Sri
SAI RAM
ENGINEERING COLLEGE
An Autonomous Institution
West Tambaram, Chennai - 44
www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University



DEPARTMENT OF
ARTIFICIAL INTELLIGENCE & DATA SCIENCE ENGINEERING

AUTONOMOUS
CURRICULUM AND

REGULATIONS 2024
Academic Year 2024-25 onwards

SYLLABUS
I - V
SEMESTERS

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

Educational Organization Management System (EOMS) Policy

We at Sri Sai Ram Engineering College are committed to empower our students not only to excel academically but also imbibe essential values, enabling them to become exemplary global citizens. We build a better nation by fostering excellence and innovative practices in Engineering, Technology and Management Education. We are dedicated to consistently enhancing our systems, infrastructure and services to meet the needs and expectations of all our stakeholders for sustainable growth

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE ENGINEERING

VISION

To emerge as a "Centre of Excellence" in the field of Artificial Intelligence and Data Science, the department is committed to inculcate discipline, offering technical education and research opportunities to the students who are ethically responsible and capable of meeting global challenges, thereby contributing to the advancement and welfare of the society.

MISSION

Department of Artificial Intelligence and Data Science Engineering, Sri Sairam Engineering College is committed to

M1 Equip students with strong foundational knowledge and practical competencies in Artificial Intelligence and Data Science for successful careers.

M2 Build students as industry-ready professionals to enhance employability.

M3 Foster higher studies, innovation, and entrepreneurship to create AI-driven start-ups and impactful solutions.

M4 Promote ethical values, social responsibility, and sustainable AI practices.

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2024

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24BSMA101	Matrices and Calculus	3	1	0	4	4
2	24HSEN101	Communicative English	3	0	0	3	3
3	24BSPH101	Engineering Physics	3	0	0	3	3
4	24BSCY101	Engineering Chemistry	3	0	0	3	3
5	24ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	24HSTA101	Heritage of Tamils	1	0	0	1	1
PRACTICALS							
1	24ESPL101	Programming in C Laboratory	0	0	2	2	1
2	24ESGE102	Engineering Practices Laboratory	0	0	4	4	2
VALUE ADDITIONS - I							
1	24ENTP101	Functional Life Skills	1	0	1	2	1
2	24ESID101	Idea Engineering Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BOS					
				Total		**27**	**22**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24BSMA201	Discrete Structures	3	1	0	4	4
2	24HSEN201	Professional English	2	0	0	2	2
3	24BSPH203	Physics for Information Science	3	0	0	3	3
4	24BSCY201	Chemistry for Environment and Sustainability	3	0	0	3	3
5	24HSTA201	Tamils and Technology	1	0	0	1	1
6	24ESGE101	Engineering Graphics	1	2	0	3	3
7	24HSNC201	NCC Course Level 1*	2	0	0	2	0
PRACTICALS							
1	24BSPL101	Physics and Chemistry Laboratory	0	0	4	4	2
2	24AIPT201	Python for Data Science Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - II							
1	24ENTP201	Digital Dynamics	1	0	1	2	0
2	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC201	MS Office (Mandatory - NC)	0	0	0	0	0
				Total		**29**	**22**

*only for NCC cadets

Approved by
Academic Council Meeting
No. 08 **Dated:** 3.9.2024

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Board of Studies
Artificial Intelligence and Data Science

AUTONOMOUS CURRICULA AND SYLLABI

SEMESTER III Regulations 2024

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
THEORY							
1	24BSMA303	Probability and Statistical Modelling	3	1	0	4	4
2	24AIPC301	Introduction to Machine Learning	3	0	0	3	3
3	24AMPC302	Foundations of Data Structures and Algorithm Design	3	0	0	3	3
4	24AIPW301	Biomedical Signal and Image Processing with Laboratory	3	0	2	5	4
5	24HSMC301	Universal Human Values - II Understanding Harmony	2	1	0	3	3
6	24HSNC301	NCC Course Level 2*	3	0	0	3	0
PRACTICALS							
1	24AIPT301	Operating System Laboratory with Theory	1	0	4	5	3
2	24AMPT301	Database Management Systems Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - III							
1	24AITP301	Aptitude Skills - I	0	0	2	2	1
2	24AIID301	Innovative Design Lab -I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC302	Programming in Java (Mandatory - NC)	0	2	0	2	0
				Total		**34**	**25**

*only for NCC cadets

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
THEORY							
1	24BSMA407	Linear Algebra and its Applications	3	1	0	4	4
2	24AIPC401	Data Communication and Computer Networks	3	0	0	3	3
3	24AIPC402	Data Exploration and Visualization	3	0	0	3	3
4	24AIPC403	Deep Learning	3	0	0	3	3
5	24XXOExxx	Open Elective – I#	3	0	0	3	3
6	24HSNC401	NCC Course Level 3*	3	0	0	3	0
PRACTICALS							
1	24AIPL401	Deep Learning Laboratory	0	0	4	4	2
2	24AIPT401	Introduction to Artificial Intelligence Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - IV							
1	24AITP401	Aptitude Skills - II	0	0	2	2	0
2	24AIID401	Innovative Design Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		Any one recommended by BoS					
				Total		**29**	**22**

*only for NCC cadets # Logistics Information System

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CP	C	PREREQUISITE COURSES
THEORY								
1	24AIPC501	IoT and Sensor Technologies	3	0	0	3	3	24AIPC401, 24AIPT201
2	24AIPC502	Big Data Analytics	3	0	0	3	3	24AMPT301, 24AIPC402
3	24AIPW501	Natural Language Processing with Laboratory	3	0	2	5	4	24BSMA303, 24AMPC302 24AIPT401
4	24XXEL5xx	Professional Elective - I	3	0	0	3	3	-
5	24XXEL5yy	Professional Elective - II	3	0	0	3	3	-
6	24XXOE9xx	Open Elective - II #	3	0	0	3	3	-
7	24MGMC501	Constitution of India	2	0	0	2	0	-
PRACTICALS								
1	24AIPL501	IoT and Sensor Technologies Laboratory	0	0	4	4	2	24AIPC401, 24AIPT201
VALUE ADDITIONS - V								
1	24AITP501	Skill Enhancement	0	0	2	2	1	-
2	24AIID501	Prototype Development Lab - I	0	0	2	2	1	24AIID401
ONLINE SUPPLEMENTARY								
		As recommended by BoS						
					Total	**30**	**23**	

