R.M.D. ENGINEERING COLLEGE
(An Autonomous Institution)
R.S.M Nagar, Kavaraipettai, Gummidipoondi Taluk, Thiruvallur District, Tamil Nadu- 601206 Affiliated to Anna University, Chennai / Approved by AICTE, New Delhi/Accredited by NAAC / All the Eligible UG Programs are accredited by NBA, New Delhi

B.TECH.- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
REGULATIONS – 2024
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates can

PEOI: Work effectively in inter-disciplinary field with the knowledge of Artificial Intelligence and Machine Learning to develop appropriate solutions to real-world problems.

PEO2: Apply their knowledge to the technological revolution through life-long learning.

PEO3: Excel as socially committed engineers or entrepreneurs with high ethical and moral values.

PEO4: Pursue advanced studies and engage in innovative research in the field of Artificial Intelligence and Machine Learning.

PROGRAM OUTCOMES (POs)

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 analyzecomplex 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 and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstratethe 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:

PSO1: Apply fundamental concepts of Artificial Intelligence and Data Science to solve technical problems.

PSO2: Utilize Artificial Intelligence and Data Science tools to provide innovative business solutions.

PSO3: 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

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

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B.E. / B.TECH- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

REGULATIONS – 2024

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTER CURRICULUM AND SYLLABI

(For the Students admitted in the Academic Year 2024-25)

SEMESTER – I								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1	24MA101	Matrices and Calculus	BSC	4	3	1	0	4
2	24GE101	Heritage of Tamils	HSMC	1	1	0	0	1
THEORY COURSES WITH LABORATORY COMPONENT								
3	24CS101	Programming in C++ (Lab Integrated)	ESC	6	3	0	3	4.5
4	24CS102	Software Development Practices (Lab Integrated)	ESC	6	3	0	3	4.5
5	24CH101	Engineering Chemistry (Lab Integrated)	BSC	5	3	0	2	4
6	24EC101	Digital Principles and System Design (Lab Integrated)	ESC	5	3	0	2	4
MANDATORY COURSES								
7	24MC101	Students Induction Program (Non Credit)	MC	3 Weeks				
8	24MC102	Programming in C (Non Credit)	MC	40 Periods				
EMPLOYABILITY ENHANCEMENT COURSES								
‘9	24HS111	Interpersonal skills, Psychometric Analysis and Career Development	EEC	1	1	0	0	1
10	24GE111	Idea Lab I (Non Credit)	EEC	1	0	0	1	0
			TOTAL	**29**	**17**	**1**	**11**	**23**

SEMESTER – II								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSE								
1	24GE201	Tamils and Technology	HSMC	1	1	0	0	1
THEORY COURSES WITH LABORATORY COMPONENT								
2	24MA201	Linear Algebra and Applications (Lab Integrated)	BSC	5	3	0	2	4
3	24CS201	Data Structures (Lab Integrated)	ESC	6	3	0	3	4.5
4	24CS202	Java Programming (Lab Integrated)	ESC	6	3	0	3	4.5
5	24PH201	Physics for Information Science (Lab Integrated)	BSC	5	3	0	2	4
6	24AM201	Introduction to Artificial Intelligence (Lab Integrated)	ESC	4	2	0	2	3
LABORATORY COURSE								
7	24GE211	Idea Lab II	EEC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8	24HS211	Innovation and Creativity Skills Development	EEC	1	1	0	0	1
AUDIT COURSE								
9	24MC201	Yoga for Stress Management (Non Credit)	AC	1	0	0	1	0
MANDATORY COURSE								
10	24MC105	Environmental Science & Sustainability (Non Credit)	MC	2	2	0	0	0
			TOTAL	**33**	**18**	**0**	**15**	**23**

SEMESTER – III								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	24GE301	Universal Human Values 2: Understanding Harmony	HSMC	3	2	1	0	3
2.	24MA301	Discrete Mathematics	BSC	4	3	1	0	4
3.	24CS301	Computer Architecture	PCC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
4.	24CS302	Advanced Java Programming (Lab Integrated)	PCC	6	3	0	3	4.5
5.	24CS303	Database Management Systems (Lab Integrated)	PCC	6	3	0	3	4.5
6.	24AM301	Artificial Intelligence and Decision Making (Lab Integrated)	PCC	4	2	0	2	3
EMPLOYABILITY ENHANCEMENT COURSES								
7.	24GE311	Product Development Lab - I	EEC	2	0	0	2	1
8.	24CS311	Aptitude and Coding Skills I	EEC	3	0	0	3	1.5
9.	24CS312	Internship/Seminar (1 Week)	EEC	1	0	0	1	0.5
MANDATORY COURSES								
10.		Indian Constitution (Non Credit)	MC	1	1	0	0	0
			TOTAL	**33**	**18**	**1**	**14**	**25**

SEMESTER – IV								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES WITH LABORATORY COMPONENT								
1.	24MA401	Probability and Statistics (Lab Integrated)	BSC	5	3	0	2	4
2.	24CS402	Design and Analysis of Algorithms (Lab Integrated)	PCC	5	3	0	2	4
3.	24IT402	Web Development Frameworks (Lab Integrated)	PCC	6	3	0	3	4.5
4.	24AM401	Machine Learning (Lab Integrated)	PCC	4	2	0	2	3
5.	24AM402	Neural Networks (Lab Integrated)	PCC	4	2	0	2	3
6.		Professional Elective I	PEC	4	2	0	2	3
EMPLOYABILITY ENHANCEMENT COURSES								
7.	24GE411	Product Development Lab -II	EEC	2	0	0	2	1
8.	24CS411	Aptitude and Coding Skills II	EEC	3	0	0	3	1.5
AUDIT COURSES								
9.		Value Education (Non Credit)	AC	1	1	0	0	0
			TOTAL	**34**	**16**	**0**	**18**	**24**

SEMESTER – V								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective III	PEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
2.	24AM501	Deep Learning (Lab Integrated)	PCC	5	3	0	2	4
3.	24AM502	Data Exploration and Visualization (Lab Integrated)	PCC	4	2	0	2	3
4.	24CS304	Operating Systems (Lab Integrated)	PCC	4	2	0	2	3
5.		Professional Elective II	PEC	4	2	0	2	3
LABORATORY COURSES								
6.		Professional Communication – I (TOEFL)	HSMC	4	0	0	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
7.	24CS511	Advanced Aptitude and Coding Skills I	EEC	3	0	0	3	1.5
8.	24CS512	Internship/Seminar (2 Weeks)	EEC	2	0	0	2	1
9.	24GE511	Product Development Lab - Ⅲ	EEC	2	0	0	2	1
MANDATORY COURSES								
10.		Essence of Indian Traditional Knowledge (Non Credit)	MC	1	1	0	0	0
			TOTAL	**32**	**13**	**0**	**19**	**21.5**

SEMESTER – VI								
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 IV	PEC	3	3	0	0	3
3.	24AM601	Automata Theory and Compiler Design	PCC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
4.		Design Thinking (Lab Integrated)	HSMC	3	1	0	2	2
5.	24AM602	Computer Vision (Lab Integrated)	PCC	4	2	0	2	3
6.	24AM603	Generative AI (Lab Integrated)	PCC	4	2	0	2	3
LABORATORY COURSES								
7.		Professional Communication – II (TOEFL)	HSMC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8.	24CS611	Advanced Aptitude and Coding Skills II	EEC	3	0	0	3	1.5
9.	24GE611	Product Development Lab – IV	EEC	2	0	0	2	1
AUDIT COURSES								
10.		Personality Development (Non Credit)	AC	2	2	0	0	0
			TOTAL	**29**	**16**	**0**	**13**	**20.5**

SEMESTER – VII								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective VI	PEC	3	3	0	0	3
2.		Open Elective II	OEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
3.	24AM701	Reinforcement Learning (Lab Integrated)	PCC	4	2	0	2	3
4.	24AM702	Natural Language Processing (Lab Integrated)	PCC	4	2	0	2	3
5.		Professional Elective V	PEC	4	2	0	2	3
LABORATORY COURSES								
6.	24AM711	MLOps	PCC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
7.	24CS711	Internship/Seminar (4 weeks)	EEC	4	0	0	4	2
			TOTAL	**24**	**12**	**0**	**12**	**18**

SEMESTER – VIII								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
EMPLOYABILITY ENHANCEMENT COURSES								
1	24AM811	Project Work	EEC	16	0	0	16	8
			TOTAL	**16**	**0**	**0**	**16**	**8**

TOTAL CREDITS : 163

CREDIT SUMMARY

S. No.	Subject Area	Credits Per Semester								Credit Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	1	1	3	-	2	3	-	-	10	6.13%
2	BSC	8	8	4	4	-	-	-	-	24	14.72%
3	ESC	13	12	-	3	-	-	-	-	28	17.18%
4	PCC	-	-	15	11.5	10	9	7	-	52.5	32.21%
5	PEC	-	-	-	3	6	3	6	-	18	11.04%
8	OEC	-	-	-	-	-	3	3	-	6	3.68%
7	EEC	1	2	3	2.5	3.5	2.5	2	8	24.5	15.03%
8	MC			✓	✓	✓	✓				
	Total	23	23	25	24	21.5	20.5	18	8	163	

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 / HONOURS VERTICALS :

PROFESSIONAL ELECTIVES / HONOURS VERTICALS								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
DATA SCIENCE AND ANALYTICS								
1.	24AM901	Foundations of Data Science	PEC	4	2	0	2	3
2.	24AM902	Text and Speech Analytics	PEC	3	3	0	0	3
3.	24AM903	No SQL Databases	PEC	4	2	0	2	3
4.	24AM904	Frameworks for Data Analytics	PEC	4	2	0	2	3
5.	24AM905	Image and Video Analytics	PEC	3	3	0	0	3
6.	24AM906	Stream Processing and Analytics	PEC	4	2	0	2	3
7.	24AM907	Social Network Analytics	PEC	3	3	0	0	3
8.	24AM908	Cognitive Science and Analytics	PEC	3	3	0	0	3
9.	24AM909	Web Analytics	PEC	3	3	0	0	3
10.	24AM812	Capstone Project	PEC	12	0	0	12	6
APPLIED AI								
1.	24AM910	Applied AI and ML	PEC	4	2	0	2	3
2.	24AM911	AI in Block Chain	PEC	3	3	0	0	3

3.	24AM912	AI in Cyber Security	PEC	3	3	0	0	3
4.	24AM913	Ethical AI	PEC	3	3	0	0	3
5.	24AM914	Industrial IoT	PEC	3	3	0	0	3
6.	24AM915	Intelligent Robots	PEC	3	3	0	0	3
7.	24AM916	Conversational AI	PEC	4	2	0	2	3
8.	24AM917	Game Development and Programming	PEC	4	2	0	2	3
9.	24AM918	AI for Marketing	PEC	3	3	0	0	3
10.	24AM812	Capstone Project	PEC	12	0	0	12	6
AI AND CLOUD								
1.	24CS911	Cloud Foundations	PEC	4	2	0	2	3
2.	24CS501	Distributed and Cloud Computing	PEC	4	2	0	2	3
3.	24CS912	Virtualization	PEC	3	3	0	0	3
4.	24CS914	DevOps	PEC	3	3	0	0	3
5.	24CS913	Data Engineering in Cloud	PEC	4	2	0	2	3
6.	24CS920	Cloud Services Management	PEC	4	2	0	2	3
7.	24AI945	Machine Learning Foundations in Cloud	PEC	4	2	0	2	3
8.	24CS915	Machine Learning for NLP in Cloud	PEC	4	2	0	2	3
9.	24CS916	Microservice Architecture	PEC	3	3	0	0	3
10.	24AM812	Capstone Project	PEC	12	0	0	12	6
HIGH PERFORMANCE COMPUTING								
1.	24AM919	Multi-Core Architecture and Programming	PEC	3	3	0	0	3
2.	24AM920	GPU Architectures and Programming	PEC	3	3	0	0	3
3.	24AM921	High Performance Computing	PEC	3	3	0	0	3
4.	24AM922	Quantum Computing	PEC	3	3	0	0	3
5.	24AM923	Fundamentals of Accelerated Computing	PEC	3	3	0	0	3
6.		Digital Signal Processing	PEC	3	3	0	0	3
7.	24AM924	Scalable Machine Learning	PEC	3	3	0	0	3
8.	24AM925	Optimization Methods in Machine Learning	PEC	3	3	0	0	3
9.	24AM926	Applied Accelerated Artificial Intelligence	PEC	4	4	0	2	3
10.	24AM812	Capstone Project	PEC	12	0	0	12	6
COMPUTATIONAL INTELLIGENCE								
Sl. No.	**Course Code**	**Course Title**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	24AM927	Nature Inspired Computing Techniques	PEC	3	3	0	0	3
2.	24CS929	Soft Computing	PEC	4	2	0	2	3
3.	24AM929	Large Language Models	PEC	4	2	0	2	3
4.		Multimodal AI	PEC	4	2	0	2	3
5.	24AM931	Affective Computing	PEC	3	3	0	0	3
6.	24AM932	Recommender Systems	PEC	3	3	0	0	3
7.	24AM933	Knowledge Engineering	PEC	3	3	0	0	3
8.	24AM934	Quantum Computing	PE	3	3	0	0	3
9.	24AM935	Recent Trends in AI	PEC	3	3	0	0	3
10.	24AM812	Capstone Project	PEC	12	0	0	12	6
INTELLIGENT HEALTHCARE								

