.
CO3: Elaborate Cryptocurrencies and AI.
CO4: Develop applications using blockchain.
CO5: Understand the limitations and future scope of AI in Blockchain.
CO6: Elaborate the various applications of AI in Blockchain.

TEXT BOOKS:

1. Ganesh Prasad Kumble, Anantha Krishnan, "Practical Artificial Intelligence and Blockchain: A guide to converging blockchain and AI to build smart applications for new economies", Packt Publications, 2020.
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015.

REFERENCES:

1. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017.

2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.

22AI002	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To learn the basic concepts of Soft Computing.
- To understand artificial neural networks.
- To apply fuzzy systems to solve problems.
- To solve problems using Genetic Algorithms.
- To discuss the various Hybrid algorithms and various Swarm Intelligence algorithms.

UNIT I	INTRODUCTION	9

Neural Networks - Application Scope of Neural Networks - Fuzzy Logic - Genetic Algorithm - Hybrid Systems - Soft Computing - Artificial Neural Network - Evolution of Neural Networks - Basic Models of ANN – Weights – Bias – Threshold – Learning Rate – Momentum Factor – Vigilance Parameter- McCulloch–Pitts Neuron - Linear Separability - Hebb Network.

UNIT II	ARTIFICIAL NEURAL NETWORKS	9

Perceptron Networks - Adaptive Linear Neuron - Multiple Adaptive Linear Neurons - Back-Propagation Network - Radial Basis Function Network - Pattern Association – Auto associative and Hetero associative Memory Networks - Bidirectional Associative Memory (BAM) - Hopfield Networks - Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps.

UNIT III	FUZZY SYSTEMS	9

Fuzzy Logic - Classical Sets (Crisp Sets) - Fuzzy Sets – Fuzzy Relation - Features of the Membership Functions - Fuzzification - Methods of Membership Value Assignments - Defuzzification - Lambda-Cuts for Fuzzy Sets (Alpha-Cuts) - Lambda-Cuts for Fuzzy Relations - Defuzzification Methods – Fuzzy Reasoning – Fuzzy Inference Systems.

UNIT IV	GENETIC ALGORITHMS	9

Biological Background - Traditional Optimization and Search Techniques- Genetic Algorithm and Search Space- - Simple GA - General Genetic Algorithm - Operators - Stopping Condition - Constraints - Problem Solving - The Schema Theorem- Classification - Holland Classifier Systems- Genetic Programming - Advantages and Limitations- Applications.

UNIT V	HYBRID SOFT COMPUTING AND SWARM INTELLIGENCE ALGORITHMS	9

Neuro-Fuzzy Hybrid Systems - Genetic Neuro-Hybrid Systems - Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP – Swarm Intelligence Algorithms - Ant Colony Optimization – Artificial Bee Colony – Particle Swarm Optimization – Firefly Algorithm.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Elaborate the basic concepts of Soft Computing.
CO2: Discuss Artificial neural networks and its applications.
CO3: Apply Fuzzy logic to solve different applications.
CO4: Solving problems using Genetic algorithms.
CO5: Discuss various algorithms in Soft computing with its applications and limitations.
CO6: Use various algorithms in Soft computing to solve real-world problems.

TEXT BOOKS:

1. S. N. Sivanandam , S. N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2019.
2. Adam Slovik, “Swarm Intelligence Algorithms: Modification and Applications”, Taylor & Francis, First Edition, 2020.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. Kwang H. Lee, First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. N.P. Padhy, S. P. Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
4. S. Rajasekaran, G. A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.
5. NPTEL Courses:
    a. Introduction To Soft Computing - https://onlinecourses.nptel.ac.in/noc23_cs40/preview

22AI003	COMPUTATIONAL NEUROSCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand what nervous systems do and determine how they function.
- To explore the computational principles governing various aspects of vision, sensory-motor control, learning, and memory.
- To analyze neural models.
- To learn to extract information through neural encoding and decoding.
- To investigate models of synaptic plasticity and learning in the brain.