Digital Devices Security, Tools and Technologies For Cyber Security

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
THEORY							
1	24AIPC601	Robotics Process Automation	3	0	0	3	3
2	24XXEL6xx	Professional Elective-III	3	0	0	3	3
3	24XXEL6yy	Professional Elective -IV	3	0	0	3	3
4	24XXEL6zz	Professional Elective -V	3	0	0	3	3
5	24HSMG501	Principles of Engineering Management	3	0	0	3	3
6	24XXOExxx	Open Elective-III	3	0	0	3	3
PRACTICALS							
1	24AIPL601	Robotics Laboratory	0	0	4	4	2
VALUE ADDITIONS - VI							
1	24AITP601	Technical Skill	0	0	2	2	0
2	24AIID601	Prototype Development Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As Recommended by BoS			**Total**	**26**	**21**

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SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24AIPC701	Generative AI with Prompt Engineering	3	0	0	3	3
2	24AIPC702	Optimization Techniques for Programming	3	0	0	3	3
3	24XXEL7xx	Professional Elective -VI	3	0	0	3	3
4	24XXOExxx	Open Elective - IV	3	0	0	3	3
5	24MGEL703	Creative Innovation and Entrepreneurship	2	0	0	2	2
PRACTICALS							
1	24AIPL701	Generative AI Laboratory	0	0	4	4	2
2	24AIPJ701	Project Work - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1	24AITP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As Recommended by BoS					
				Total		**28**	**21**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24xxEL8xx	Professional Elective - VII	3	0	0	3	3
PRACTICALS							
1	24AIPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24AIIN801	Internship	0	0	9	9	3
				Total		**24**	**12**

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PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24AIEL507	AI Planning and Search Algorithms	3	Embedded AI	24BSMA201, 24AIPT401 24BSMA303, 24AIPT201
2	24AIEL508	Computability and Complexity Theory	3	Embedded AI	24BSMA201, 24AMPC302 24BSMA303, 24ESCS101
3	24AIEL512	Responsible AI	3	Embedded AI	24BSMA201, 24AIPT201, 24AIPT401
4	24AIEL513	Information Security and Privacy	3	Smart and Secure Systems	24AMPT301, 24AIPT201, 24AIPC401, 24AIPT301
5	24AIEL514	Embedded Sensor Networks and Middleware Architectures	3	Smart and Secure Systems	24AMPT301, 24AIPT201, 24AIPC401
6	24AIEL518	IoT Based Smart Systems	3	Smart and Secure Systems	24AIPC401, 24AIPT401
7	24ITEL501	Computer Graphics and Multimedia	3	Computing Technologies	24BSMA301, 24AMPC302
8	24ITEL502	Graph Theory	3	Computing Technologies	24BSMA402, 24AMPC301
9	24ITEL511	Distributed Systems	3	Computing Technologies	24AIPT301, 24AMPC401, 24AMPC302
10	24AIEP502	Visual Perception and Intelligent Systems Laboratory with Theory	3	Automation Tools for AI	24AIPC301, 24BSMA303
11	24AIEP503	AI Infrastructure and Optimization Technique Laboratory with Theory	3	Automation Tools for AI	24AMPC302, 24AIPC301, 24AIPT401
12	24AIEP506	Business Visualization Laboratory with Theory	3	Automation Tools for AI	24BSMA201, 24AIPC402
13	24MGEL5xx	Intellectual Property Rights	3	Management	-

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No. 08 Dated: 3-9-2024

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PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24AIEL509	AI for Reliability Analysis	3	Embedded AI	24BSMA201, 24AMPC302, 24BSMA303, 24AIPT201
2	24AIEL510	Foundation of Statistical Machine Learning	3	Embedded AI	24ITPT401, 24BSMA201, 24ITTP402, 24BSMA303
3	24AIEL511	AI in Drug Design	3	Embedded AI	24AIPC301, 24AIPT401
4	24AIEL515	Data Privacy and Protection Techniques	3	Smart and Secure Systems	24AIPC401
5	24AIEL516	Smart Building and Automation Security	3	Smart and Secure Systems	24AMPT401
6	24AIEL517	Introduction to Smart and Secure Systems	3	Smart and Secure Systems	24AIPT401, 24AIPC401
7	24ITEL503	Cloud Computing	3	Computing Technologies	24AIPT301, 24AIPC401
8	24ITEL510	Advanced Analysis of Algorithms	3	Computing Technologies	24AMPC302
9	24ITEL512	Parallel Algorithms	3	Computing Technologies	24BSMA201, 24AMPC302
10	24AIEP501	Software Design Patterns for Intelligent Automation Laboratory with Theory	3	Automation Tools for AI	24AMPC302, 24AMPT301, 24AIPC401
11	24AIEP504	AI for Enterprise Data Analytics Laboratory with Theory	3	Automation Tools for AI	24BSMA407, 24AIPC402
12	24AIEP505	Artificial Intelligence Applications in Robotics Laboratory with Theory	3	Automation Tools for AI	24BSMA407, 24AIPC402
13	24MGEL5yy	Total Quality Assurance	3	Management	-