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	24AM936	AI and ML for Healthcare	PEC	4	2	0	2	3
2.	24AM937	Medical Image Analysis	PEC	4	3	0	0	3
3.	24AM938	Clinical Data Science	PEC	4	3	0	0	3
4.	24AM939	Deep Learning in Genomics and Life Sciences	PEC	4	3	0	0	3
5.	24AM940	Smart and Interactive Healthcare Technologies	PEC	3	3	0	0	3
6.	24AM941	Bio-Informatics	PEC	3	3	0	0	3
7.	24AM942	Computational Neuroscience	PEC	3	3	0	0	3
8.	24AM943	Computational Biology and Sequence Analysis	PEC	3	3	0	0	3
9.	24AM944	Applied ML for Life Sciences	PEC	3	3	0	0	3
10.	24AM812	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.	24AM001	Foundations of Deep Learning	OEC	3	3	0	0	3
2.	24AM002	Introduction to Soft Computing	OEC	3	3	0	0	3
3.	24AM942	Computational Neuroscience	OEC	3	3	0	0	3
4.	24AM941	Bio-Informatics	OEC	3	3	0	0	3
5.	24AM005	Introduction to Generative AI	OEC	3	3	0	0	3
6.	24AM006	Foundations of Natural Language Processing	OEC	3	3	0	0	3

R2024 CURRICULUM OF
B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
WITH SPECIALIZATION IN ANY ELECTIVE VERTICAL

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

R2024 CURRICULUM OF
B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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

R2024
B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING WITH MINOR DEGREE

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

2.	Advanced Web Development	Computer Science and Business Systems
3.	Fintech and Blockchain	Computer Science and Business Systems

R2024

MINOR DEGREE CURRICULUM OFFERED BY

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(for other B.E. / B.Tech. Programmes)

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE

SI. No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1.	24AM007	Data Science for Engineers	3	3	0	0	3
2.	24AM008	Algorithms in Artificial Intelligence	3	3	0	0	3
3.	24AM009	Machine Learning Algorithms	3	3	0	0	3
4.	24AM010	Foundations of Deep Learning	3	3	0	0	3
5.	24AM813	Capstone Project	12	0	0	12	6

Course Code		L	T	P	C
	MATRICES AND CALCULUS				
24MA101		**3**	**1**	**0**	**4**

OBJECTIVES:

The course will enable the learners to:

- explain the concepts of matrix algebra techniques.
- understand various techniques to solve second and higher order differential equations.
- demonstrate simple applications of functions of several variables and vector calculus.
- comprehend the basic concepts of multiple integrals.
- illustrate elementary ideas of vector calculus.

UNIT I MATRICES **12**

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 (excluding similarity transformation) – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL EQUATIONS **12**

Second and Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's seriesfor functions of two variables – Maxima and minima of functions of two variables– Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Area enclosed by Cartesian Coordinates (excluding polar coordinates) – Triple integrals (excluding spherical and cylindrical coordinates)
– Volume of solids (Cartesian Coordinates only).

UNIT V VECTOR CALCULUS **12**

Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and Solenoidal vector fields – Green's theorem in a plane, Stoke's theorem and Gauss divergencetheorem

(Statement only) - Simple applications involving cubes and rectangular parallelopipeds.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Compute the matrix inverse and their higher powers.

CO2: Solve second and higher order differential equations.

CO3: Determine the maxima and minima of functions of two variables.

CO4: Determine the volume and surface area using multiple integrals.

CO5: Evaluate integrals using the concept of vector calculus.

CO6: Apply matrix algebra techniques to diagonalize the matrix.

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, 44th Edition, 2021.

REFERENCES:

1. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
2. M. K. Venkataraman, "Engineering Mathematics", Volume I, 4th Edition, The National Publication Company, Chennai, 2003.
3. Sivaramakrishna Dass, C. Vijayakumari, "EngineeringMathematics", Pearson Education India, 4th Edition 2019.
4. H. K. Dass, and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3rd Edition 2014.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
6. NPTEL course on "Engineering Mathematics - I", by Prof. Jitendra Kumar, IIT Kharagpur: https://onlinecourses.nptel.ac.in/noc21_ma58/preview

Course Code		L	T	P	C
24GE102	HERITAGE OF TAMILS	1	0	0	1

OBJECTIVES:

The course will enable the learners 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 Citiesand 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

COURSE 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.

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. Social Life of Tamils (Dr.K.K. Pillay) A joint publication of TNTB & ESC and RMRL –(in print)
5. Social Life of the Tamils - The Classical Period (Dr.S .Singaravelu) (Published by:International Institute of Tamil Studies.
6. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
7. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by:International Institute of Tamil Studies.)
8. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:
9. Department of Archaeology & Tamil Nadu Text Book and Educational ServicesCorporation, 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 NaduText Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL)

Course Code		L	T	P	C
	PROGRAMMING IN C++				
24CS101	**(Theory Course with Laboratory Component)**	**3**	**0**	**3**	**4.5**

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 usingexceptions.

UNIT I PROGRAMMING FUNDAMENTALS 9+9

Types of computer programming languages - Genesis of C++ - Program Life Cycle - Structure of C++ program - Identifiers - Variables - Keywords - Number System -Binary Number System -Octal Number System- Decimal Number System -Hexadecimal Number System - Data types - Constants - Errors – Operators- Expressions - Type Conversions - Control-Flow Statements - Conditional Statements - Iterative Statements -Unconditional Control Statements - Arrays - One-Dimensional Arrays - Two-Dimensional Arrays - Multi -Dimensional Arrays - Strings - String Manipulation Functions - Array of Strings.

List of Exercise/Experiments:

1. Write 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++ 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++ programs using strings:
    a. Checking for palindrome.
    b. Count the occurrences of each character in a given word.

UNIT II POINTERS AND FUNCTIONS 9+9

Pointers - Pointer Variables - Pointer Operators & Expressions -Pointers with Arrays - Functions - Scope Rules -Function Arguments -return Statement - Function Variables - Storage Classes - Types of storage classes - Create Header Files - User-Defined Functions - Inline Functions - Function Overloading -Recursion - Namespaces.

List of Exercise/Experiments:

1. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members: EID, Ename, Designation, DOB, DOJ, Basic pay 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 9+9

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 Exercise/Experiments:

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

Practice Questions & Scenario Based Questions:

1. Imagine you are working as a software engineer at a tech company. Your team is developing a mathematical software library that will be used in various applications across the company. One of the features that your team lead has asked you to implement is a function that calculates the number of trailing zeros in the factorial ofa number.

   The team lead has emphasized the importance of encapsulation in your implementation.

2. Create a C++ class Calculator representing a simple calculator. The class should have the following attributes and methods:

   Attributes: Two operands and an operation (+, -, *, /)

   Methods: Perform the operation and return the result

   Implement constructors to initialize the calculator with default values (0,0) and with specified values. Also, implement a destructor to perform any necessary cleanup.

UNIT IV OPERATOR OVERLOADING, INHERITANCE AND POLYMORPHISM 9+9

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 – PureVirtual Functions – Polymorphism.

List of Exercise/Experiments:

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 aresupported: Single inheritance b) Multiple inheritance c) Multi level inheritance d) Hierarchicalinheritance.

Practice Questions & Scenario Based Questions:

1. Joy is a software developer at a 3D modeling company. The company is developinga new software tool that will be used by architects and engineers to design and analyze 3D models of various structures. One of the features that her project manager has asked is to implement a function that calculates the volume of basic 3Dshapes like cylinders and cuboids. The project manager has emphasized the importance of using function overloading in her implementation..

2. Imagine you are a software developer tasked with creating a utility program for a school that handles student scores. The school wants a simple program where teachers can enter the scores of students for a particular test, and the program will then provide the highest and lowest scores among them. This will help the teachers quickly identify the top performer and the student who might need extra help.

   Your task is to write program that satisfies the above scenario using **inline function**

3. Develop a software system to manage part-time worker students at a university. These students have unique attributes such as their name, student ID, hourly wage, and hours worked per week. Your goal is to create a C++ program that models this system.

4. Ramu is a software developer at a company specializing in developing softwaresolutions for geometric shapes. Recently, a client approached with a request to create a program to calculate the areas of rectangles and triangles.

UNIT V I/O, FILES AND EXCEPTIONS 9+9

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 Exercise/Experiments:

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

Practice Questions & Scenario Based Questions:

1. Develop a simple library management system. Create a base class Book representing a book in the library. The class should have attributes such as title, author, and ISBN (International Standard Book Number). Implement a virtual functiondisplayDetails() to display information about the book.

2. A software developer working on a banking application. One of the requirements is toanalyze account holders' balances based on a minimum balance threshold. The application should read account information from a sequential access file, where each line represents an account record in the format: account_holder_name, balance.

3. The financial company is developing a new software tool that will be used by financial analysts to perform various calculations. One of the features of that projectis to implement is a function that performs division of two numbers.

   Write a program that takes two integer inputs, numerator and denominator, from the user. Implement error handling to check if the denominator is zero. If the denominator is zero, display the message "Division by zero is not allowed!" using an

   exception. If the denominator is not zero, calculate the result of the division and display it.

4. Mini project.

TOTAL: 45+45 = 90 PERIODS

OUTCOMES:

Upon completion of the 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.

CO6: Develop applications using C++ concepts

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, TataMcGraw-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”, ThirdEdition, Thomson Course Technology, 2007.

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.

Course Code		L	T	P	C
	SOFTWARE DEVELOPMENT PRACTICES				
24CS102	**(Theory Course with Laboratory Component)**	**3**	**0**	**3**	**4.5**

OBJECTIVES:

The Course will enable learners to:

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

UNIT I AGILE SOFTWARE DEVELOPMENT AND Git and GitHub 9+9

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 Exercise/Experiments:

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 9+9

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 Exercise/Experiments:

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

UNIT III CSS 9+9

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 Exercise/Experiments:

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

UNIT IV JAVASCRIPT BASICS 9+9

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 Exercise/Experiments:

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

UNIT V JAVASCRIPT OBJECTS 9+9

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

List of Exercise/Experiments:

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: 45+45=90 PERIODS

OUTCOMES:

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

CO1: Understand basic software engineering practices effectively.

CO2: Apply version control using Git and GitHub, and manage code repositories proficiently.

CO3: Design web applications using HTML, CSS, and JavaScript.

CO4: Analyze problems and create solutions using CSS for better web page presentation and usability.

CO5: Develop interactive web pages using JavaScript with an event-handling mechanism.

CO6: Apply the technological changes and improve skills continuously.

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.
   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:

1. Systems with either Netbeans or Eclipse
2. Java/JSP/ISP Webserver/Apache
3. Tomcat / MySQL / Dreamweaver or
4. Equivalent/ Eclipse, WAMP/XAMP

Course Code	ENGINEERING CHEMISTRY	L	T	P	C
24CH101	(Theory Course with Laboratory Component)	3	0	2	4

OBJECTIVES:

The course will enable the learners

- To gain a comprehensive knowledge on polymers utilized in various industrial sectors.
- To acquire knowledge on the fundamental principles of energy storage devices.
- To gain insights into the basic concepts and applications of chemical sensors and cheminformatics.
- 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 INDUSTRIAL POLYMERS **15**

Polymers: Terminology – functionality, degree of polymerization, properties – glass transition temperature and molecular weight (weight average method).

Engineering plastics: preparation, properties and application of Polyethylene, Teflon, Polyethylene terephthalate and Epoxy resin- industrial applications of Polyethylene and Polyethylene terephthalate in packaging.

Special polymers: preparation, properties and applications of piezoelectric polymer - Polyvinylidene fluoride, electroactive polymer-Polyacetylene and biodegradable polymer - Polylactic acid .

(Theory-9)

1. Determination of the molecular weight of polymer using viscometer.
2. Determination of degradation of biodegradable polymer using photoreactor.
3. Demonstrate the applications of biodegradable plastic using 3D printing.

(Laboratory-6)

UNIT II ENERGY STORAGE DEVICES AND GREEN FUEL **15**

Introduction to Electrochemical cell and its terminology - electrochemical series and its applications.

Batteries: classification - construction and working principle -primary alkaline battery - secondary battery - Pb-acid battery.

Green fuel – Hydrogen - production (Photo electrocatalytic and photo catalytic water splitting), construction, working principle and applications in H_2 -O_2 fuel cells.

Batteries used in E- vehicle: Ni-metal hydride battery, Li-ion Battery - recycling of Li-ion batteries by direct cycling method; environmental effects of different energy storage devices.

(Theory-9)

1. Construction of electrochemical cell.
2. Determination of discharging state of Pb-acid battery by estimating the strength of the acid correlates with specific gravity.
3. Study of performance of a battery using battery analyzing module.

(Laboratory-6)

UNIT III CHEMICAL SENSORS AND CHEMINFORMATICS 15

Introduction: classification of chemical sensors -principle, construction and working of chemical sensors; pH sensor – Glass electrode; Breath analyzer; Industrial sensor – CO_2 sensors- Sensor for health care – Glucose sensor.

Cheminformatics: definition, scope, and significance; applications in the environmental sector – carbon footprint measurements, data analysis and interpretation.

(Theory-9)

1. Determination of the amount of given hydrochloric acid using a pH meter.
2. Calculate the carbon footprint from the provided dataset, analyze the results and draw conclusions.

(Laboratory-6)

UNIT IV SMART MATERIALS 15

Shape Memory Alloys: introduction - shape memory effect – functional properties of SMAs – types of SMA - Nitinol (Ni-Ti) alloys and its applications.