UNIT I	NEURAL ENCODING	9

Firing Rates and Spike Statistics: Introduction- Spike Trains and Firing Rates - What Makes a Neuron Fire? Spike-Train Statistics – The Neural Code

Reverse Correlation and Visual Receptive Fields – Estimating Firing Rates Introduction to the Early Visual System Reverse-Correlation Methods: Simple Cells Static Non linearities: Complex Cells - Receptive Fields in the Retina and LGN Constructing Visual Receptive Fields

UNIT II	NEURAL DECODING AND INFORMATION THEORY	9

Discrimination - Population Decoding - Spike-Train Decoding

Information Theory: Entropy and Mutual Information – Information and Entropy Maximization – Entropy and Information for Spike Trains

UNIT III	MODEL NEURONS	9

Phase Plane Analysis – I - Phase Plane Analysis – II - Analyzing HHE – Bifurcations - Other Point Models – Levels of Neuron Modeling-Conductance-Based Models – The Cable Equation- Multi-compartment models

UNIT IV	NETWORK MODELS	9

Firing Rate Models – Feedforward Networks – Recurrent Networks – Excitatory-Inhibitory Networks – Stochastic Networks

UNIT V	PLASTICITY	9

Synaptic Transmission and Synaptic Strength - Ways of Modification of Synaptic Strength - Types of Plasticity - Short Term Plasticity - Long Term Plasticity – Computational Implications

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Elaborate the fundamentals of neural encoding.
CO2: Apply neural encoding techniques.
CO3: Use Information Theory to decode neural signals.
CO4: Analyze and model the dynamics of neurons.
CO5: Design and analyze neural networks.
CO6: Implement the concepts of synaptic plasticity.

TEXT BOOKS:

1. Dayan, Peter, and L. F. Abbott, Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems. Cambridge, MA: MIT Press, 2005. ISBN: 9780262041997.
2. Paul Miller, An Introductory Course in Computational Neuroscience, MIT Press, 2018.

REFERENCES:

1. Signal and Systems, Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab Prentice Hall, 1997.
2. Methods in Neuronal Modeling, Second Edition From Ions to Networks , Edited by Christof Koch and Idan Segev, MIT Press
3. Ionic Channels of Excitable Membranes, Second Edition, Bertil Hille, Sinauer Associates

Inc.,1992
4. NPTEL: Computational Neuroscience - Course (nptel.ac.in)

22AI004	BIO-INFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand and develop models for Biological Data.
- Implement image processing Techniques to Bioinformatics Data
- Implement Micro Array analysis over Genome Expression.
- Understand the study of simbiology.
- Understand the pharmacokinetic modeling.
- Understand the working model of biological data in Matlab.

UNIT I	INTRODUCTION	9

Overview of Bioinformatics Technologies – Structural Bioinformatics – Data Format and Processing – Secondary Resources and Applications – Role of Structural Bioinformatics – Biological Data Integration System

UNIT II	BIOINFORMATICS TOOL BOX	9

Sequence Analysis – NGS – Graph Theory – Gene Ontology – Importing Data and Deploying.

UNIT III	BIOLOGICAL DATA ANALYSIS	9

Microarray Data Analysis – Mass Spectrometry Data Analysis – Statistical Classification of Biological Data.

UNIT IV	IMAGE PROCESSING	9

Key Features of Image Processing – Importing and Exporting Images – Image File Formats and Format Conversion – Pre and Post Processing Images – Spatial Transformations and Image Registration – Microarray Image Analysis.

UNIT V	SYSTEMS BIOLOGY	9

Basics of Enzyme Kinetics – Kinetic Laws – Modeling Biological System: Simulation, Sensitivity Analysis, Parameter Estimation using Simbiology – Pharmacokinetic Modeling: Simulation, Population Study – Model of the Yeast Heterotrimeric G Protein Cycle and Glycoly .

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Develop models for Biological Data.
CO2: Implement image processing Techniques to Bioinformatics Data
CO3: Implement Micro Array analysis over Genome Expression.
CO4: Understand the study of simbiology.
CO5: Illustrate the pharmacokinetic modeling.
CO6: Elaborate the working model of biological data in Matlab.

TEXT BOOKS:

1. Yi-Ping Phoebe Chen(Ed),"Bioinformatics Technologies", Springer Publications, 2015
2. G. Alterovitz, M. F. Ramoni, "Systems Bioinformatics: An Engineering Case-Based Approach", Artech House, 2017.