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INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
L&T BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24CSIE501	UI/UX Developer	3	Information Technology
2	24ITIE502	Software Engineering Tools	3	Information Technology
3	24ITIE602	Fundamentals of Business Analytics	3	Information Technology
4	24ITIE603	NODE.JS - The Complete Guide	3	Cross-Platform
5	24ITIE604	Security Professional	3	Security and Risk Management
6	24AIIE601	Full Stack Foundation-Core Java	3	Information Technology
7	24CSIE602	Cyber Defense	3	Information Security
8	24CSIE603	Fundamentals of Agile Methodology with Devops Integration	3	Software Development
9	24CSIE701	Building Web Services with Java Network Programming	3	Information Technology
10	24ITIE702	AI and Edge Computing	3	Artificial Intelligence & Data Science

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
HCL BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24EIIE611	Embedded System For Connected Devices	3	Embedded
2	24CSIE612	C++ For Embedded Systems	3	Embedded
3	24ITIE711	Advanced C++ For Embedded Programming	3	Embedded
4	24EIIE712	Product Development Process	3	Embedded
5	24AIIE712	Project Phase-I	4	Embedded
6	24AIIE811	Internship	3	Embedded
7	24AIIE812	Project Phase-II	6	Embedded

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No. 8 Dated: 3.9.2024

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Artificial Intelligence and Data Science

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
CTS BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24AIIE510	Machine Learning	3	Artificial Intelligence and Machine Learning
2	24AIIE511	Python, Cloud Fundamentals	3	Cloud Computing
3	24AIIE512	AI ML, Prompt Engineering	3	Artificial Intelligence and Machine Learning

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES
INTEL BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24AIIE507	Machine Learning Applications	3	Artificial Intelligence
2	24AIIE508	Operating System with Laboratory	3	Information Technology
3	24AIIE509	Generative AI	3	Artificial Intelligence

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No. 8 Dated: 3.9.2024

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Artificial Intelligence and Data Science

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates will apply technical expertise in Embedded AI and AI Automation Tools to address industry challenges and build successful careers..

PEO2 Students will demonstrate technical competence, professional skills, and adaptability to excel in multidisciplinary environments.

PEO3 Students will uphold the research mindset to launch technical start-ups, lead corporate initiatives, and entrepreneurial ventures focusing on AI-based products.

PEO4 Students will integrate ethical values and social responsibility in developing AI solutions that improve societal well-being and support economic progress.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 Analyze, design, and develop data-driven solutions to address real-world engineering and societal problems.

PSO2 Apply advanced technologies and Artificial Intelligence tools ethically to develop innovative business solutions, and effectively contribute to multidisciplinary projects.

COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences (BS)	18	32	30
Engineering Sciences (ES)	5	12	09
Humanities and Social Sciences (HS)	8	13	13
Professional Electives (EL)	14	23	23
Program Core + Program Lab (PC+PL)	22	46	38
Program theory with Lab (PW) / Program Lab With Theory (PT)	12	30	20
Open Elective (OE)	7	12	12
Training & Placement (TP)	2	14	4
Innovation & Development (ID) / Project (PJ)	10	32	16
Internships (IN)	2	9	3
Mandatory Courses (MC)	NA	4	NA
Total		**227**	**168**

PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



01 Engineering knowledge
Apply math, science, computing, and engineering knowledge to solve complex engineering problems.

02 Problem Analysis
Identify and analyze complex problems using research to draw valid conclusions.

03 Design / Development of solutions
Design practical and innovative solutions considering safety, cost, culture, and the environment.

04 Investigate complex problems
Use research methods—experiments, modeling, and data analysis—to investigate complex problems.

05 Engineering Tool Usage
Apply modern engineering and IT tools for analysis and problem solving with awareness of their limits.

06 The Engineer and the World
Assess societal, environmental, legal, health, and cultural impacts of engineering solutions.

07 Ethics
Follow professional ethics, human values, diversity, inclusion, and legal responsibilities.

08 Individual & Teamwork
Work effectively as an individual and as a team member or leader in multidisciplinary groups.

09 Communication
Communicate clearly in writing and presentations for diverse technical and non-technical audiences.

10 Project Management and Finance
Apply management and financial principles to plan and execute projects effectively.

11 Life-long learning
Engage in independent lifelong learning and adapt to new technologies with critical thinking.

SEMESTER - I

24BSMA101 - SDG NO. 4	MATRICES AND CALCULUS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To develop a strong foundation in matrix algebra and its applications.
- To introduce the concepts of limits, continuity, differentiation, and optimization for functions of several variables.
- To familiarize students with the principles of vector calculus relevant to engineering problems.
- To provide an understanding of double and triple integrals along with their practical applications.
- To impart knowledge of Fourier series and its significance in engineering analysis.

MODULE I MATRICES 12

Eigenvalues and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem (excluding proof) – Symmetric and orthogonal matrices - Reduce the quadratic to canonical form using orthogonal transformation - Nature of quadratic forms.

MODULE II FUNCTIONS OF SEVERAL VARIABLES 12

Limits, Continuity - Definitions - Partial derivatives - Taylor's series - Jacobians, Maxima and Minima - Method of Lagrange multipliers.

MODULE III VECTOR DIFFERENTIATION 4

Scalar and vector valued functions - Gradient and directional derivatives – Tangent plane - Divergence and curl - Irrotational and solenoidal vector fields - Scalar and vector potentials - Vector identities (without proof).

MODULE IV VECTOR INTEGRATION 8

Line integral over a plane curve - Surface integral - Area of a curved surface - Volume integral - Greens, Gauss divergence and Stoke's theorems - Verification and application in evaluating line, surface and volume integrals. (Cube and Cuboids).

MODULE V MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from cartesian to polar coordinates - Triple integrals – Volume of solids (Spherical and Cylindrical polar coordinates).

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/05/2024

Chairman
Board of Studies
Department of Humanities & Sciences

MODULE VI FOURIER SERIES **12**

Fourier series – Convergence of Fourier series - Half range sine and cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Calculus and Analytic geometry, G.B. Thomas and R.L. Finney, 9th Edition, Pearson, Reprint, 2002.