Chromogenic materials: introduction – types, applications in chemical and biological detection, display technologies, smart windows and light- modulating devices, biomedical and healthcare.

Smart Hydrogels: Introduction - Super Absorbent Polymers (SAP) - preparation, properties and applications of polyacrylic acid and sodium polyacrylate

(Theory-9)

1. Demonstrate the shape memory effect using Nitinol wire.
2. Determination of pH sensitivity of bromothymol blue.
3. Determination of absorption efficiency of hydrogel by using kinetic study.

(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)

1. Preparation of nano $BaSO_4$ by precipitation method.
2. Demonstrate the efficiency of nano adsorbents in polluted water.

(Laboratory-6)

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Examine the role of polymers in different industrial sectors.

CO2: Identify the suitability of batteries for various fields.

CO3: Apply the fundamental principles of chemical sensors, cheminformatics and their applications across various industries.

CO4: Analyze the types of smart materials used in various engineering fields.

CO5: Explore the applications of nanomaterials in various fields, considering their advantages and limitations.

CO6: Integrate the concepts of chemistry for various engineering applications.

TEXTBOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 19th Edition, 2024.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd reprint, 2012.

REFERENCES:

1. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry,S. Chand &company, New Delhi, 12th Edition, 2022.
2. V.R. Gowarikar, Polymer Science, New Age International Publishers, 4th edition,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. Barry A. Bunin, Brian Siesel, and J. Bajorath, "Chemoinformatics: Theory, Practice, & Products", Springer, First Edition, 2007.
5. Geoffrey A. Ozin, Andre C. Arsenault and Ludovico Cademartiri, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC publishers, 2nd Edition, 2015.

6. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", Pearson Education Pvt. Ltd., 6th edition, 2019.

7. NPTEL course on "Polymers: concepts, properties, uses and sustainability" Prof. Abhijit P Deshpande, IIT-Madras, https://onlinecourses.nptel.ac.in/noc20_ch41/preview
8. NPTEL course on "Electrochemical Energy Storage" Prof. Subhasish Basu Majumder, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc21_mm34/preview

9. NPTEL course on "Nanotechnology, Science and Applications" Prof. Prathap Haridoss, IIT-Madras, https://onlinecourses.nptel.ac.in/noc22_mm33/preview

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S. No.	Description of Equipment	Quantity
1.	Conductivity meter	12 Nos.
2.	pH meter	12 Nos.
3.	UV-Visible Spectrophotometer	2 Nos.
4.	Potentiometer	12 Nos.
5.	CAN Enabled BMS unit	4 Nos.
6.	Photoreactor	2 Nos.

Course Code		L	T	P	C
	DIGITAL PRINCIPLES AND SYSTEM DESIGN				
24EC102	**(Theory Course with Laboratory Component)**	**3**	**0**	**2**	**4**

OBJECTIVES:

The Course will enable learners to:

- acquire the knowledge in Digital fundamentals and its simplification methods.
- familiarize the design of various combinational digital circuits using logic gates.
- realize various sequential circuits using flip flops.
- elucidate various semiconductor memories and related technology.
- 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 ofBoolean expressions using logic gates and universal gates.

List of Exercise/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, BinaryParallel Adder – Carry look ahead Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/De-mux, Parity Generator/Checker

List of Exercise/Experiments:

2. Design of adders
3. Design of subtractors.
4. Design of binary adder using IC7483
5. Design of Multiplexers & Demultiplexers.
6. Design of Encoders and Decoders.
7. 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 Exercise/Experiments:

8. Design and implementation of 3 bit ripple counters.
9. Design and implementation of 3 bit synchronous counter
10. Design and implementation of shift registers

UNIT IV SYNCHRONOUS SEQUENTIAL 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 anddynamic RAM – Programmable Logic Devices: Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Implementation of combinational logic circuits using PLA, PAL.

TOTAL: 45 PERIODS (THEORY) + 30 PERIODS (LAB) = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Apply Boolean algebra to simplify and implement digital circuits.

CO2: Design combinational circuits to meet specific functional requirements using logic gates. CO3: Demonstrate the operation of counters and shift registers using flip-flops in sequential circuits.

CO4: Analyze synchronous sequential circuits to determine their behavior and performance characteristics.

CO5: Evaluate various types of memory devices, discussing their roles and functionalities in digital systems.

CO6: Construct combinational circuits using Programmable Logic Devices (PLDs) to solve complex digital design problems.

TEXTBOOKS:

1. M. Morris Mano and Michael D. Ciletti, Digital Design, With an Introduction tothe 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.John.M Yarbrough, Digital Logic: Applications and Design, 1st Edition, Cengage India,2006

NPTEL LINK:

https://nptel.ac.in/courses/108105132

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

IC Trainer Kit -15 Nos

ICs each - 30 Nos (7400/ 7404 / 7486 / 7408 / 7432 / 7483 / 7473 / 7411/7474)

Course Code		L	T	P	C
24MC101	STUDENT INDUCTION PROGRAM (SIP)	3 Weeks			

OBJECTIVES

The course will enable the learners to:

- Facilitate the adjustment of new students to the new environment, ensuring they feel comfortable and supported.
- Inculcate the institution's ethos and culture in new students, helping them internalize these values.
- Encourage the building of bonds among students and between students and faculty members.
- Expose students to a sense of larger purpose and guide them in their journey of self-exploration.

The various modules or core areas recommended for the 3-week SIP are

Module 1: Universal Human Values I **18**

Welcome and Introductions - Aspirations and Concerns - Self- Management - Health - Relationships - Society - Natural Environment - Sum Up - Self-evaluation and Closure.

Module 2: Physical Health and Related Activities **6**

Special Lecturers: Happy and Healthy lifestyle - Physical Health -Mental Health - Health and Fitness.

Module 3: Familiarization of Department/ Branch and Innovation **8**

Principal Address - Address by Head of Science and Humanities - Addresses by Respective Department HoDs – Campus Tour – CoE introduction – Introduction of Student Activity Cell (SAC).

Module 4: Visit to a Local Area **4**

Virtual tour: Government Museum - Theosophical Society - Fort St. George - Ripon Building - Kalakshetra Foundation - Anna Centenary Library - Marina Beach - St. Thomas Mount - Vivekananda House**.**

Module 5: Lectures by Eminent People **10**

Special Lecturers: Academics – industry – Careers – Art - Self-management.

Module 6: Proficiency Modules **30**

Basic Competencies: C Programming, Foundation in Mathematics, Interpersonal Communication.

Module 7: Literature / Literary Activities **7**

Literary Debate - Creative Writing Workshop - Literature Circle Discussions - Author Study and Presentation.

Module 8: Creative Practices **10**

Activity: Handicrafts (Painting / Drawing / Pottery / Knitting / Jewellery making, etc.)

Module 9: Extra Curricular Activities **10**

Students Activity Cell: Activities from Coding Club – Math Club -- Language Club - AstronomyClub - ECO Club - Photography Club - Tedx Club -Yoga Club.

Valedictory and Closing Ceremony **2**

TOTAL: 105 PERIODS

COURSE OUTCOMES

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

- Achieve a smooth transition where students feel comfortable and confident in their new environment.
- Demonstrate a strong understanding and practice of the institution's ethos and culture within the campus community.
- Build meaningful and supportive relationships with peers and faculty members.
- Develop a clear sense of purpose and engage in self-exploration, leading to a deeper understanding of personal goals and aspirations.

REFERENCE:

https://www.aicte-india.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf

Course Code	INTERPERSONAL SKILLS, PSYCHOMETRIC ANALYSIS AND CAREER DEVELOPMENT	L	T	P	C
24HS111		1	0	0	1

OBJECTIVES

The course will enable the learners to:

- Evaluate and enhance language proficiency by using SMART Vox to assess communication skills and linguistic abilities.
- Explore future technologies, solve real-time problems, and prepare students for campus recruitment.
- Assess and develop work style, cognitive abilities, emotional intelligence, and work competencies
- Explore placements, internships, higher education options, GATE and CAT exams, and career development.
- Understand career milestones, assess personal skills and personality, and develop effective goal-setting strategies for successful career planning

UNIT I LANGUAGE PROFICIENCY EVALUATION 3

Identification of Strengths and Weaknesses - Assessing Language Skills (Diagnostic tests and interactive exercises) - Measuring Language Competence (Proficiency Levels) - Identifying Support Needs - Developing Individual Learning Plans - Enhancing Student Experience (Building Confidence) – Evaluation using SMART Vox

UNIT II CAREER GUIDANCE 3

Future of Engineering- Various aspects of Technology and its Applications - Future of Technologies – Branch Specific emerging technologies - Problems solving through open source - Campus recruitment process.

UNIT III PSYCHOMETRIC EVALUATION 3

Understanding Behavioural work style (Personality)- Testing of numerical, logical, and verbal reasoning skills (Cognitive Abilities / Aptitude) – Measure of emotional intelligence and interpersonal skills – Determination of Culture Preferences in various workplace scenarios – Evaluation of Work Competencies through targeted games and simulations

UNIT IV CAREER PREPARATION 3

Present Scenario of Engineering - Placement Opportunities - Internship Opportunities - Types of Internships- Higher Education opportunities in India and Abroad - Understanding GATE and CAT Exams - Other Opportunities - Career path development plans.

UNIT V CAREER VISION AND PLANNING **3**

Introduction to career milestones - Overview of the Vision Assessment and its benefits - Psychometric evaluation - Numeracy, Literacy, Visual Reasoning, Algorithmic Thinking - Introduction to a goal-setting model - Identification career pathways aligned with personality profiles - Evaluate personal skills and abilities in various areas.

COURSE OUTCOMES **TOTAL: 15 PERIODS**

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

CO1: Assess and improve their English language proficiency using SMART Vox, gaining insights into their communication skills and linguistic competence

CO2: Understand future engineering trends, emerging technologies, importance of solving real-time problems, and the process of campus recruitment.

CO3: Evaluate their behavioral work style, cognitive abilities, emotional intelligence, cultural preferences, and work competencies.

CO4: Understand the current engineering landscape, placement opportunities, and higher education prospects to develop effective career path plans

CO5: Develop a clear and actionable vision for their future career path.

Course Code		L	T	P	C
24GE111	IDEA LAB – I	0	0	1	0

The students may be grouped into 3 to 4. The device/Machine/system/component are studied by the students and a final presentation to be done by the students about the study of various devices or machinery at the end of the semester.

OBJECTIVES:
Students completing this course are expected to

- Understand the functionalities and limitation of various machines/equipment
- Demonstrate various operations that can be performed using various machines

LIST OF EXPERIMENTS

1. Study of fundamental operations of 3D Printer and Scanner with Software.
2. Study of Laser cutting machine.
3. Study of CNC Router machine.
4. Study of Fundamentals of basic circuit design, Soldering and Desoldering.
5. Study of PCB Milling Machine.

TOTAL: 15 PERIODS

OUTCOMES
After successful completion of the course the students will be able to

CO1 Describe the working of the 3D Printer.

CO2 Explain the operation of the CNC router and laser cutting machines.

CO3 Explain the basic parts and PCB fabrication process.

CO4 Develop the ability to handle delicate electronic components carefully, minimizing damage during the soldering process.

CO5 Describe the process for converting ideas into prototypes.

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	Multimeter	5 Nos
6	Solder Stations	5 Sets
7	Desoldering Machine	1 No
8	PCB Milling Machine	1 No
9	Variable Power Supply	1 No
10	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	5 Sets

SEMESTER II

Course Code		L	T	P	C
24GE201	TAMILS AND TECHNOLOGY	1	0	0	1

OBJECTIVES:

The course will enable the learners 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

COURSE 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.

REFERENCE BOOKS

1. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

3.
4. Social Life of Tamils (Dr.K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
5. Social Life of the Tamils - The Classical Period (Dr.S .Singaravelu) (Published by: International Institute of Tamil Studies.
6. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
7. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
8. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:
9. 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).

Course Code	LINEAR ALGEBRA AND APPLICATIONS	L	T	P	C
24MA201	(Theory Course with Laboratory Component)	3	0	2	4

OBJECTIVES:

The course will enable the learners to:

- comprehend the fundamental concepts of matrices.
- illustrate the basic notions associated with vector spaces and its properties.
- utilize the Gram-Schmidt ortho normalization process.
- understand the components and implications for vector spaces by rank-nullity dimension theorem.
- calculate the eigenvalues and eigenvectors of linear transformations.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 15

Matrices – Row echelon form – Rank of a matrix – System of linear equations – Consistency – Gauss elimination method – Gauss Jordan method.

Experiments using C language:

1. Solve the system of equations using Gauss Elimination method. 2. Solve the system of equations using Gauss Jordan method.

UNIT II VECTOR SPACES 15

Real and Complex fields – Vector spaces over Real and Complex fields – Subspace – Linear space – Linear independence and dependence (Statement only) – Bases and dimensions.

Experiments using C language:

1. Check whether the given vectors are linearly independent or not. 2. Find the basis and dimension for given vectors.

UNIT III INNER PRODUCT SPACES 15

Inner product space and norms – Properties – Orthogonal, Orthonormal vectors – Gram- Schmidt ortho normalization process – Least squares approximation.

Experiments using C language:

1. Find the orthogonal vectors using inner product. 2. Find the orthonormal vectors using inner product.

UNIT IV LINEAR TRANSFORMATION 15

Linear transformation – Range and null space – Rank and nullity – Rank nullity Dimension theorem – Matrix representation of linear transformation – Eigenvalues and eigenvectors of linear transformation.