REFERENCES:

1. Michael R. King, Nipa A. Mody, "Numerical and Statistical Methods for Bioengineering: Applications in MATLAB", Cambridge University Press, 2011.
2. John L. Semmlow, "Bio signal and Medical Image Processing", CRC Press, 2004.
3. Frank C. Hoppensteadt, Charles S. Peskin, "Modeling and Simulation in Medicine and Life Sciences", Springer, 2010.
4. C. Gibas, Per Jambeck, "Developing bio- informatics computer skills", O'Reilly Media, 2001

22AI005	INTRODUCTION TO GENERATIVE AI	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of Generative AI.
- To build Generative AI systems to generate images.
- To understand the concept used in Generative AI Models.
- To use various Generative AI models.
- To compare and use the various Large Language Models.
- To understand the basics of Prompt Engineering.

UNIT I	INTRODUCTION	9

Generative Models – Image transformation – Challenges - Deep Neural Networks – Perceptron – back propagation – CNN – RNN – Optimizer.

UNIT II	IMAGE GENERATION	9

Creating encodings of images – variational objective – Inverse Autoregressive flow – Importing CIFAR – Creating the network from TensorFlow 2.

UNIT III	GENERATIVE ADVERSARIAL NETWORKS	9

Generative Adversarial Networks – Vanilla GAN – Improved GANs – Progressive GAN – Challenges – Paired style transfer – Unpaired style transfer – Deepfakes – Modes of operation – key feature set – High level flow – Replacement – Re-enactment.

UNIT IV	LARGE LANGUAGE MODELS	9

Overview of LLMs - Transformers – GPT – Types of LLMs – Key concepts – other Transformers – T5 – Generative Pre-Training Models – Multi-modal Models – DALL.E 2

UNIT V	PROMPT ENGINEERING	9

Basics – In-Context Learning – In-Context Prompting – Techniques – Image Prompting – Prompt Hijacking – Challenges.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Elaborate the basic concepts of Generative AI.
CO2: Build Generative AI systems to generate images.
CO3: Apply the concepts used in Generative AI Models.
CO4: Use various Generative AI models.
CO5: Compare and use the various Large Language Models.
CO6: Analyze the basics of Prompt Engineering.

TEXT BOOKS:

1. Ben Auffarth, Generative AI with LangChain, Packt Publishing, 2023.
2. Amit Bahree, Generative AI in Action, Manning Publication, First Edition, 2023.

REFERENCES:

1. David Foster, Generative Deep Learning, 2nd Edition, O'Reilly Media, 2023.
2. Numa Dhamani and Maggie Engler, Introduction to Generative AI, Manning Publication, First Edition, 2024.
3. Valentina Alto, Modern Generative AI with ChatGPT and OpenAI Models, Packt publications, 2024.

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

22AI006	INTRODUCTION TO DATA SCIENCE (Lab Integrated)	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- To learn the fundamentals of Data Science.
- To experiment and implement python libraries for data science Learn the tools and packages in Python for Data Science.
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization libraries in Python

UNIT I	INTRODUCTION	6+6

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.

List of Exercise/Experiments:

2. Download, install and explore the features of R/Python for data analytics
    - Installing Anaconda
    - Basic Operations in Jupiter Notebook
    - Basic Data Handling

UNIT II	PYTHON LIBRARIES FOR DATA SCIENCE	6+6

Introduction to Numpy - Multidimensional Ndarrays – Indexing – Properties – Constants – Data Visualization: Ndarray Creation – Matplotlib - Introduction to Pandas – Series – Dataframes – Visualizing the Data in Dataframes - Pandas Objects – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – Joins- Pivot Tables - String operations – Working with time series – High performance Pandas.

List of Exercise/Experiments:

5. Working with Numpy arrays - Creation of numpy array using the tuple, Determine the size, shape and dimension of the array, Manipulation with array Attributes, Creation of Sub array, Perform the reshaping of the array along the row vector and column vector, Create Two arrays and perform the concatenation among the arrays.
6. Working with Pandas data frames - Series, DataFrame , and Index, Implement the Data Selection Operations, Data indexing operations like: loc, iloc, and ix, operations of handling the missing data like None, Nan, Manipulate on the operation of Null Vaues (is null(), not null(), dropna(), fillna()).
7. Perform the Statistics operation for the data (the sum, product, median, minimum and maximum, quantiles, arg min, arg max etc.).
8. Use any data set compute the mean ,standard deviation, Percentile.

UNIT III	CLASSIFICATION	6+6

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.

Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass

Classification - Semi-Supervised Classification.

List of Exercise/Experiments:

4. Apply Decision Tree algorithms on any data set.
5. Apply SVM on any data set
6. Implement K-Nearest-Neighbor Classifiers

UNIT IV	**CLUSTERING AND OUTLIER DETECTION**	**6+6**

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches.