REFERENCES:

1. Higher Engineering Mathematics, B. V. Ramana, 11th reprint, Tata McGraw-Hill, New Delhi, 2010.
2. Engineering Mathematics for first year, T. Veerarajan, Tata McGraw-Hill, New Delhi, 2008.
3. A text-book of Engineering Mathematics, N.P. Bali and Manish Goyal, 9th Edition, Laxmi Publications, Reprint, 2008.
4. Higher Engineering Mathematics, B. S. Grewal, 40th Edition, Khanna Publishers, New Delhi, 2007.

WEB REFERENCES:

1. https://testbook.com/maths/cayley-hamilton-theorem
2. https://www.iitg.ac.in/rafik/Tutorials/MA-102/2013/lect-10.pdf
3. https://ms.unimelb.edu.au/__data/assets/pdf_file/0007/2516596/functions_sev_var.pdf
4. https://www.mecmath.net/VectorCalculus.pdf
5. https://egyankosh.ac.in/bitstream/123456789/64855/1/Unit4.pdf
6. https://williamsgj.people.charleston.edu/Fourier%20Series.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=oJDlt_Xv-mM
2. https://www.youtube.com/watch?v=8h3yY0im5XU
3. https://www.youtube.com/watch?v=LGxE_yZYigI
4. https://www.youtube.com/watch?v=ma1QmE1SH3I
5. https://www.youtube.com/watch?v=QPw4GYz5Unc
6. https://www.youtube.com/watch?v=1mMYaPkXcNI

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/05/2024

S. Ramakrishnan
Chairman
Board of Studies
Department of Humanities & Sciences

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

1. Diagonalize the matrix using orthogonal transformation and apply Cayley Hamilton Theorem to find the inverse and integral powers of a square matrix. (K3)
2. Evaluate the limit, examine the continuity and use derivatives to find extreme values for functions of several variables. (K3)
3. Compute the derivatives of scalar and vector point functions. (K3)
4. Use the vector point function to establish the relation between line, surface and volume integrals. (K3)
5. Apply double and triple integrals to find the area and the volume of a region. (K3)
6. Compute Fourier series expansion of a function. (K3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

SEMESTER - I

24HSEN101 - SDG NO. 4	COMMUNICATIVE ENGLISH	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Develop the basic LSRW skills
- Acquire enhanced knowledge of English grammar
- Improve modern and technical vocabulary
- Enhance the communicative and cognitive skills
- Interpret the texts and write reviews critically

Recommended by Board of Studies of HAS dept. Meeting No. 6 Dated: 31/05/2024

S. Narasakshmay
Chairman
Board of Studies
Department of Humanities & Sciences

MODULE - I COMMUNICATION PROCESS **8**

Listening – informal conversations - Speaking – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - Reading comprehension – skimming/ scanning/ predicting – question & answers – objective and descriptive answers - Writing – paragraph writing, personal notes - Language Development – parts of speech, prefix, suffix, word formation

MODULE - II LANGUAGE BARRIERS, LEVELS AND CHANNELS **8**

Listening –interviews - Speaking – describing a simple process – asking and answering questions - Reading – critical reading – finding key information in a given text – ideation, mind mapping - Writing - dialogue,, instructions – Language Development – regular, irregular verbs, tenses, framing questions,

MODULE - III NARRATION AND SUMMATION **8**

Listening - long texts - TED talks - extensive speech on current affairs - Speaking – role plays – asking about routine actions and expressing opinions - Reading- longer texts & making a critical analysis of the given text - Writing – essay (comparative / analytical), jumbled sentences, recommendations - Language Development – writing single sentence definitions, sequence words

MODULE - IV WRITING MECHANICS **7**

Listening -debates and discussions – practicing multiple tasks –Speaking - self introduction about friends/ places/ hobbies - Reading -Making inference from the reading passage – Predicting the content of the reading passage - Writing – informal letters, e-mails - accuracy, coherence, brevity – Language Development- single word substitutes, compound words- conditionals

MODULE - V INTERPRETATION SKILLS **7**

Listening- popular speeches and presentations - Speaking - impromptu speeches -Reading - articles – magazines - Writing – review writing, channel conversion – bar diagram/ table, poster/ picture interpretation - Language Development – modal verbs, collocations, 21st century vocabulary

MODULE - VI COGENT EXPOSITIONS **7**

Listening - Motivational speeches - Speaking - Debates and discussion - Reading - analytical reading - newspapers - Writing - process description - Language Development - voices, sentences expressing purpose, synonyms & antonyms

TOTAL: 45 PERIODS

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Meeting No. 6 Dated: 31/05/2024

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TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. A Course in Technical English, D. Praveen Sam and K.N. Shoba, Cambridge University Press, 2020

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc19_hs31/preview
2. https://www.myenglishpages.com/speaking/#google_vignette

ONLINE RESOURCES:

1. https://wwPearson.com/english/catalogue/business-english/technical-english.html
2. https://ww.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

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

1. Improve understanding and application of listening, speaking, reading, and writing skills (K2)
2. Demonstrate the ability to write personal notes, clear and coherent paragraphs (K2)
3. Apply analytical skills to write essays, rearrange jumbled sentences, and formulate recommendations (K3)
4. Apply skills to develop email etiquette and construct professional emails and informal letters (K3)
5. Analyze and interpret data to write comprehensive and effective reviews (K3)
6. Enhance vocabulary, improve grammatical accuracy, and confidently engage in debates (K2)

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Department of Humanities & Sciences

CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	3	-	2	-	-
CO6	-	-	-	-	-	-	-	-	3	-	2	-	-

SEMESTER - I

24BSPH101 - SDG NO. 4,7,9,11	ENGINEERING PHYSICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the basic concepts of mechanics and its use in engineering applications.
- To understand the concept of waves and lasers and its applications.
- To illustrate the various laws of electromagnetic waves and its applications.
- To apply the concepts of quantum mechanics to engineering studies.
- To understand the basics of crystal for engineering applications.
- To identify the basic principles involved in thermal physics and its applications.