Experiments using C language:

1. Find the Rank and Nullity of a matrix.
2. Find the eigenvalues and eigenvectors of a matrix.

UNIT V EIGENVALUE PROBLEMS AND MATRIX DECOMPOSITION 15

Eigenvalue problems – Power method – Jacobi method – Singular value decomposition – QR decomposition.

Experiments using C language:

1. Solve the system of equations using Jacobi method.
2. Find QR decomposition of a matrix.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Solve the system of linear equations using Gauss elimination and Gauss Jordan method.

CO2: Analyze vector spaces to determine their bases and dimensions.

CO3: Apply Gram-Schmidt process to ortho normalize sets of vectors.

CO4: Apply rank nullity theorem to analyse linear transformations.

CO5: Compute the eigenvalues and eigenvectors using singular value decomposition.

CO6: Understand the ideas of least squares approximations and its applications.

TEXT BOOKS:

1. A.H. Friedberg, A. J. Insel, and L. Spence, “Linear Algebra”, Prentice Hall of India, 5th Edition, New Delhi, 2008.
2. Steven J. Leon, “Linear Algebra with Applications”, Pearson Educational International”, 9th Edition, United States of America, 2015.

REFERENCES:

1. G. Strang, “Linear Algebra and its applications”, Thomson (Brooks / Cole), 4th Edition, New Delhi, 2005.
2. C.F. Gerald and P.O. Wheatley, “Applied Numerical Analysis”, 7th Edition, Pearson Education, New Delhi, 2004.
3. Richard Branson, “Matrix Operations”, Schaum's outline series, 1989.
4. Bernard Kolman, R. David R. Hill, “Introductory Linear Algebra”, Pearson Educations, New Delhi, First Reprint, 2009.
5. S. Kumaresan, “Linear Algebra - A geometric approach”, Prentice Hall of India, New Delhi, Reprint, 2010.
6. NPTEL course on "Linear Algebra", by Prof. K. C. Sivakumar, IIT Madras: https://archive.nptel.ac.in/courses/111/106/111106051/#

Course Code	DATA STRUCTURES	L	T	P	C
24CS201	(Theory Course with Laboratory Component)	3	0	3	4.5

OBJECTIVES:

The Course will enable learners to:

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

UNIT I LINEAR DATA STRUCTURES – LIST 9+9

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 Exercise/Experiments:

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

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9+9

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 Exercise/Experiments:

- 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 9+9

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

List of Exercise/Experiments:

- 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 9+9

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

List of Exercise/Experiments:

- Graph representation and Traversal algorithms.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9+9

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

List of Exercise/Experiments:

- Implement searching and sorting algorithms.

TOTAL: 45+45=90 PERIODS

OUTCOMES:

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

CO1: Analyze algorithms and abstract data types (ADTs).
CO2: Evaluate fundamental data structures.
CO3: Implement linked data structures and its application.
CO4: Apply advanced tree data structures.
CO5: Understand basic graph theory concepts.
CO6: Evaluate various searching and sorting algorithms.

TEXTBOOKS:

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 paperpublications, 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 inC++", Second Edition, Silicon Press, 2007.
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501578165051392105 84/ overview

LIST OF EQUIPMENTS:

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

Course Code	JAVA PROGRAMMING	L	T	P	C
24CS202	(Theory Course with Laboratory Component)	3	0	3	4.5

OBJECTIVES:

The Course will enable learners to:

- Explain object oriented programming concepts and fundamentals of Java
- Apply the principles of packages, interfaces and exceptions
- Develop a Java application with I/O streams, threads and generic programming
- Build applications using strings and collections.
- Apply the JDBC concepts

UNIT I JAVA FUNDAMENTALS **9+9**

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

List of Exercise/Experiments:

1. Develop a Java application to generate Electricity bill. You must use one super classcalled 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 asfollows: 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 asfollows: 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)
   - Find kth smallest element in an unsorted array
   - Find the sub array with given sum
   - Matrix manipulations – Addition, Subtraction, Multiplication
   - Remove duplicate elements in an Array
   - 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 **9+9**

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 Exercise/Experiments:

1. Develop a Java application to implement currency converter (Dollar to INR, EUROto INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM andvice 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% ofBP 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 andbuilt-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 areaof 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 9+9

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 Exercise/Experiments:

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 9+9

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

List of Exercise/Experiments:

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 notbe 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 usingthe concept of inter thread communication.
3. Collections:
   a. Write a program to perform string operations using Array List. 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** **9+9**

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 Exercise/Experiments:

Mini Project (using JDBC)

TOTAL: 45+45=90 PERIODS

OUTCOMES:

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

CO1: Solve core Java programming concepts.

CO2: Utilize object-oriented programming (OOP) principles.

CO3: Demonstrate competency in handling exceptions and implementing multithreading.

CO4: Develop expertise in input/output (I/O) operations and file handling.

CO5: Apply advanced Java programming concepts with generics and lambda expressions.

CO6: Implement database connectivity using JDBC.

TEXTBOOKS:

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”, 11thEdition, 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, ThirdEdition, Pearson Education, 2008.
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview

LIST OF EQUIPMENTS:

Java and Eclipse / NetBeans IDE or Equivalent

Course Code	PHYSICS FOR INFORMATION SCIENCE (Theory Course with Laboratory Component)	L	T	P	C
24PH201		3	0	2	4

OBJECTIVES:

The course will enable the learners to:

- understand the classical free electron theory and Fermi distribution function
- relate the theory of laser with its applications in optical fibers
- solve the Schrodinger's wave equation in one dimensional and three dimensional box
- gain the basic knowledge in quantum operators and quantum gates
- comprehend the behavior of semiconductor diodes in various electron devices and nano electronic devices

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 15

Classical free electron theory - Expression for electrical conductivity and thermal conductivity - thermal conductivity of a bad conductor- Lee's disc method -Effect of temperature on Fermi function - Density of energy states and average energy of an electron at 0 K- Effective mass of electron - Concept of hole.

Semiconductors - Direct and Indirect bandgap semiconductors - Intrinsic Carrier Concentration - Bandgap Determination.

(Theory -9)

1. Determination of Thermal conductivity of a bad conductor - Lee's Disc Method
2. Bandgap determination of intrinsic semiconductor

(Laboratory- 6)

UNIT II LASER 18

Characteristics of Laser, Spatial and Temporal Coherence - Population inversion - Relation between Einstein's A and B coefficients - Components of Laser - Optical amplification (qualitative) - Semiconductor lasers: Homojunction and Heterojunction- Application: Engineering applications of lasers in data storage (qualitative), Principle of Fiber optics- Fiber optic communication system - Fiber optic sensors (pressure and displacement).

(Theory 9)

1. Determination of divergence of the laser beam
2. Determination of acceptance angle and numerical aperture of an optical fiber
3. Determination of wavelength of semiconductor laser

(Laboratory 9)

UNIT III QUANTUM THEORY **15**

Introduction- Blackbody Radiation - Newton's law of cooling - Planck's quantum theory- matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, Time independent and Time-dependent Schrödinger's wave equations, Physical significance of wave function, Particle in a one-dimensional potential box - Particle in a three-dimensional box (qualitative) - degenerate and non-degenerate energy levels- Quantum tunneling - Scanning Tunneling Microscope (STM).

(Theory -9)

1. Determination of emissivity (Newton's law of cooling)
2. Determination of Planck's constant

(Laboratory- 6**)**

UNIT IV BASICS OF QUANTUM COMPUTING **12**

Quantum Operators: Linear vector spaces - inner product space - Hilbert space - examples Vectors and Tensors: Scalars and vectors, Dirac notations of Bra-Ket notation-Matrix representation of observables and states.

Quantum Computing: Quantum states - classical bits - quantum bits or qubits - Entanglement and superposition - multiple qubits - Bloch sphere - quantum gates - CNOT gate - Advantages of quantum computing over classical computing.

(Theory -9)

1. Truth table verification of CNOT gate through Virtual Laboratory

(Laboratory-3)

UNIT V NANOELECTRONIC DEVICES **15**

Introduction to Nano materials – synthesis by sol gel method, properties - Quantum confinement - Quantum structures: Density of energy states of quantum wells, quantum wires and quantum dots - band gap of nanomaterials - Quantum dot laser- Single electron phenomena -single electron transistor - Quantum system for information processing.

(Theory -12)

1. Synthesis of Nano-powders by sol-gel method

(Laboratory- 3)

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

CO1: Derive electrical and thermal conductivities using classical free electron theory

CO2: Calculate the electrical conductivity and bandgap in Intrinsic semiconductors

CO3: Associate the basic principles of working of laser and their applications in fiber optics

CO4: Calculate the energy eigen value and eigen function for a particle in a one- dimensional and three dimensional box using Schrodinger wave equations

CO5: Use quantum operators to frame equations for logic gates in Quantum computing

CO6: Relate the quantum properties of nanoscale materials with their applications

TEXTBOOKS:

1. Neil W Ashcroft and N David Mermin, Solid State Physics, Harcourt College Publishers,1976
2. M.N. Avadhanulu and P.G. Kshirsagar, A textbook of Engineering Physics, S. Chand and Company, New Delhi, 2014.
3. David J. Griffiths, Introduction to Quantum Mechanics, 2nd Edition, Pearson Prentice-Hall (2004).
4. Thomas G. Wong, Introduction to Classical and Quantum Computing, Rooted Grove (2022).

REFERENCES:

1. R. A. Serway and J.W. Jewett, Physics for Scientists and Engineers, Ninth Edition, Cengage Learning, 2014.
2. Marikani, Materials Science, PHI Learning Private Limited, Eastern Economy Edition, 2017.
3. R. Wolfson, Essential University Physics, Volume 1 and 2 with Mastering Physics, Global Edition,3rd Edition, Pearson 2017.
4. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning India, 2012.
5. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press (2014).
6. Mermin, N. David, Making better sense of quantum mechanics. Reports on Progress in Physics 82.1 (2018): 012002.
7. Michael Nielsen, L. Isaac Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2010).
8. NPTEL course on "Introduction to LASER" by Prof. M. R. Shenoy, IIT Delhi : https://onlinecourses.nptel.ac.in/noc24_ph45/preview

9. NPTEL course on “Introduction to Quantum Computing: Quantum Algorithms and Qiskit” by Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan, IIT Madras, IBM Research, IBM Systems : https://onlinecourses.nptel.ac.in/noc24_cs67/preview
10. NPTEL course on “Introduction to Semiconductor Devices” by Prof. Naresh Kumar Emani, IIT Hyderabad : https://onlinecourses.nptel.ac.in/noc24_ee99/preview
11. Physics for Computer Science and Information Technology Laboratory Manual, R.M.D. Engineering College, 2022.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Description of Equipment	Quantity
1.	Semiconductor Laser	6 Nos.
2.	Determination of optical fiber parameters	6 Nos.
3.	Lee’s disc apparatus	6 Nos.
4.	Bandgap determination set-up	6 Nos.
5.	Sol-gel synthesis of nano-powders	2 Nos.
6.	Planck’s constant apparatus	6 Nos.
7.	Emissivity Determination	6 Nos.

Course Code	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L	T	P	C
24AM201	(Theory Course with Laboratory Component)	2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- Understand the basics and applications of Artificial Intelligence.
- Apply the basics of Python programming.
- Use python libraries to solve simple problems.
- Understand the different types of Machine Learning algorithms.
- Solve real world problems using AI/ML.
- Explore the various applications in the field of Artificial Intelligence and Machine Learning.

UNIT I ARTIFICIAL INTELLIGENCE **6+6**

Introduction – Types of AI – ANI, AGI, ASI – Narrow, General, Super AI, Examples - AI problems – Production Systems – State space Representation – Applications of AI in various industries.

List of Exercise:

1. Build a simple AI model using python.

UNIT II BASICS OF PYTHON **6+6**

Introduction to Python programming – Arithmetic Operators - values and types - variables, expressions, statements – Functions – Conditionals and Recursion –Iteration.

Lists: Sequence, Mutable, Traversing, Operations, list slices, list methods - Tuples: Immutable, Tuple Assignment, Tuple as Return Values, Comparing and Sorting.

List of Exercises:

1. Compute the GCD of two numbers.
2. Operations on Tuples: a) finding repeated elements, b) slice a tuple c) reverse a tuple d) replace last value of a tuple.

UNIT III PYTHON LIBRARIES **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 Exercises:

1. Download, install and explore the features of R/Python for data analytics
   - Installing Anaconda
   - Basic Operations in Jupyter Notebook
   - Basic Data Handling
2. 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.
3. 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()).

4. Perform the Statistics operation for the data (the sum, product, median, minimum and maximum, quantiles, arg min, arg max etc.).

5. Use any data set compute the mean ,standard deviation, Percentile.

UNIT IV MACHINE LEARNING **6+6**

Introduction – ML Algorithms Overview – Types – Supervised – Unsupervised – Reinforcement Learning – Introduction to Neural Networks – Working of Deep Learning – Applications of DL – Ethical consideration in AI and ML.

List of Exercise:

1. Apply any Machine Learning model to predict the sales in a store.

UNIT V CASE STUDIES **6+6**

Disease Prediction – Share Price Forecasting – Weather Prediction – Domain Specific Case Studies.

List of Domain Specific Case Studies:

- For CSE & allied: Sentiment analysis of product reviews using machine learning.
- For ECE & allied: Smart homes using AI.
- For EEE: Forecasting of Renewable energy availability during a specified period using AI.
- Civil: Application of ML for crack detection on concrete structures.
- Mech: Predictive Maintenance for CNC Machines Using AI and Machine Learning.