List of Exercise/Experiments:

3. Apply K-means algorithms for any data set.
4. Perform Outlier Analysis on any data set.

UNIT V	**DATA VISUALIZATION**	**6+6**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

List of Exercise/Experiments:

6. Basic plots using Matplotlib.
7. Implementation of Scatter Plot.
8. Construction of Histogram, bar plot, Subplots, Line Plots.
9. Implement the three dimensional potting.
10. Visualize a dataset with Seaborn.

TOTAL:30+30 = 60 PERIODS

OUTCOMES:

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

CO1: Explain the fundamentals of data science
CO2: Experiment python libraries for data science
CO3: Apply and implement basic classification algorithms
CO4: Implement clustering and outlier detection approaches
CO5: Present and interpret data using visualization tools in Python

TEXT BOOKS:

13. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit 1)
14. Ashwin Pajankar, Aditya Joshi, Hands-on Machine Learning with Python: Implement Neural Network Solutions with Scikit-learn and PyTorch, Apress, 2022.
15. Jake VanderPlas, “Python Data Science Handbook – Essential tools for working with data”, O’Reilly, 2017.

REFERENCES:

10. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
11. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012.
12. Samir Madhavan, Mastering Python for Data Science, Packt Publishing, 2015
13. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts,
14. Techniques and Applications", 1st Edition, Springer, 2017
15. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential
16. Concepts", 3rd Edition, O'Reilly, 2017
17. Hector Guerrero, “Excel Data Analysis: Modelling and Simulation”, Springer International Publishing, 2nd Edition, 2019
18. NPTEL Courses:

a. Data Science for Engineers - https://onlinecourses.nptel.ac.in/noc23_cs17/preview
b. Python for Data Science - https://onlinecourses.nptel.ac.in/noc23_cs21/preview

22AI007	INTRODUCTION TO ARTIFICIAL INTELLIGENCE (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the various Intelligent agents and search strategies in AI.
- To learn about different problem-solving strategies using heuristic function.
- To learn about knowledge-based agents and first order logics.
- To understand knowledge representation and planning.
- To know about the expert system.

UNIT I	ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS	9+6

Introduction to AI – Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies.

Lab Programs:

5. Implement basic search strategies – 8-Puzzle, 8 - Queens problem.
6. Implement Breadth First Search & Depth first Search Algorithm
7. Implement Water Jug problem.
8. Solve Tic-Tac-Toe problem.

UNIT II	PROBLEM SOLVING	9+6

Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP

Lab Programs:

5. Implement A* and memory bounded A* algorithms.
6. Implement Minimax algorithm & Alpha-Beta pruning for game playing.
7. Constraint Satisfaction Problem
8. Mini Project – Chess. Sudoku.

UNIT III	LOGICAL AGENTS	9+6

Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic

First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining – Resolution.

Lab Programs:

3. Implement Unification algorithm for the given logic.
4. Implement forward chaining and backward chaining using Python.

UNIT IV	KNOWLEDGE REPRESENTATION AND PLANNING	9+6

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information

Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – non-deterministic domains – Time, schedule, and resources – Analysis

Lab Programs:

3. Implementation of object detection.
4. Implement classical planning algorithms.

UNIT V	LEARNING AND EXPERT SYSTEMS	9+6

Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.

Expert Systems: Functions – Main structure – if-then rules for representing knowledge –

developing the shell – Dealing with uncertainty

Lab Programs:

3. Develop an Expert system.
4. Mini-Project – Develop Machine Learning based classification Models.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Illustrate the structure of agents and to implement various Intelligent agents.

CO2: Apply search strategies in problem solving and game playing using heuristic function.

CO3: Implement logical agents and first-order logic problems.

CO4: Apply problem-solving strategies with knowledge representation mechanism for solving hard problems.

CO5: Demonstrate the basics of expert systems and to develop models using machine learning techniques.

TEXT BOOKS:

2. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
5. Bratko, Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

7. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.
8. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
9. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
10. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.
11. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems,1st Edition by Patterson, Pearson, India, 2015.
12. NPTEL Courses:
    a. An Introduction to Artificial Intelligence - https://onlinecourses.nptel.ac.in/noc23_cs05/preview
    b. Artificial Intelligence: Knowledge Representation And Reasoning - https://onlinecourses.nptel.ac.in/noc23_cs09/preview

22AI008	MACHINE LEARNING ALGORITHMS (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To discuss the basics of Machine Learning and model evaluation.
- To study dimensionality reduction techniques.
- To understand the various classification algorithms.
- To elaborate on unsupervised learning techniques.
- To discuss the basics of neural networks and various types of learning.