MODULE - I PROPERTIES OF MATTER 8

Elasticity – Hooke's law- Poisson's ratio - Stress - strain diagram and its uses - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders.

MODULE - II MECHANICAL WAVES AND LASERS 7

Waves on a string – standing waves – traveling waves – Energy transfer of a wave – Reflection and refraction of light waves – interference –Theory of air wedge and experiment - Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO_2 laser – Basic applications of lasers in industry.

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MODULE - III ELECTROMAGNETIC WAVES 8

The Maxwell's equations – wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field – properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter – polarization – Producing electromagnetic waves – Energy and momentum in EM - Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

MODULE - IV BASIC AND APPLIED QUANTUM MECHANICS 7

Black body radiation – Planck's derivation – Electrons and matter waves –The Schrodinger equation (Time dependent and time independent forms) – significance of wave function – Normalization –Free particle – particle in a infinite potential well: 1D, 2D and 3D Boxes; - Barrier penetration and quantum tunneling (qualitative) – Scanning Tunneling Microscope.

MODULE - V CRYSTAL PHYSICS 8

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - X-Ray diffraction - Calculation of number of atoms per unit cell - Atomic radius - Coordination number – packing. factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy. Crystal Growth: Chochralski technique - Molecular beam epitaxy.

MODULE - VI THERMAL PHYSICS 7

Transfer of heat energy - Conduction, Convection and Radiation - Thermal conductivity, Forbe's method and Lee's disc method - Conduction through compound media - series and parallel methods - Heat exchangers - Refrigerators and Solar water heaters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattacharya & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur & S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu And P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2016.

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Meeting No. 6 Dated: 31/05/2024

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REFERENCES:

1. D. Halliday, Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.
4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.
7. Arthur Beiser. "Concepts of Modern Physics", McGraw-Hill, 6th Edition. 2003.
8. Charles Kittel, "Introduction to Solid State Physics". John Wiely & Sons. 8th Edition, 2005.

OUTCOMES:

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

1. Apply the concepts of stress, torsion, and bending to study the mechanical behavior of structural elements using theoretical and experimental methods. (K3)
2. Analyze wave phenomena and interference to study energy transfer, and evaluate laser principles with their industrial applications. (K4)
3. Examine Maxwell's equations and electromagnetic wave theory to analyze wave propagation, polarization and reflection-transmission phenomena in different media (K4)
4. Utilize the principles of quantum mechanics to explain black body radiation, matter waves, particle confinement in potential wells and tunneling phenomena. (K3)
5. Examine and compare the characteristics of various crystal structures, polymorphic forms, and crystal growth techniques. (K4)
6. Apply the principles of heat transfer to determine the thermal conductivity and explain the role of heat exchangers in refrigerators and solar water heaters. (K3)

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CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

SEMESTER - I

24BSCY101 - SDG NO. 4,7,8,9,11,12,17	ENGINEERING CHEMISTRY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To enumerate the importance, synthesis, and applications of polymers.
- To impart basic knowledge of chemistry and the principles involved in electrochemistry, energy storage devices, and their commercial applications.
- To familiarize the fundamental laws and concepts of important photophysical and photochemical processes, as well as spectroscopy.
- To explore the fundamental concepts, laws, and principles of thermodynamics, and apply its derivations to optimize and innovate engineering processes across various disciplines.
- To comprehend the chemistry of fuels and combustion, and their applications across various engineering and industrial processes.
- To gain an understanding of the emergence and challenges of nanomaterials and nanotechnology across various scientific and technological disciplines.

MODULE - I POLYMER CHEMISTRY 8

Polymers: Definition, Degree of polymerization, Functionality of monomer, Classification of polymer with examples, Types of polymerization, Mechanism of addition polymerization (Free radical mechanism).

Plastics: Definition and Characteristics - Thermoplastics & Thermosets. Preparation, properties and engineering applications of plastics -PVC, Teflon, Kevlar and Bakelite.

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Fibers: Characteristics fibers - Preparation, properties and applications of Nylon and Dacron. Biodegradable polymers & Conducting Polymers: Characteristics, Classification and their applications.

MODULE - II ELECTROCHEMISTRY AND BATTERY TECHNOLOGY **7**

Electrochemistry: Types of Cells (Electrochemical and Electrolytic cell) – Redox reaction – Single and Standard electrode potential, Reference electrodes - SHE, Calomel electrode, Measurement of Single Electrode Potential, Nerns't equation (Derivation & Problems), Electrochemical series and its significance.

Batteries: Evolution of batteries – Primary and Secondary battery (Lead acid battery), Next Generation Battery Technology (NGBT) - Solid-state batteries (Lithium-ion), Sodium-ion batteries.

MODULE - III PHOTOCHEMISTRY & SPECTROSCOPY **7**

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination-Photo processes - Jablonski diagram (Internal Conversion, Intersystem crossing, Fluorescence, Phosphorescence), Chemiluminescence and Photo-sensitization.

Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and Rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

MODULE - IV CHEMICAL THERMODYNAMICS **8**

Terminology of Thermodynamics - Laws of Thermodynamics – I law – Significance – Mathematical formulation and its applications. II law – Need for the II law. Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes, entropy of phase transitions; Clausius inequality. Helmholtz and Gibbs free energy functions, Criteria of spontaneity, Maxwell relations, Gibbs-Helmholtz equation, Van't Hoff Isotherm and Isochore.

MODULE - V FUELS **8**

Fuels: Introduction –Classification of fuels – Coal – Analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – Octane number and Cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gas (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of fuels: Introduction – Calorific value – Higher and Lower Calorific values - Theoretical calculation of Calorific value(Dulong formula) – Flue gas analysis (ORSAT Method).