List of Exercise:

1. Build a machine learning model to solve any real-world problem from your domain.

TOTAL: 30(L) + 30(P) = 60 PERIODS

OUTCOMES:

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

CO1: Elaborate the basics and applications of Artificial Intelligence**.**

CO2: Apply the basics of Python programming to solve problems.

CO3: Use python libraries to solve simple ML problems.

CO4: Outline the different types of Machine Learning algorithms.

CO5: Use Machine Learning Algorithms to solve real world problems.

CO6: Outline the recent developments in the field of Artificial Intelligence.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Jake VanderPlas, "Python Data Science Handbook – Essential tools for working with data", O'Reilly, 2017.
3. Steve Abrams, "Artificial Intelligence and Machine Learning for Beginners: A simple guide to understanding and Applying AI and ML", Independently published, May 14, 2024.

REFERENCES:

1. Vinod Chandra S S, Anand Hareendran S, Artificial Intelligence and Machine Learning, PHI Learning, 2014.
2. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice Hall, 2010.
3. Ethem Alpaydın, Introduction to Machine Learning, Second Edition, the MIT Press, Cambridge, Massachusetts, London, England.
4. Stephen Marsland, Machine Learning - An Algorithmic Perspective, 2nd Edition, 2015, by Taylor & Francis Group, 2015.
5. Tom M. Mitchell, Machine Learning, McGraw-Hill Science, ISBN: 0070428077
6. Mayuri Mehta, Vasile Palade, Indranath Chatterjee, Explainable AI: Foundations, Methodologies and Applications, Springer, 2023.
7. Siddhartha Bhattacharyya, Indrajit Pan, Ashish Mani, Sourav De, Elizabeth Behrman, Susanta Chakraborti, "Quantum Machine Learning", De Gruyter Frontiers in Computational Intelligence, 2020.

LIST OF EQUIPMENTS:

1. Systems with Anaconda, Jupyter Notebook, Python.

Course Code		L	T	P	C
24GE211	IDEA LAB – II	0	0	2	1

OBJECTIVES:

Students completing this course are expected to

- Develop hands-on experience and practical application of theoretical knowledge.
- Develop their ability to explain the process involved.

LIST OF EXERCISES:

1. Printing of a 3D part.
2. Scanning of a 3D part.
3. Design and fabrication of press fit object using laser cutting machine.
4. Design and fabrication of 3D part using CNC Router.
5. Design and fabrication of simple PCB.
6. Soldering and desoldering of given electronic circuit.

TOTAL: 30 PERIODS

OUTCOMES:

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

CO1 Analyze the latest manufacturing methods in advancements and technologies related to their field.

CO2 Understand the operations of a laser cutting machine and CNC Router.

CO3 Analyze the process of design and fabrication of PCB and Soldering operations

CO4 Develop technical proficiency and problem-solving abilities, making more competent and confident in their field.

CO5 Develop themselves with the skills needed to address industry-specific 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	Multimeter	5 Nos
6	Solder Stations	5 Sets
7	Desoldering Machine	1 No
8	PCB Milling Machine	1 No
9	Variable Power Supply	1 No
10	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	5 Sets

Course Code	INNOVATION AND CREATIVITY SKILLS DEVELOPMENT	L	T	P	C
24HS211		1	0	0	1

OBJECTIVES:

The course will enable the learners to:

- Understand study plans, co-curricular activities, programming skills, recruitment test patterns, and hiring strategies through national qualifiers and hackathons.
- Equip students with strategies for higher education, resume enhancement, project management, and securing internships
- Understand entrepreneurship fundamentals, including key differences, global hubs, business ideas, and scalability.
- Develop essential entrepreneurial skills such as opportunity recognition, patience, risk management, communication, persistence, and leadership
- Understand life, success, self-confidence, health, scientific heritage, personal counseling, and cybercrime awareness

UNIT I STEPPING STONE – ENGINEERING CAREERS AND SKILL DEVELOPMENT 3

Study Plans and Resources - Identification of key resources and job opportunities - career prospects and academic growth through co-curricular activities - importance of programming/coding skills - Overview of test patterns and essential skills for popular campus recruiters - Comparison of IT Services, Dream, and Super Dream offers and their recruitment processes - National Qualifier Tests and their impact on hiring processes – Overview of Corporate contests and hackathons (e.g., TCS Codevita, HackerRank)

UNIT II STEPPING STONE – HIGHER EDUCATION AND CAREER DEVELOPMENT3

Overview of higher education opportunities: GATE, GRE, GMAT, XAT, CAT, MAT - Exam formats, preparation strategies, and timelines - Resume Enhancement Strategies - Project Management - Steps to develop projects from proposal to prototype - Internship Pathways - Strategies for maximizing internship experiences for career advancement

UNIT III FUNDAMENTALS OF ENTREPRENEURSHIP: FROM IDEAS TO VENTURES 3

Introduction to Entrepreneurship – Intrapreneur vs. entrepreneur - Roles and Contributions - Global Entrepreneurship Hubs - Overview of Key Global Locations - Idea vs. Commercial Value - Transforming Ideas into Viable Business Models - Characteristics of Successful Business Ideas - Understanding Market Competition - Basics of Copyrights and Intellectual Property - Scalability in Business Ventures - Strategies for Scaling a Business

UNIT IV HUMAN SKILLS FOR ENTREPRENEURSHIP 3

Identifying and capitalizing on business opportunities - Case studies and anecdotes - Patience and Risk Management - The role of patience in entrepreneurial success and decision-making - Effective Communication - Techniques for clear and persuasive communication - Importance

of communication in building and leading teams - Leadership qualities and their impact on entrepreneurial ventures - Analyzing success and failure stories

UNIT V FOUNDATIONS OF PERSONAL DEVELOPMENT AND WELL-BEING 3

Understanding Life and Success - Self-Confidence and Fear - Practical strategies for enhancing self-esteem - Adolescent Issues - Health Management - Basics of a balanced diet - Benefits of physical activity - Scientific Heritage of India - Overview of India's scientific achievements and contributions - Cyber Crime Awareness - Types and prevention strategies.

TOTAL: 15 PERIODS

COURSE OUTCOMES

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

CO1: Create study plans, value co-curricular activities, develop programming skills, and navigate for career advancement

CO2: Understand about higher education options, resume enhancement, project management, and securing internships

CO3: Learn entrepreneurship skills and strategies to develop successful business ideas.

CO4: Develop key entrepreneurial skills like opportunity recognition, risk management, and leadership through real-world examples

CO5: Explore personal development, health management, scientific heritage, and cybercrime awareness.

Course Code		L	T	P	C
24MC102	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	2	0	0	0

OBJECTIVES:

The course will enable the learners

- 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 of carbon footprint, environmental impact assessment, clean development mechanism, solutions.

Field study – Alternate energy sources and its impacts

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

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: To investigate and use conservational practices to protect natural resources.

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

CO3: To analyze the values of biodiversity and its conservational methods.

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

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

CO6: To develop innovative solutions and strategies to address sustainability challenges.

TEXTBOOKS:

1. Anubha Kaushik and C.P. Kaushik, "Perspectives in environmental studies", New Age International Publishers, 8th edition, 2024.
2. Benny Joseph, Environmental Science and Engineering, McGraw-Hill, 1st edition, 2017.
3. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education, 3rd edition, 2014.
4. Erach Bharuch, Textbook of Environmental Studies for Undergraduate Courses, Universities Press(I) Pvt. Ltd., 3rd edition, 2021.

REFERENCES:

1. William P. Cunningham and 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. and 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.

Course Code		L	T	P	C
24AC201	YOGA FOR STRESS MANAGEMENT	0	0	1	0

OBJECTIVES:

The course will enable the learners to:

- Understanding the different types of stress and managing stress.
- Develop an understanding of practicing yoga
- Learning to do asanas, including sitting, standing and lying postures

Unit I: Stress Management **3**

Definition of Stress - Stress in Daily Life - Impact of Stress on Life - Identifying the Causes of Stress - Symptoms of Stress - Managing Stress (Habits, Tools, Training, Professional Help) - Complications of Stress Mismanagement - The Importance of Sleep for Mental Wellness - Connection Between Sleep and Digestion.

Unit II: Introduction to Yoga **3**

Meaning and Definition of Yoga - Aims and Objectives of Yoga - Guidelines for Practicing Asanas - Benefits of Yoga

Unit III: Different Asanas **3**

Methods of Performing Asanas - Pranayama - Suryanamaskar Asanas - Sitting Postures: Uttanpadasana, Paschimottanasana ,Janu Sirsasana , Baddha Konasana - Shishupal Asana - Vajrasana

Unit IV: Standing Postures **3**

Uttanasana -Trikonasana -Vrikshasana -Tadasana - Superbrain asana

Unit 5: Lying Postures **3**

Pavana Muktasana - Pada Sanchalanasana – Jhulana Lurhakanasana -Dhanurasana – Marjaryasana. BitilasanaDictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1: relieve stress and achieve mental wellness.

CO2: experience the benefits of yoga

CO3: keep self and body healthy

REFERENCE BOOK:

1. Iyengar, Bellur Krishnamukar Sundara. "Light on yoga." (1965).

2. Desikachar, Tirumalai Krishnamacharya Venkata. The heart of yoga: Developing a personal practice. Simon and Schuster, 1999.

3. Davis, Martha, Elizabeth Robbins Eshelman, and Matthew McKay. The relaxation and stress reduction workbook. New Harbinger Publications, 2008.

4. Krishnamacharya, Tirumalai, et al. "Yoga makaranda: The nectar of yoga." Swathi Soft (2013).

SEMESTER – III

Course Code	**DISCRETE MATHEMATICS**	**L**	**T**	**P**	**C**

24MA301	(Common to B.E. CSE, B.Tech. IT and AIML) **(Theory Course)**	3	1	0	4

OBJECTIVES

The course will enable the learners to:

- describe the arguments using connectives and rules of inference.
- introduce the basic concept of counting and generating functions.
- construct recurrence relations for mathematical models.
- define the graphs and its models.
- understand the concept of group theory, Lattices and Boolean algebra.

UNIT I LOGIC AND PROOFS **12**

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

UNIT IICOMBINATORICS **12**

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 **12**

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 **12**

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 VLATTICES AND BOOLEAN ALGEBRA **12**

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: 60 PERIODS

COURSE OUTCOMES

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

CO1: examine the validity of the arguments.

CO2: apply various proof techniques and principles using analytic and combinatorial methods.

CO3: develop the recurrence relation for the sequence.

CO4: implement graph theory techniques to solve real time problems.

CO5: apply the concepts of groups, rings, and fields in solving algebraic problems.

CO6: solve problems in Lattices and Boolean algebra.

TEXT BOOKS:

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

REFERENCES:

1. R.P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, New Delhi, Reprint 2019.
2. S. Lipschutz, and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 4th Edition, 2021.
3. T. Koshy, "Discrete Mathematics with Applications", Elsevier Publications, 1st Edition, 2014.

Course Code	**UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY (Common to all Branches)**	**L**	**T**	**P**	**C**
24GE301		**2**	**1**	**0**	**3**

OBJECTIVES:

Students completing this course are expected to:

- Development of a holistic perspective based on self-exploration about themselves (human beings), 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	**NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION**	**12**

Purpose and motivation for the course, recapitulation from Universal Human Values-I

- Self-Exploration–what is it? - 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 fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfil the above human aspirations: Understanding and living in harmony at various levels.

Include 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!**	**12**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss programs for ensuring health vs dealing with disease

UNIT-III	**UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY-HARMONY IN HUMAN-HUMAN RELATIONSHIP**	**12**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect; Difference between respect and differentiation; the other salient values in relationship
- 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.

Include 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. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV	**UNDERSTANDING HARMONY IN NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE**	**12**

Understanding the harmony in nature
- Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence.
- Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V	**IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY IN PROFESSIONAL ETHICS**	**12**

Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. 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.

Include practice exercises and case studies will be taken up in practice (tutorial) sessions eg. To discuss the conduct as an engineer or scientist etc.

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

CO1	be aware of themselves, and their surroundings (family, society, nature).
CO2	be more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3	have better critical ability
CO4	become sensitive to their commitment towards what they have understood (human values, human relationships, and human society).
CO5	be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXT BOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, NewDelhi, 2010.

REFERENCES:

1. A Nagaraj, “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. Heaton, Dennis P. "The story of stuff." (2010): 553-556.
9. Gandhi, Mohandas Karamchand, “The story of my experiments with truth: An autobiography”, Om Books International, 2018.
10. Andrews, Cecile, “Slow is beautiful: new visions of community, leisure, and joie de vivre”, New society publishers, 2006.
11. Kumarappa, Joseph Cornelius, “The economy of permanence. CP”, All India Village Industries Assn., 1946.

24CS301	COMPUTER ORGANIZATION AND ARCHITECTURE (Common to CSE, IT,CSBS and AIML)	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 – Representation 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: Analyse the performance of computers by identifying factors that contribute to performance.

CO3: Compare various I/O methods and understand memory management principles.

CO4: Explain data flow in arithmetic algorithms.

CO5: Demonstrating the concept of parallelism in hardware and software.

CO6: Design hardware to solve computationally intensive problems.

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, Tata McGraw 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.