UNIT I INTRODUCTION **9+6**

Machine Learning – Types – Applications – Preparing to Model – Activities – Data – Exploring structure of Data – Data Quality and Remediation – Data Pre-processing – Modelling and Evaluation: Selecting a Model -Training a Model – Model representation and Interpretability – Evaluating Performance of a Model – Improving Performance.

Lab Programs:

4. Implementation of Candidate Elimination algorithm
5. Implementation of ML model evaluation techniques (R-Squared/Adjusted R-Squared/Mean Absolute Error/Mean Squared Error)
6. Implementation of ML model evaluation techniques (Confusion Matrix/F1 Score/AUC-ROC Curve)

UNIT II FEATURE ENGINEERING AND DIMENSIONALITY REDUCTION **9+6**

Feature Engineering – Feature Transformation – Feature Subset Selection - Principle Component Analysis – Feature Embedding – Factor Analysis – Singular value decomposition and Matrix Factorization – Multidimensional scaling – Linear Discriminant Analysis – Canonical Correlation Analysis – Isomap – Locally linear Embedding – Laplacian Eigenmaps.

Lab Programs:

5. Write python code to identify feature co-relations (PCA)
6. Interpret Canonical Covariates with Heatmap
7. Feature Engineering is the way of extracting features from data and transforming them into formats that are suitable for Machine Learning algorithms. Implement python code for Feature Selection/ Feature Transformation/ Feature Extraction.
8. Mini Project – Feature Subset Selection

UNIT III SUPERVISED LEARNING **9+6**

Linear Regression -Relation between two variables – Steps – Evaluation – Logistic Regression – Decision Tree – Algorithms – Construction – Classification using Decision Tree – Issues – Rule-based Classification – Pruning the Rule Set – Support Vector Machines – Linear SVM – Optimal Hyperplane – Radial Basis Functions – Naïve Bayes Classifier – Bayesian Belief Networks.

Lab Programs:

4. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select the appropriate data set for your experiment and draw graphs.
5. Implement and demonstrate the working of the decision tree-based ID3 algorithm
6. Build a Simple Support Vector Machines using a data set

UNIT IV UNSUPERVISED LEARNING **9+6**

Clustering – Types – Applications - Partitioning Methods – K-means Algorithm – K-Medoids – Hierarchical methods – Density based methods DBSCAN – Finding patterns using Association Rules – Hidden Markov Model.

Lab Programs:

4. Implement a k-Nearest Neighbour algorithm to classify the iris data set. Print both correct

and wrong predictions

5. Implement market basket analysis using association rules
6. Mini Project using Clustering analysis.

UNIT V	NEURAL NETWORKS AND TYPES OF LEARNING	9+6

Biological Neuron – Artificial Neuron – Types of Activation function – Implementations of ANN –Architectures of Neural Networks – Learning Process in ANN – Back propagation – Deep Learning – Representation Learning – Active Learning – Instance based Learning – Association Rule Learning – Ensemble Learning Algorithm – Regularization Algorithm- Reinforcement Learning – Elements- Model-based- Temporal Difference Learning.

Lab Programs:

5. Build an ANN by implementing the Single-layer Perceptron. Test it using appropriate data sets.
6. Implement Multi-layer Perceptron and test the same using appropriate data sets.
7. Build a RBF Network to calculate the fitness function with five neurons.
8. Mini Project – Face recognition,

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Explain the basics of Machine Learning and model evaluation.
CO2: Study dimensionality reduction techniques.
CO3: Understand and implement various classification algorithms.
CO4: Understand and implement various unsupervised learning techniques.
CO5: Build Neural Networks and understand the different types of learning.