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MODULE - VI NANOCHEMISTRY 7

Introduction - Types of nanomaterials - Emergence and challenges in nanotechnology- Synthesis routes for nanomaterials: Bottom-up and top-down approaches - Sol-gel, precipitation, Thermolysis, Laser ablation, Chemical Vapour Deposition (CVD), Electro deposition - Properties of nanomaterials- Mechanical properties, Chemical, Optical, Electrical and Magnetic properties-applications of nanomaterials (Gold nanoparticles as an example). Quantum Dots - concept, properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand &CompanyLTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P)LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD,New Delhi, 2013.
4. Ravikrishnan A, 'Engineering Chemistry', Sri Krishna Hitech Publishing Company Pvt. Ltd, New Edition 2024.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi,2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
4. Chemistry of Nanomaterials Vol.1 S.S.R Kumar Challa (Ed).
5. Advanced chemistry by Phillip Matthews Vol.1 and Vol.2.
6. Chemistry in Engineering and Technology Vol. 1 & 2, J.C. Kuriacose and J. Rajaram.
7. Applied chemistry - A textbook for Engineers and Technologists by H.D. Gesser.

OUTCOMES:

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

1. Explain the importance of polymers in science and technology, describe their roles in different applications and discuss their impacts on modern advancements. (K3)
2. Recognize the basic principles of electrochemistry and describe their application in battery technologies. (K3)

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3. Apply the concepts of key photophysical and photochemical processes, as well as spectroscopy, to develop and optimize various applications. (K3)
4. Describe the principles of the second law of thermodynamics and its derivations to analyze engineering applications across all disciplines. (K3)
5. Categorize the chemistry of fuels and combustion and their applications at various levels. (K3)
6. Demonstrate the knowledge of nanomaterials, including their properties, behavior, interactions and applications across various disciplines of science and technology. (K3)

CO-PO, MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	-	-	2	-	-	-	-	-
CO2	3	3	3	-	-	2	-	-	-	-	-
CO3	3	2	3	-	2	-	-	-	-	-	-
CO4	3	2	3	-	-	1	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-
CO6	2	1	2	-	-	-	-	-	-	-	-

SEMESTER - I

24ESCS101 106105171 SDG NO. 4 & 9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Interpret Mathematical problems using algorithms, flowchart and pseudocode.
- To understand the programming language.
- To develop C Programs using basic Programming Constructs, Loops, Arrays and Strings.
- To develop applications in C using Functions, Pointers and Structures.
- To perform I/O operations and File Handling in C.

MODULE-I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 7

Introduction to Problem Solving through programs- Algorithm-Flowchart-Pseudocode-Memory, Variables, Values, Instructions, Programs-compilation process-Syntax and Semantic Errors- The language of C: Phases

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of developing a running computer program in C - Character set – Constants – Keywords – Primitive data types –Declaration, Type Conversion.

MODULE - II BASICS OF C PROGRAMMING **7**

Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, selective – If, Else-If, Switch- repetitive structures-for, while, do while, Nested loops, go to, break, continue –Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation.

MODULE - III ARRAYS AND STRINGS **8**

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

MODULE - IV FUNCTIONS AND POINTERS **9**

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions - Factorial and Fibonacci Generation - Towers of Hanoi problem - – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

MODULE - V STRUCTURES **7**

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

MODULE - VI FILE PROCESSING **7**

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

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Sri Sairam Engineering College

TEXT BOOKS:

1. R.G. Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2018.
3. Kernighan, B.W and Ritchie D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1. Yashwant Kanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
2. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018.
3. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication, 2015.
4. Jeri R. Hanly & Elliot B.Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
5. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programing_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

OUTCOMES:

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

1. Solve basic problems using algorithms, flowcharts, and pseudo code.(K3)
2. Analyze the various programming constructs for basic computational problems.(K4)
3. Implement simple C programs using arrays and strings. (K3)

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4. Use functions, recursion, and pointers to perform calculations, searching, and sorting.(K3)
5. Apply structures and dynamic memory allocation in handling complex programming tasks. (K3)
6. Organize sequential and random file processing techniques to provide solutions for real-world computational problems. (K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2
CO4	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	-	3	-	-	-	-	-	-	-	-	-	2	3
CO6	-	-	3	-	-	-	-	-	-	-	-	3	3

SEMESTER - I

24HSTA101 - SDG NO. 4	HERITAGE OF TAMILS	L	T	P	CP	C
		1	0	0	1	1

OBJECTIVES:

- Develop interest for classical language and literature to promote Tamil heritage
- Understand the ancient Tamil sculptures, folk and martial arts and contribution of Tamil to the freedom of India

அலகு ஐ மொழி மற்றும் இலக்கியம்

இந்திய மொழிக் குடும்பங்கள் — திராவிட மொழிகள் — தமிழ் ஒரு செம்மொழி — தமிழ் செவ்விலக்கியங்கள் — சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை — சங்க இலக்கியத்தில் பகிர்தல் அறம் — திருக்குறளில் மேலாண்மைக் கருத்துகள்

UNIT I LANGUAGE AND LITERATURE 5

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

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Meeting No. 6 Dated: 31/05/2024

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அலகு II இடைகால மற்றும் நவீன இலக்கியங்கள்

தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம் — ஆழ்வார்கள் மற்றும் நாயன்மார்கள் — சிற்றிலக்கியங்கள் — தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி — தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

Unit II MEDIEVAL AND MODERN LITERATURE 5

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.

அலகு III மரபு ஓ பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை

நடுகல் முதல் நவீன சிற்பங்கள் வரை — ஐம்பொன் சிலைகள் — பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் — தேர் செய்யும் கலை — சுடுமண் சிற்பங்கள் — நாட்டுப்புறத் தெய்வங்கள் — குமரிமுனையில் திருவள்ளுவர் சிலை — இசைக் கருவிகள் — மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் — தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

UNIT III HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 5

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 Econornic Life of Tamils.