24CS302	ADVANCED JAVA PROGRAMMING	L	T	P	C

	(Lab Integrated) **(Common to All Branches)**	**3**	**0**	**3**	**4.5**

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+9**

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	**DATE HANDLING AND SERIALIZATION**	**9+9**

Date – Calendar – Comparable interface – Observer Interface — Serialization – Dates - Numbers, and Currency - Working with Dates - Numbers and Currencies - Object Serialization - Serializable Interface - Writing and Reading Serializable Objects -Transient Keyword- SerialVersionUID.

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. Create a class hierarchy representing different types of objects (e.g., Person, Employee). Serialize instances of these classes to a file using object serialization.

UNIT III	**STREAM API AND FUNCTIONAL PROGRAMMING PARADIGMS**	**9+9**

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 AND I/O TECHNIQUES	9+9

String Tokenizer – Parsing - Tokenizing and Formatting - Locating Data via Pattern Matching, Tokenizing - Streams - Types of Streams - The Byte-stream I/O hierarchy - Character Stream Hierarchy – Random Access File class – the java.io. Console Class - 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. 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.
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+9

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+45 = 90 PERIODS

OUTCOMES:

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

CO1: Implement various data structures by utilizing core Java features and libraries

CO2: Demonstrate proficiency in handling Java I/O operations, including file manipulation for efficient data storage and retrieval.

CO3: Apply and Analyze the Stream API for functional programming and data processing.

CO4: Implement advanced object serialization for complex data structures.

CO5: Utilize regular expressions for text parsing and string manipulation.

CO6: Build applications using advanced Java programming techniques.

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

24CS303	DATABASE MANAGEMENT SYSTEMS (Lab Integrated) (Common to all Branches)	L	T	P	C
		3	0	3	4.5

COURSE OBJECTIVES:

The Course will enable the learners:

- 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	9+9

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 Exercise/Experiments

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.

UNIT II	STRUCTURED QUERY LANGUAGE	9+9

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 Exercise/Experiments

Case Study using real life database applications anyone from the following list and do the following exercises.

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

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements
2. Database Querying – Simple queries, Nested queries, Sub queries and Joins
3. Views, Sequences, Synonyms
4. Database Programming: Implicit and Explicit Cursors
5. Procedures and Functions
6. Triggers
7. Exception Handling

UNIT III	RELATIONAL ALGEBRA, CALCULUS AND NORMALIZATION	9+9

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 Exercise/Experiments

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.

Apply Normalization rules in designing the tables in scope.

UNIT IV	TRANSACTIONS, CONCURRENCY CONTROL AND DATA STORAGE	9+9

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 Exercise/Experiments

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

Ability to showcase ACID Properties with sample queries with appropriate settings for the above scenario.

UNIT V	QUERY OPTIMIZATION AND ADVANCED DATABASES	9+9

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.

Explain Plan Statement – Parsing Output – Join Orders and Methods – Indexes - Standard Issues – Query Tuning - Explain Plan vs Explain Analyses.

List of Exercise/Experiments

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 PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.

TOTAL: 45 + 45 = 90 PERIODS

OUTCOMES:

After completing the course, students will have the ability 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:Evaluate and implement transaction processing, concurrency control mechanisms, and recovery procedures to maintain data integrity.
CO6:Analyze and optimize database queries and understand the features and applications of advanced and distributed database systems, including NoSQL.

TEXTBOOKS:

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:
10. https://infyspringboard.onwingspan.com/web/en/page/home

24AM301	ARTIFICIAL INTELLIGENCE AND DECISION MAKING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To implement various 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 illustrate the uncertain knowledge representation.
- To apply decision making to solve real world problems.

UNIT I	PROBLEM SOLVING	6+6

Search Algorithms - Uninformed Search Strategies - Heuristic search strategies – Heuristic functions – Local Search and Optimization Problems – Local Search in Continuous spaces – Search with Nondeterministic actions – Search in Partially Observable Environments – Online Search Agents and Unknown Environments.

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	CSP AND GAME SEARCH ALGORITHMS	6+6

Constraint Satisfaction Problems - Constraint propagation – Backtracking search for CSP – Local search

for CSP – Structure of Problems - Game Theory - Optimal decisions in games – Alpha-beta search – Monte-Carlo search – Stochastic Games – Partially observable Games – Limitations of Game search Algorithms.

Lab Programs:

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

UNIT III	**LOGICAL AGENTS**	**6+6**

Knowledge-based agents – Wumpus World - Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic - First-Order Logic – Representation - Syntax and semantics – Using First-Order Logic - Knowledge Engineering 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**	**6+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	**UNCERTAIN KNOWLEDGE AND REASONING**	**6+6**

Quantifying Uncertainty – Probabilistic Reasoning – Probabilistic Reasoning over Time – Making Simple Decisions – Combining beliefs and desires under uncertainty – Utility Theory – Utility Functions – Multi-attribute Utility Functions – Decision Networks – Value of Information – Unknown Preferences.

Lab Programs:

1. Implement Bayesian networks and perform inferences.
2. Build a utility function using people choices with different features (multi-attribute utility function).

TOTAL: 30+30 = 60 PERIODS

OUTCOMES:

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

CO1: Implement various search strategies.

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: Represent uncertain knowledge and build a decision network using a real-world scenario.

CO6: Implement AI algorithms to solve real-world problems.

TEXT BOOKS:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2022.
2. 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

LIST OF EQUIPMENTS:

Systems with C++/Python

24CS311	APTITUDE AND CODING SKILLS – I (Common to All Branches)	L	T	P	C
		0	0	3	1.5

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: 45 PERIODS

OUTCOMES:

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

CO1: Develop vocabulary for effective communication skills.
CO2: Build the logical reasoning enhance critical thinking.
CO3: Develop error correction and debugging skills in programming.
CO4: Apply programming skills to develop programs efficiently
CO5: Solve problems using quantitative skills
CO6: Develop effective reading and listening skills.

SEMESTER – IV

Course Code	PROBABILITY AND STATISTICS (Common to B.E. CSE, B.Tech. IT and AIML) **(Theory Course with Laboratory Component)**	L	T	P	C
24MA401		3	0	2	4

OBJECTIVES

The course will enable the learners to:

- provide the necessary basic concepts of random variables and introduce some standard distributions.
- comprehend the concepts of joint distributions, marginal and conditional 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, Independent events, Conditional probability (definition) - Random variable - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

List of Exercises/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 Exercises/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 Exercises/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 block design - Latin square design.

List of Exercises/Experiments using R Programming:

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

UNIT VSTATISTICAL QUALITY CONTROL 15

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

List of Exercises/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

COURSE OUTCOMES

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

CO1: compute the statistical measures of standard distributions.

CO2: apply joint, marginal and conditional distributions to solve practical problems CO3: determine the correlation and regression for two dimensional random variables CO4: employ the concept of testing of hypothesis to solve real life problems.

CO5: apply the concept of analysis of variance for various experimental designs.

CO6: prepare the control charts for variables and attributes for analyzing the data.

TEXTBOOKS:

1. R.A. Johnson, I. Miller and J. Freund, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2023.

2. J.S. Milton and J.C. Arnold, "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2019.

REFERENCES:

1. J. L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, Reprint 2020.
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, 4th Edition, 2013.
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, Reprint 2021.

24CS304	OPERATING SYSTEMS (Common to CSE, IT and AIML)	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
   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: Demonstrate the basic concepts of operating systems and process.

CO2: Implement process management techniques using inter-process communication.

CO3: Implement the concepts of process synchronization and deadlocks.

CO4: Apply various memory management schemes for the suitable scenario.

CO5: Describe various I/O and file management techniques.

CO6: Develop practical skills in developing system-level programming.

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:

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

24CS402	DESIGN AND ANALYSIS OF ALGORITHMS (Common to CSE, IT and AIML)	L	T	P	C
		3	0	2	4

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	9+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	9+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.

UNIT III	DYNAMIC PROGRAMMING	9+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 the longest common subsequence

UNIT IV	GREEDY TECHNIQUE AND ITERATIVE IMPROVEMENT	9+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

UNIT V	BACKTRACKING AND BRANCH AND BOUND	9+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. Solve knapsack problem using branch and bound technique

TOTAL: 45+30=75 PERIODS

OUTCOMES:

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

CO1: Understand the different algorithm design paradigms.

CO2: Design algorithms for real world problems using algorithmic design techniques.

CO3: Analyse the efficiency of simple recursive and non-recursive algorithms.

CO4: Analyse the algorithm's worst, best and average case behaviour in terms of time and space.

CO5: Understand the approximation algorithms for solving NP Hard problems

CO6: Solve the problems by selecting suitable algorithmic design techniques.

TEXT BOOKS:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.

REFERENCES:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
3. http://nptel.ac.in/

LIST OF EQUIPMENTS:

1. Standalone PC with C/C++/Java

24AM401	MACHINE LEARNING	L	T	P	C
		2	0	2	3

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	6+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	6+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	6+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	6+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	6+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: Bagging – Boosting – GBM – XGBoost – Regularization Algorithm- Reinforcement Learning – Elements.

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: 30+30 = 60 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.
CO6: Use Machine Learning Algorithms to build applications.

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. Sebastian Raschka, Python Machine Learning, Packt Publications, Second Edition, 2017.

3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, O'Reilly Publications, Third Edition, 2022.
4. Peter Harrington, "Machine Learning in Action", Manning Publications, 2012.
5. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
6. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.
7. Bishop C.M., Pattern Recognition And Machine Learning, Springer, 2009.
8. NPTEL Courses:
    a. Introduction to Machine Learning - https://onlinecourses.nptel.ac.in/noc23_cs18/preview

LIST OF EQUIPMENTS:

Systems with Anaconda, Jupyter Notebook, Python, Pytorch, scikit-learn, Tensorflow, Colab

24AM402	NEURAL NETWORKS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithms.
- To know the issues of various feed forward and feedback neural networks.
- To gain deep insight about Boltzmann Machine Learning
- To explore Autoencoders and Hopfield Nets

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

A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process. A simple example of learning – Three types of Learning – Types of Neural Network Architectures

Lab Programs:

4. Study of JAX and its installation
5. Perform matrix operations.
6. Plot multiple curves in single plot.
7. Plot Activation function used in neural network
8. Create a simple neural network

UNIT II **PERCEPTRONS** **6+6**

Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment – A geometrical view of Perceptrons – What perceptrons can't do Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

Lab Programs:

5. Create a Perceptron.
6. Pattern Classification using Perceptron network.
7. Build a neural network by implementing the Single-layer Perceptron. Test it using appropriate data sets.

UNIT III **BACK PROPAGATION** **6+6**

Learning the weights of a linear neuron-error surface – learning weights of logistic output neuron-Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

Lab Programs:

4. Create a Back Propagation Feed-forward neural network.

5. Implement and train a Bayesian Neural network.
6. Compute and visualize the Hessian for a 2D weight system.

UNIT IV	BOLTZMANN MACHINE LEARNING	6+6

How a Boltzmann machine models data - Restricted Boltzmann machine- example of RBM learning-Collaborative filtering-learning layers of features by stacking RBMs.

Lab Programs:

4. Model real valued data with RBM.
5. Demonstrate looking for patterns in gene expression profiles in baker's yeast.

UNIT V	AUTOENCODERS AND HOPFIELD NETS	6+6

From PCA to autoencoders-Deep autoencoders-document retrieval- semantic hashing – learning binary codes for image retrieval- shallow autoencoders Hopfield Network – Hopfield Models-Hopfield nets with hidden units

Lab Programs:

5. Design a Hopfield Network which stores 4 vectors
6. Image retrieval
7. Digit Retrieval using Autoencoders and Hopfield Networks.

TOTAL: 30+30 = 60 PERIODS

OUTCOMES:

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

CO1: Understand the similarity of Biological networks and Neural networks

CO2: Perform the training of neural networks using various learning rules.

CO3: Understand the concepts of forward and backward propagations.

CO4: Analyze the architecture and learning algorithms of Boltzmann Machines and their applications in deep learning.

CO5: Design and train Hopfield networks for associative memory tasks and evaluate their performance.

CO6: Develop and experiment with autoencoders (shallow and deep) for feature extraction and data compression.

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon S Haykin, PHI Ed
2. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.
3. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer. 2011.
4. Geoffrey Hintonand Terrence J. Sejnowski,Unsupervised Learning: Foundations of Neural Computation.

REFERENCES:

1. Neural Networks for Machine Learning – Geoffrey E. Hinton, UoFT https://www.youtube.com/playlist?list=PLLssT5z_DsK_gyrQ_biidwvPYCRNGI3iv
2. Neural Networks in Computer Intelligence, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Ed., 2004.
4. Artificial Neural Networks – B. Vegnanarayana Prentice Hall of India P Ltd 2005

24IT402	WEB DEVELOPMENT FRAMEWORKS	L	T	P	C
		3	0	3	4.5

COURSE OBJECTIVES:

The Course will enable the learners:

- To understand web semantics and related tools and framework
- Able to get hands on latest JS based web frameworks
- To develop a scalable and responsive web application
- To develop an industry ready application web enterprise feature

UNIT I	ADVANCED TYPESCRIPT	9+9

Introduction to HTML5 and CSS3, Media Queries, JS, DOM, BootStrap, Variables, Loops, Operators, Scope, Hoisting, Arrays, Spread, REST, DeStructuring

Introduction, Advantage of Using TS over JS, and where to Use and not to use TS - Understanding the Compiler (Transpiler), and its options, Scope of TS - Variable Scopes, Static Data Types - String, Number,Interface, Date - Union, Tuple, Undefined Data Types, Unknown vs any vs Never - Object Oriented , Arrow Funcions - Types, KeyOf, TypeOf, InstanceOf ,Narrowing, Conditional Types - Generics,Enum ,Required / Partial / Optional - Arrays, Modules ,Async Processing w Call backs ,Type Inference, Type Compatability, Utility Type - Unit Testing,TSLint

List of Exercise/Experiments

1. Create a TS Object for Bank Account (w attributes like à customer name, account type, balance, data of creation, bank name, branch name, pan card number). Using JS Object keyword, try to perform following activities
    - List down all the entries of the bank object
    - Check the existence of a key
    - If key found, get the value for the key
2. Spread Operator
    - Merge Customer and Account Arrays
    - Update the Customer Object with the new values
    - Develop a function that takes an Spread Argument and calculates total balance.