TEXT BOOKS:

3. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson,2019. (Unit 1 – chap 1,2,3/ Unit 2 – Chap 4 / Unit 4 – 9 / Unit 5 – Chap 10, 11)
4. Ethem Alpaydin, "Introduction to Machine Learning, Adaptive Computation and Machine Learning Series", Third Edition, MIT Press, 2014. (Unit 2 – Chap 6 / Unit 4 – chap 8.2.3/ Unit 5 – Chap 18)

REFERENCES:

8. Anuradha Srinivasaraghavan,Vincy Joseph, "Machine Learning", First Edition, Wiley, 2019.(Unit 3 – Chap 7,8,9,10,11 / Unit 4 – 13, 11.4, 11.5,12)
9. Peter Harrington, "Machine Learning in Action", Manning Publications, 2012.
10. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition,
11. Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
12. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.
13. Christoph Molnar, "Interpretable Machine Learning - A Guide for Making Black Box Models Explainable", Creative Commons License, 2020.
14. NPTEL Courses:
    a. Introduction to Machine Learning - https://onlinecourses.nptel.ac.in/noc23_cs18/preview

22AI009	FOUNDATIONS OF DEEP LEARNING (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the basics of deep neural networks.
- To implement deep learning models.
- To elaborate CNN and RNN architectures of deep neural networks.
- To familiarize autoencoders in neural networks.
- To learn about the deep generative models.
- To apply Deep Learning to solve real-world problems.

UNIT I	DEEP NETWORKS	9+6

Challenges motivating deep learning - Deep feedforward networks - Learning XOR - Gradient based learning - Hidden Units – Architecture Design – Back Propagation – Regularization – Parameter Norm Penalties – Constrained Optimization – Under-Constrained Problems – Dataset Augmentation – Noise Robustness – Semi-Supervised Learning – Multi-Task Learning – Early Stopping – Parameter Tying and Sharing – Bagging and Other Ensemble methods – Dropout – Adversarial Training.

List of Exercises:

3. Implement a simple feed-forward neural network.
    a. Create a basic network
    b. Analyze performance by varying the batch size, number of hidden layers, learning rate.
    c. Create a confusion matrix to validate the performance of your model.
    d. Visualize a neural network.
4. Solve XOR problem using Multi Layer Perceptron.

UNIT II	OPTIMIZATION FOR TRAINING DEEP MODELS	9+6

Pure optimization – Challenges – Basic Algorithms – Parameter initialization Strategies – Algorithms with Adaptive Learning Rates – Approximate Second-Order methods – Optimization Strategies and Meta Algorithms.

List of Exercises:

3. Implement Stochastic Gradient Descent Algorithm.
4. Implement Gradient Descent with AdaGrad.

UNIT III	CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS	9+6

Convolution Operation – motivation – Pooling – Infinitely Strong prior – Variants – Structured Output – Data Types – Efficient Convolutional Algorithms – Random or Unsupervised features – Neuroscientific Basis - Deep Learning – Sequence Modelling - Computational Graphs - RNN - Bidirectional RNN – Encoder-Decoder - Sequence to Sequence RNN - Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units - Strategies for multiple time scales – LSTM and Gated RNNs - Optimization for Long Term Dependencies.

List of Exercises:

3. Implement a Recurrent Neural Networks (RNN) and process any sequential data such as characters, words or video frames.
4. Implement RNN with Long Short Term Networks (LTSM).

UNIT IV	AUTOENCODERS	9+6

Autoencoders: Undercomplete autoencoders - Regularized autoencoders – Power, Layer Size and Depth - Stochastic encoders and decoders – Denoising Autoencoders - Learning with autoencoders – contractive Autoencoders – Applications of autoencoders.

List of Exercises:

2. Implement different types of autoencoders.

UNIT V	DEEP GENERATIVE MODELS	9+6

Boltzmann Machine – Restricted Boltzmann Machine – Deep Belief Networks – Deep Boltzmann Machines - Boltzmann Machines for Real-Valued Data – Convolutional Boltzmann Machines - Boltzmann Machine for Structured or Sequential Outputs – Directed Generative Nets – Evaluating Generative Models.

List of Exercises:

2. Solve a real world problem using CBM.

TOTAL: 45 + 30 = 75 PERIODS

OUTCOMES:

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

CO1: Demonstrate the basics of deep neural networks to solve real world problems.
CO2: Implement deep learning models.
CO3: Elaborate CNN and RNN architectures of deep neural networks.
CO4: Use autoencoders in neural networks.
CO5: Illustrate the various deep generative models.
CO6: Apply deep generative models to solve real world problems.

TEXT BOOKS:

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

REFERENCES:

7. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.
8. Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
9. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.
10. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
11. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
12. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", John Wiley & Sons Inc., 2007.