UNIT II	INTRODUCTION TO REACTJS	9+9

Introduction to React - ES6 Features,What is React?,React Features - Setting up React Development Environment:- Node.js and npm installation,Create React App,Project structure - JSX (JavaScript XML):- What is JSX?,JSX Syntax and Rules,JSX Expressions - Components in React:- Functional Components,Class Components,Props and PropTypes - State and Lifecycle :- State and setState,Lifecycle Methods,Mounting, Updating, and Unmounting,Handling Events in React - Event Handling in React :- Synthetic Events,Event Binding, - Conditional Rendering:-If-else Statements,Ternary Operator,Logical && Operator
Lists and Keys:-Rendering Lists,Keys and Reconciliation,Extracting Components.

List of Exercise/Experiments

1. A leading bank from APAC wants to modernize their banking services and decided to build a online multi channel mobile ecommerce platform. As part of the drive, starting building following feature set in a staggered model emplying ReactJS as front end library and associated libs from React eco system. Feature to be implemented are

- User Login Page
- Account Summary
- Funds Transfer (within bank and outside bank)
- Recurring and Fixed deposits
- Letter of Credit
- Salary or 3rd Party Payment

2. Unit 2 Scope – Project Setup, Web App Layout Completion using BootStrap or Tailwind, Login Page Implementation, Landing Page Implementation, Authentication and Authorization Implementation.

UNIT III	REACTJS COMPONENTS	9+9

Forms and Controlled Components :- Form Handling in React, Controlled Components, Uncontrolled Components - Basic Hooks :- useState,useRef,useEffect, - Routing in React:- Introduction to React Router,Route, Link, and Switch Components, Route Parameters,useNavigate,useParams, - REST API – Axios GET/PUT/Delete/Remove, Interceptor, Headers, Authorization Token, Promise and Observables (via rxjs)

List of Exercise/Experiments

1. Extend the Project developed in previous section with newly learnt concepts
    - Unit 3 Scope – Forms and Validation (React Form Validation), Integration of Back End Apis via Axios,API Security Implementaiton, Routes and Navigation with Priviate Routes, Usage of useEffect, UseContext hooks

UNIT IV	REACT PRO TOOLKIT: ERROR MANAGEMENT, ABSTRACTIONS AND DATA HANDLING	9+9

Error Handling :- Error Boundaries,componentDidCatch,Error Handling Strategies
Higher-Order Components (HOCs) :- What are HOCs?,Creating and Using HOCs,HOCs vs Render Props,Code Splitting and Lazy Loading,Server-Side Rendering - Data Fetching with React Query :- React Query,Introduction to React Query,Query Keys and Query Functions, Query Invalidation and Refetching.

List of Exercise/Experiments

1. Extend the Project developed in previous section with newly learnt concepts
    - Unit 4 Scope – Completion of Remaining Modules, Error Handling, HOC and AUX implementation, Lazy loaded components for improved performance
2. Extend the Project developed in previous section with newly learnt concepts

UNIT V	REACT UNDER THE HOOD: TESTING, CONTEXT API, AND REDUX	9+9

Testing React Components :- Introduction to Testing,Jest Framework,React Testing Library
Context API :- Creating Context,Providing and Consuming Context,useContext Hook
Redux Overview :- What is Redux?,Redux Principles,Single Source of Truth - Redux Actions and Reducers :- Redux Actions,Redux Reducers,Combining Reducers.

List of Exercise/Experiments

1. Extend the Project developed in previous section with newly learnt concepts
    - Unit 5 Scope – Unit Testing using JEST, Redux implementation for state management.

Business Use Case Implementations

1. Student Management System
2. Retail Bank System
3. eCommerce System
4. Student LMS Management System

TOTAL: 45+45=90 PERIODS

COURSE OUTCOMES:

After completing the course, students will have the ability to

CO1. Understand and apply modern web technologies including HTML5, CSS3, JavaScript, and advanced TypeScript concepts to build dynamic web components.

CO2. Develop responsive and modular front-end applications using ReactJS, including component creation, state management, and routing.

CO3. Implement advanced React features like hooks (useState, useEffect, useRef), React Router, and REST API integration using Axios for dynamic content handling.

CO4. Utilize higher-order components (HOCs), lazy loading, and server-side rendering to optimize and abstract React applications.

CO5. Perform unit testing using Jest and RTL, and manage global application state efficiently using Context API and Redux.

CO6. Design and deliver scalable and real-world enterprise web applications with complete user interface flow, security, and error handling.

TEXTBOOKS:

1. David Flanagan, Javascript The Definitive Guide, Paperback, 7th Edition, 2020.
2. David Choi ,Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL Paperback – Import, 18 December 2020.
3. Mehul Mohan, Advanced Web Development with React Paperback – 1 January 2020.

E-RESOURCES:

1. Parental Website - https://reactjs.org/
2. The Road to Learn React: Your journey to master plain yet pragmatic React.js by Robin Wieruch
3. Learning React: Functional Web Development with React and Redux by Alex Banks and Eve Porcello
4. Learning React by KirupaChinnathambi
5. "React Up & Running" by StoyanStefanov
6. https://www.edureka.co/reactjs-redux-certification-training
7. CodePen
8. CodeSandbox (Preferred)

9. Stackblitz

LIST OF EQUIPMENTS:

- NodeJS (v22.11.2)
- Github as code repository
- Visual studio code as IDE
- RTL as unit testing framework
- Responsive design w bootstrap
- ReactJS installation (v17)
- Chrome / FIreFox Browsers (latest)
- Responsive using Media Queries & Bootstrap Material&Antdesign
- Design based Apps

24CS411	APTITUDE AND CODING SKILLS – II (Common to All Branches)	L	T	P	C
		0	0	3	1.5

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: 45 PERIODS
OUTCOMES: **Upon completion of the course, the students will be able to:** **CO1:** Develop advanced vocabulary for effective communication 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. **CO5:** Develop advanced vocabulary for effective reading skills **CO6:** Apply advanced algorithm design techniques to develop programs

PROFESSIONAL ELECTIVES
DATA SCIENCE AND ANALYTICS

24AM901	FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- To learn the fundamentals of Data Science.
- To describe and understand data for analysis.
- To describe and analyze relationships between variables.
- To apply various data pre-processing strategies.
- To apply data wrangling on data for further processing.

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. Explore a dataset and describe it using basic statistics and represent it using simple graphs.
2. Group data and find averages or counts for each group.
3. Build a simple machine learning model from a dataset and show how well it works.

UNIT II	DESCRIBING DATA	6+6

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

List of Exercise/Experiments:

1. Use graphs to find patterns or trends in a dataset.
2. Compare two or more columns to find relationships in a dataset.
3. Find the average, spread, and z-scores for numbers in a dataset.
4. Find which values are close to the average and which are far using z-scores.

UNIT III	DESCRIBING RELATIONSHIPS	6+6

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient –

Regression –regression line –least squares regression line –

Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean.

List of Exercise/Experiments:

1. Use a scatter plot to see how two variables are related. Calculate the correlation coefficient to measure the strength of the relationship.
2. Find the line of best fit (regression line) for two variables. Calculate r^2 to see how well the line fits the data.
3. Use a Multiple Linear Regression model to predict a target variable from multiple inputs, and plot the predicted vs. actual values to evaluate model performance.
4. Create a dashboard or summary using charts and key numbers.

UNIT IV	DATA PREPROCESSING	6+6

Data Preprocessing – Purpose – Tools – Levels – Cleaning up the Table – Unpacking – Restructuring – Reformulating the Table - Data Cleaning: – Missing Values – Outliers – Errors - Data Fusion vs Data Integration – Directions – Adding attributes – data objects - Entity identification – Data Reduction vs data redundancy – Types – Performing Numerosity Data reduction – Sampling – Principal Component

Analysis – Data Transformation – Normalization and Standardization – Discretization – Smoothing – Aggregation - Binning.

List of Exercise/Experiments:

1. Clean and preprocess a dataset by handling missing values, scaling features, treating outliers, and creating dummy variables.
2. Train and tune a model using cross-validation to understand and manage the bias-variance trade-off.
3. Perform Outlier Analysis on any data set.

UNIT V	**DATA WRANGLING**	**6+6**

Processing Uni-dimensional Data: Creating Vectors - Inspecting the Data Distribution with Histograms- Aggregating Numerical Data - Arithmetic Operators - Indexing vectors- Multidimensional data: Creating matrices - Reshaping - visualization (2d,3d) - Heterogeneous Data: Data frames - Aggregation - Transformation - Indexing - Accessing Database: Filtering - Ordering - Removing Duplicates - Grouping and Aggregating - Joining - Handling with Many Files.

List of Exercise/Experiments:

1. Create and reshape matrices, apply matrix operations, and visualize data using 2D heatmaps and 3D surface plots.
2. Build a DataFrame, perform aggregation and transformation, filter and sort data, remove duplicates, group, and join tables.
3. Simulate SQL-style operations like filtering, ordering, deduplication, and grouping in a DataFrame.

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: Illustrate the basics of data for analysis.
CO3: Identify relationships between variables.
CO4: Implement various data pre-processing strategies.
CO5: Implement data wrangling for further processing of data.
CO6: Apply Data preprocessing on real-time data sets.

TEXT BOOKS:

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units 2, 3)
2. Roy Jafari, Hands-On Data Preprocessing in Python: Learn how to effectively prepare data for successful data analytics, Packt Publications, First Edition, 2022. (Unit 4)
3. Marek Gagolewski, Minimalist Data Wrangling with Python, Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0), 2022. (Unit 5)

REFERENCES:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit 1)
2. Hui Lin, Ming Li, Practitioner’s Guide to Data Science, 1st Edition, Chapman and Hall/CRC, 2023.
3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012.
4. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data, Packt Publications, 2020.

5. Dr. Tirthajyoti Sarkar, Shubhadeep Roychowdhury, Data Wrangling with Python: Creating actionable data from raw sources, Packt Publications, First Edition, 2019.
6. Robert H. Shumway, David S. Stoffer, Time Series Analysis and Its Applications With R Examples, Fourth Edition, 2016, Springer.
7. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning: Data Mining, Inference, and Prediction, Springer, Second Edition, 2017.
8. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, O'Reilly, Third Edition,2022.
9. Jake VanderPlas, "Python Data Science Handbook – Essential tools for working with data", O'Reilly, 2017.
10. Ashwin Pajankar, Aditya Joshi, Hands-on Machine Learning with Python: Implement Neural Network Solutions with Scikit-learn and PyTorch, Apress, 2022.
11. 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

LIST OF EQUIPMENTS:

Systems with Anaconda, Jupyter Notebook, Python, Pandas, NumPy, MathPlotlib

24AM902	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.

24AM906	STREAM PROCESSING AND ANALYTICS	L	T	P	C
		2	0	2	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	6+6

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.

List of Exercises:

1.Working on Data Streams:

a) Simulate a real-time sensor data stream (temperature, humidity) using PyFlink's from_collection and compute incremental mean/variance.
b) Implement a sliding window of size 10 to track the maximum value of a stock price stream from a CSV file.

c) Use reservoir sampling to maintain a 5% sample of a clickstream dataset (local JSON file).
d) Detect concept drift in a synthetic data stream (e.g., mean shifts from 25°C to 30°C) using the ADWIN algorithm from the river library.
e) Compare tumbling vs. sliding window aggregates (sum, average) on a stream of e-commerce transactions

UNIT II	STREAMING ALGORITHMS	6+6

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.

List of Exercises:

1. **Working on Streaming Algorithms**
   a. Implement a micro-clustering algorithm on a stream of IoT sensor data. (e.g., MiniBatchKMeans from scikit-learn)
   b. Train a VFDT (Very Fast Decision Tree) using the HoeffdingTreeClassifier from the river library on a streaming dataset (e.g., credit card fraud detection).
   c. Handle concept drift in a decision tree by resetting the model when drift is detected (use synthetic data with abrupt drift).
   d. Compare CluStream (streaming clustering) vs. offline k-means on a dataset of network intrusion logs.
   e. Implement grid-based clustering (e.g., D-Stream) on a stream of geospatial coordinates.

UNIT III	FREQUENT PATTERN MINING	6+6

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.

List of Exercises:

1. **Track Heavy hitters and implement pattern mining for data streams**

a. Track heavy hitters (top-10 most frequent items) in a Twitter hashtag stream using the Lossy Counting algorithm.
b. Mine frequent itemsets over a landmark window (last 1000 transactions) using the FP-Growth algorithm on a retail dataset.
c. Use reservoir sampling to detect frequent items in a stream of e-commerce product views.
d. Implement sequence pattern mining (e.g., detect "A → B → C" patterns) in a stream of website navigation logs.
e. Analyze temporal patterns (hourly/daily trends) in a stream of server log entries.

UNIT IV	EVALUATING STREAMING ALGORITHMS	6+6

Learning from Data Streams - Evaluation Issues - Design of Evaluation Experiments - Evaluation Metrics - Comparative Assessment - Evaluation Methodology in Non-Stationary Environments.

List of Exercises:

1. **Evaluating streaming algorithms with accuracy, confusion matrices & throughput latency**

a. Compute prequential accuracy (test-then-train) for a streaming classifier on a dataset like ElectricityTiny from river.
b. Compare latency and throughput of PyFlink vs. pure Python for processing 10,000 sensor records.
c. Design an experiment to evaluate how a clustering algorithm (e.g., CluStream) degrades with increasing concept drift.

d. Use confusion matrices and ROC curves to evaluate a fraud detection model on a simulated transaction stream.
e. Benchmark memory usage of a sliding window implementation vs. reservoir sampling.

UNIT V	DATA FLOW MANAGEMENT	6+6

Distributed Data Flows – Apache Kafka – Apace Flume - Processing Streaming Data – Storing Streaming Data – Delivering Streaming Metrics.

List of Exercises:

1. **Setup Kafka & store the stream in SQLite**
   a. Set up a local Apache Kafka instance and ingest a stream of weather data using PyFlink's FlinkKafkaConsumer.
   b. Store processed stream data (e.g., aggregated sensor readings) in SQLite using PyFlink's JdbcSink.
2. **Build a real-time dashboard with Grafana** to visualize streaming metrics stored in SQLite.
   a. Implement exactly-once processing in PyFlink by enabling checkpoints and idempotent sinks.
3. **Design an end-to-end pipeline:** Kafka (ingest) → PyFlink (process) → SQLite (store) → Grafana (visualize).

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: To outline the framework for real time stream processing.
CO2: To learn various algorithms for data streaming.
CO3: To identify frequent item sets by mining from data streams.
CO4: To introduce approaches to evaluate stream learning algorithms.
CO5: To use tools for distributed data flow management.
CO6: To design solutions to stream processing problems

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.

LIST OF EQUIPMENTS:

Apache Flink, Python API via PyFlink, Apache Kafka, SQLite, TimescaleDB , Grafana

APPLIED AI

24AM910	APPLIED AI and ML	L	T	P	C
		2	0	2	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	6+6

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	6+6

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	6+6

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	6+6

Concepts of Classification algorithms- Model Performance- Application of Binary Classification- Multi class classification-Multi label classification-Challenges in solving real world classification problems.

ase Studies: 1.HR Employee Attrition Prediction
2. KC Roasters Coffee Quality Prediction

rojects: 1. Travel Package Purchase Prediction
2. Potential Customers Prediction

UNIT V	DEEP LEARNING	6+6

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.

ase Study: 1. Audio MNLST Digit Recognition,
2.Street View Housing Number Digit Recognition

Project: Food Image Classification

TOTAL: 30+30 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

24AM911	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.

24AM915	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.

HIGH PERFORMANCE COMPUTING

24AM919	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.

24AM920	GPU Architectures and Programming	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To understand the basics of GPU architectures
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

UNIT I	GPU ARCHITECTURE	9
Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.		
UNIT II	**CUDA PROGRAMMING**	**9**
Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.		
UNIT III	**PROGRAMMING ISSUES**	**9**
Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.		

UNIT IV	OPENCL BASICS	9
OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.		
UNIT V	**ALGORITHMS ON GPU**	**9**
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.		
		TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Able to describe GPU Architecture

CO2: Write programs using CUDA, identify issues and debug them

CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication

CO4: Write simple programs using OpenCL

CO5: Identify efficient parallel programming patterns to solve problems

CO6: Explore techniques for multi-GPU programming and distributed parallelism.

TEXT BOOKS:

1. Shane Cook, CUDA Programming: A Developers Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.(Unit – I,II,III)
2. Benedict Gaster,Lee Howes, David R. Kaeli , "Heterogeneous Computing with OpenCL" Published by Elsevier, 2012.(Unit – IV,V)

REFERENCES:

1. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", 3rd Edition, Morgan Kauffman, 2015.
2. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors – A Hands-on Approach", Third Edition, Morgan Kaufmann, 2016.
3. David Kirk and Wen-mei Hwu, "Programming Massively Parallel Processors" – 4th Edition, Morgan Kaufmann, 2022
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org
6. Nicholas Wilt, CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.
7. https://onlinecourses.nptel.ac.in/noc25_cs37/preview?

24AM924	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.

COMPUTATIONAL INTELLIGENCE

24AM927	**NATURE INSPIRED COMPUTING TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the fundamentals of nature inspired techniques which influence computing
- To learn the computing inspired by nature
- To study the Swarm Intelligence
- To know about Immuno computing techniques
- To familiarize with DNA Computing

UNIT I	**INTRODUCTION**				**9**

From Nature to Natural Computing – Philosophy - Three Branches: Overview - Conceptualization - Individuals, Entities and agents - Parallelism and Distributivity -Interactivity, Adaptation- Feedback- Self-Organization-Complexity, Emergence and Reductionism - Bottom-up Vs Top-Down- Determination, Chaos and Fractals.

UNIT II	**COMPUTING INSPIRED BY NATURE**				**9**

Evolutionary Computing - Hill Climbing and Simulated Annealing - Darwin's Dangerous Idea - Genetics Principles - Standard Evolutionary Algorithm -Genetic Algorithms – Crossover – Mutation - Evolutionary Programming - Genetic Programming.

UNIT III	**SWARM INTELLIGENCE**				**9**

Introduction - Ant Colonies - Ant Foraging Behavior - Ant Colony Optimization, S-ACO Algorithm - Scope of ACO algorithms - Ant Clustering Algorithm (ACA) - Swarm Robotics -Foraging for food - Social Adaptation of Knowledge - Particle Swarm and Particle Swarm Optimization (PSO).

UNIT IV	**IMMUNOCOMPUTING**				**9**

Introduction- Immune System - Physiology and main components - Pattern Recognition and Binding - The Immune Network Theory- Danger Theory - Evaluation Interactions - Immune algorithms - Bone Marrow Models - Forrest's Algorithm - Artificial Immune Networks.

UNIT V	**COMPUTING WITH NEW NATURAL MATERIALS**				**9**

DNA Computing: Introduction - The DNA Molecule – Manipulating DNA - Adleman's experiment - Test tube programming language - Universal DNA Computers - PAM Model - Splicing Systems - Lipton's Solution to SAT Problem - Scope of DNA Computing - From Classical to DNA Computing.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basics Natural systems.
CO2: Analyze the concepts of Natural systems and its applications.
CO3: Learn Ant Colony Optimization and Swarm Robotics.
CO4: Articulate immune algorithms and Artificial immune networks.
CO5: Learn DNA Molecule and Scope of DNA computing.

TEXT BOOKS:

1. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithmsand Applications", Chapman and Hall/ CRC, Taylor and Francis Group, 2007.

REFERENCES:

1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods,and Technologies", MIT Press, Cambridge, MA, 2008.
2. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005.

24AM932	**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.

24AM933	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.

INTELLIGENT HEALTHCARE

24AM936	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

24AM937	MEDICAL IMAGE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand of various medical imaging modalities.
- Explore advanced deep learning techniques for medical image analysis.
- Develop solutions by preprocessing medical images, implementing machine learning and deep learning algorithms.
- Examine the ethical implications and societal impact of deploying machine learning models in healthcare.
- Elaborate on recent advances and research trends in machine intelligence for medical image analysis.

UNIT I	INTRODUCTION TO MEDICAL IMAGING	9

Overview of medical imaging modalities -MRI, CT, X-ray, Ultrasound-Basics of image acquisition, processing, and visualization in medical imaging-Challenges and importance of medical image analysis-Introduction to common medical imaging datasets.		
UNIT II	**FUNDAMENTALS OF MACHINE LEARNING**	**9**
Introduction to machine learning concepts-Supervised, unsupervised, and semi-supervised learning-Feature extraction and feature selection techniques-Evaluation metrics for machine learning models.		
UNIT III	**DEEP LEARNING FUNDAMENTALS**	**9**
Basics of artificial neural networks (ANNs)-Convolutional Neural Networks (CNNs) for image analysis-Recurrent Neural Networks (RNNs) for sequential data analysis-Transfer learning and pre-trained models.		
UNIT IV	**MEDICAL IMAGE PREPROCESSING**	**9**
Image preprocessing techniques specific to medical images -noise reduction, normalization-Segmentation techniques-thresholding, region growing-Registration and alignment of medical images-Data augmentation for medical image datasets		
UNIT V	**MEDICAL IMAGE ANALYSIS**	**9**
Classification of medical images using machine learning algorithms-Object detection and localization in medical images-Case studies and applications of machine learning in medical image analysis. Overview of deep learning architectures for medical image analysis-Semantic segmentation for medical images-Generative models for medical image synthesis-Ethical considerations and challenges in deploying deep learning models in healthcare.		
TOTAL: 45 PERIODS		

OUTCOMES:

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

CO1: Demonstrate a comprehensive understanding of various medical imaging modalities.

CO2: Apply machine learning and deep learning techniques.

CO3: Develop solutions by preprocessing medical images, implementing machine learning and deep learning algorithms.

CO4: Understand the ethical considerations and regulatory requirements associated with deploying machine intelligence models in healthcare settings.

CO5: Elaborate on recent advances and research trends in machine intelligence for medical image analysis.

CO6: Illustrate the applications of ML and DL in medical image analysis.

TEXT BOOKS:

1. Le Lu, Yefeng Zheng, Gustavo Carneiro, Lin Yang , Deep Learning and Convolutional Neural Networks for Medical Image Computing Precision Medicine, High Performance and Large-Scale Dataset, Springer, 2017.
2. Atam P. Dhawan, “Medical Image Analysis", Wiley Publications, 2010.

REFERENCES:

1. Ton J. Cleophas and Aeilko H. Zwinderman , Machine Learning in Medicine - A Complete Overview", Springer, 2015.
2. Nadine Barrie Smith and Andrew Webb, “Introduction to Medical Imaging: Physics, Engineering and Clinical Applications", Cambridge University Press, 2010.

24AM941	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

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE

24AM007	DATA SCIENCE FOR ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To learn the fundamentals of Data Science.
- To describe and understand data for analysis.
- To describe and analyze relationships between variables.
- To apply various data pre-processing strategies.
- To apply data wrangling on data for further processing.

UNIT I	INTRODUCTION	9

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.

UNIT II	DESCRIBING DATA	9

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

UNIT III	DESCRIBING RELATIONSHIPS	9

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient –
Regression –regression line –least squares regression line –
Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean.

UNIT IV	DATA PREPROCESSING	9

Data Preprocessing – Purpose – Tools – Levels – Cleaning up the Table – Unpacking – Restructuring – Reformulating the Table - Data Cleaning: – Missing Values – Outliers – Errors - Data Fusion vs Data Integration – Directions – Adding attributes – data objects - Entity identification – Data Reduction vs data redundancy – Types – Performing Numerosity Data reduction – Sampling – Principal Component Analysis – Data Transformation – Normalization and Standardization – Discretization – Smoothing – Aggregation - Binning.

UNIT V	DATA WRANGLING	9

Processing Uni-dimensional Data: Creating Vectors - Inspecting the Data Distribution with Histograms- Aggregating Numerical Data - Arithmetic Operators - Indexing vectors- Multidimensional data: Creating matrices - Reshaping - visualization (2d,3d) - Heterogeneous Data: Data frames - Aggregation - Transformation - Indexing - Accessing Database: Filtering - Ordering - Removing Duplicates - Grouping and Aggregating - Joining - Handling with Many Files.

TOTAL:45 PERIODS

OUTCOMES:

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

CO1: Explain the fundamentals of data science.
CO2: Illustrate the basics of data for analysis.
CO3: Identify relationships between variables.
CO4: Implement various data pre-processing strategies.
CO5: Implement data wrangling for further processing of data.
CO6: Apply Data preprocessing on real-time data sets.

TEXT BOOKS:

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units 2, 3)
2. Roy Jafari, Hands-On Data Preprocessing in Python: Learn how to effectively prepare data for successful data analytics, Packt Publications, First Edition, 2022. (Unit 4)
3. Marek Gagolewski, Minimalist Data Wrangling with Python, Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0), 2022. (Unit 5)

REFERENCES:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit 1)
2. Hui Lin, Ming Li, Practitioner’s Guide to Data Science, 1st Edition, Chapman and Hall/CRC, 2023.
3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012.
4. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data, Packt Publications, 2020.
5. Dr. Tirthajyoti Sarkar, Shubhadeep Roychowdhury, Data Wrangling with Python: Creating actionable data from raw sources, Packt Publications, First Edition, 2019.
6. Robert H. Shumway, David S. Stoffer, Time Series Analysis and Its Applications With R Examples, Fourth Edition, 2016, Springer.
7. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning: Data Mining, Inference, and Prediction, Springer, Second Edition, 2017.
8. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, O'Reilly, Third Edition,2022.
9. Jake VanderPlas, “Python Data Science Handbook – Essential tools for working with data”, O’Reilly, 2017.
10. Ashwin Pajankar, Aditya Joshi, Hands-on Machine Learning with Python: Implement Neural Network Solutions with Scikit-learn and PyTorch, Apress, 2022.
11. 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

LIST OF EQUIPMENTS:

Systems with Anaconda, Jupyter Notebook, Python, Pandas, NumPy, MathPlotlib