அலகு IV நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

UNIT IV FOLK AND MARTIAL ARTS 5

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

அலகு V தமிழர்களின் திணைக் கோட்பாடுகள்

தமிழகத்தின் தாவரங்களும், விலங்குகளும் — தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் — தமிழர்கள் போற்றிய அறக்கோட்பாடு — சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் — சங்ககால நகரங்களும் துறைமுகங்களும் — சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி — கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

UNIT V THINAI CONCEPT OF TAMILS 5

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

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அலகு VI இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு — இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் — சுயமரியாதை இயக்கம் — இந்தியமருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு — கல்வெட்டுகள், கையெழுத்துப்படிகள் — தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

UNIT VI CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE **5**

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: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு — மக்களும் பண்பாடும் — கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்)
2. கணினித் தமிழ் — முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி — வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை — ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian> Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - „Sangam City Civilization on the banks of river Vaigai... (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OUTCOMES:

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

1. மொழிக் குடும்பங்களின் வரலாறு மற்றும் தமிழ் இலக்கியங்களை மதிப்பிடுகிறார்கள் Students evaluate the history of language families and Tamil literatures (K3)

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2. பக்தி மரபுகளின் தாக்கம் பெற்ற தமிழ் இலக்கியங்களைப் புரிந்துகொள்கிறார்கள் Students understand Tamil literatures influenced by Philosophical and religious traditions (K3)
3. தமிழகத்தின் பாறை, சிற்பம், ஓவியம்- கலை மரபுகளைப் பகுப்பாய்வு செய்கிறார்கள் Students analyze the artistic traditions of Tamil Nadu such as rock art, sculpture, and painting (K3)
4. தமிழக நாட்டுப்புறக் கலைகள் மற்றும் தற்காப்புக் கலைகளின் மாண்புகளை உணர்ந்து கொள்கிறார்கள் Students realize the significance of Tamil Nadu's folk arts and martial arts (K3)
5. பழந்தமிழரின் திணையியல் வாழ்வியலை மீளாய்வு செய்கிறார்கள் Students re-examine the ecological lifestyle (Thinai-based life) of the ancient Tamils (K3)
6. தேசிய இயக்கம் மற்றும் இந்தியப் பண்பாட்டில் தமிழர்களின் பங்களிப்பினை நினைவுகூர்கிறார்கள் Students recall the contribution of Tamils to the National Movement and Indian culture (K3)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	-	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	-	-	-	-	-	-	2	2	2
CO3	2	3	3	-	-	-	-	-	-	-	2	2	2
CO4	2	3	3	-	-	-	-	-	-	-	2	2	2
CO5	2	3	3	-	-	-	-	-	-	-	2	2	2
CO6	2	3	3	-	-	-	-	-	-	-	2	2	2

SEMESTER - I

24ESPL101 - SDG NO. 4 & 9	PROGRAMMING IN C LABORATORY	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To develop programs in C using basic Programming Constructs.
- To develop applications in C using Arrays and Strings.
- To design and implement applications in C using Functions, Structures.
- To develop applications in C using Files.

LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.

Recommended by Board of Studies of HKS dept. Meeting No. 6 Dated: 21/05/2024

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2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is a leap year or not? (Hint: not every century is a leap. For example 1700, 1800 and 1900 is not a leap year).
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is an Armstrong number or not.
6. Write a program to check whether a given number is odd or even.
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to print half pyramid of *.
10. Write a program to display array elements using two dimensional arrays.
11. Write a program to perform swapping using a function.
12. Write a program to display all prime numbers between two intervals using functions.
13. Write a program to solve towers of Hanoi using recursion.
14. Write a program to get the largest element of an array using the function.
15. Write a program to concatenate two strings.
16. Write a program to find the length of String.
17. Write a program to find the frequency of a character in a string.
18. Write a program to store Student Information in Structure and Display it.
19. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:

(a) Total marks obtained by each student.

(b) The highest marks in each subject and the marks of the student who secured it.

(c) The student who obtained the highest total marks.

20. Write a program to demonstrate file operations (e.g. count the number of characters, words and lines in a file, replace a specific word with the given word in the same file).

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Stand alone desktops with C compiler 30 Nos. (Or)
   Server with C compiler supporting 30 terminals or more.

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 30.5.24

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Sri Sairam Engineering College

OUTCOMES:

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

1. Apply basic constructs,arrays,strings,functions and recursion for executing C programming applications.(K3)
2. Analyze C programs involving pointers and structures.(K4)
3. Evaluate applications using sequential and random access files.(K5)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	2	-	-	-	-	-	-	1	1
CO2	-	-	3	-	-	-	-	-	-	-	-	1	2
Co3	-	-	3	-	-	-	-	-	-	-	-	2	2

SEMESTER - I

24ESGE102 SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To provide exposure to the students with hands-on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering.

Recommended by
Board of Studies of CSE dept.
Meeting No. 7 Dated: 20.5.24

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ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp, and energy meter.
2. Fluorescent lamp wiring.
3. Staircase wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipment – Resistor- colour coding, measurement of AC signal parameter (peak-peak RMS, period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR, and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices, and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of Half Wave Rectifier and Full Wave Rectifier.
6. Simulation of Half Wave Rectifier and Full Wave Rectifier using TinkerCAD.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings,unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

Recommended by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1-6-2024

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Board of Studies
Mechanical Engineering

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding demo practice.

Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Demonstration on:

1. Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
2. Foundry operations like mould preparation for gear and step cone pulley.
3. Fitting – Exercises – Preparation of square fitting and V – fitting models.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Electrical

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items:	
Iron box, fan and regulator, emergency lamp	1 Each
4. Megger (250V/500V)	1 No
5. Power Tools:	
Range Finder	2 Nos
Digital Live-wire detector	2 Nos

Electronics

1. Soldering guns	10 Nos
2. Assorted electronic components for making circuits	50 Nos
3. Small PCBs	10 Nos
4. Multimeters	40 Nos

Recommended by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1.6.2024

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Mechanical Engineering

Civil

1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2.	Carpentry vice (fitted to work bench).	15 Nos
3.	Standard woodworking tools.	15 Sets
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	Power Tools:	
	Rotary Hammer	2 Nos
	Demolition Hammer	2 Nos
	Circular Saw	2 Nos
	Planner 2 Nos	
	Hand Drilling Machine	2 Nos
	Jigsaw 2 Nos	

Mechanical

1.	Arc welding transformer with cables and holders	5 Nos
2.	Arc welding transformer with cables and holders	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5.	Centre lathe.	2 Nos
6.	Hearth furnace, anvil and smithy tools.	2 Sets
7.	Moulding table, foundry tools.	2 Sets
8.	Power Tool: Angle Grinder.	2 Nos
9.	Study-purpose items: centrifugal pump, air-conditioner.	1 each

OUTCOMES:

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

1. Infer the values of resistance, peak to peak RMS values, time period, frequency. [K2]
2. Outline the logic gates, rectifier, timer circuits and soldering practices. [K2]
3. Demonstrate the measurement of electrical parameters such as voltage, current, resistance, power and energy. (K2)
4. Illustrate the residential wiring, staircase wiring and fluorescent lamp wiring.[K2]
5. Prepare the carpentry and plumbing joints. (K2)

Recommended by
Board of Studies of Mech dept.
Meeting No. 8 Dated: 1-6-2024

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Mechanical Engineering

6. Perform the basic operations of welding, sheet metal work and basic machining operations in Lathe and Drilling (K2)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-		-	-	-	-	-	-	-	-	2	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2
CO6	2	-	-	-	-	-	-	-	-	-	-	2	2

SEMESTER - I

24ENTP101 - SDG NO.4	FUNCTIONAL LIFE SKILLS	L	T	P	CP	C
		1	0	1	2	1

OBJECTIVES:

- Resolve common communication problems
- Observe the effectiveness of nonverbal messages
- Communicate precisely through the digital media
- Understand the importance of empathetic listening
- Explore reading and speaking processes

MODULE - I LISTENING 5

Techniques of effective listening
Listening and comprehending
Probing questions
Barriers to listening
Reflection from listening

MODULE - II SPEECH MECHANICS 5

Pronunciation
Enunciation
Vocabulary
Fluency

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MODULE - III READING SKILLS 5

Techniques of effective reading
Kinds of reading
Gathering ideas and information from the text
Evaluating the ideas and information
Interpreting the text from multiple angles

MODULE - IV WRITING ASPECTS 5

Writing process
Effective writing strategies
Different modes of writing
Optimizing the use of resources
Editing

MODULE - V PRESENTATION SKILLS 5

Types of presentations
Nonverbal communication
Understanding the purpose and the audience
Beginning and closure of presentations
Presentation tools and strategies

MODULE - VI ARTICULATION ASPECTS 5

Perform exercises
Slow speeches
Long speeches
Monologues, Dialogues and Conversation
Feedback necessity

TOTAL : 30 PERIODS

REFERENCES:

1. Sen, Madhuchanda.2010, An Introduction to Critical Thinking, Delhi, Pearson.
2. Effective Communication Skills Strategies for Success. Edited by Nitin Bhatnager and Mamta Bhatnager. 2023, Pearson
3. Technical Communication: Principles and Practice, Meenakshi Raman and Sangeeta Sharma. Oxford University Press, 2015

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WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. https://www.myenglishpages.com/speaking/#google_vignette

OUTCOMES:

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

1. Employ reading, writing, and listening skills to communicate clearly in academic and professional contexts.
2. Demonstrate confident oral communication and presentation skills using appropriate tools and techniques.
3. Interpret ethical, inclusive, and culturally aware communication in team and societal settings

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	3	2	-	2	-	-

SEMESTER - I

24ESID101 - SDG NO. 1-17	IDEA ENGINEERING LAB - I	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To understand the significance of Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) of the United Nations
- To familiarize with SDG targets and indicators
- To identify the Constitutional implementation pertaining to SDGs in Panchayat Raj
- To acquire knowledge of the State and the Central government welfare schemes
- To recognize the role of educational Institutions in community development
- To develop critical thinking skills to address complex societal challenges through an immersion program

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MODULE - 1 United Nations Sustainability and the Sustainable Development Agenda **3**

- Introduction to Sustainability
- Indian Rural Environment: Necessity and Sustainability
- Millennium Development Goals (MDGs)
- United Nations Sustainable Development Goals (SDGs) & the Agenda
- Overview of the Sustainable Development Goals (SDGs)

MODULE - 2 Universal SDG Targets **4**

- SDG Framework
- Key Components
- Pillars of the SDGs
- Targets of the Goals
- Indicators of the Targets

MODULE-3 SDG and Indian Gram Panchayat **3**

- Gram Panchayat
- Salient Features of Constitutional Amendments
- Transition from SDGs to LSDGs (Localizing Sustainable Development Goals)

MODULE-4 Government Schemes **4**

- Introduction to State and Central Government Schemes
- Overview of Government Schemes
- Localization and Implementation at the Regional Level
- Impact on Local Communities

MODULE-5 Community Engagement **4**

- Key Recommendations of the National Education Policy
- Guidelines for Fostering Social Responsibility
- Awareness
- Participation
- Collaboration

MODULE-6 Idea Generation **12**

- Immersion Program
- Focus Areas
- Channelizing Ideas
- Forming Working Teams for SDGs (Sustainable Development Goals)

TOTAL: 30 PERIODS

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REFERENCES:

1. Joy Elamon and Ms. Mariamma Sanu George,"The Handbook on Sustainable Development Goals and Gram Panchayats" , State Institute for Rural Development (SIRD).
2. Dr.C.R.Rene Robin, Dr.PA.Shanthi , Dr.B.Thanuja & Dr.V.Yuvaraj ,"Sairam SDG Idea Engineering Lab I", Sri Sairam Engineering College.

WEB REFERENCES

1. UN Sustainable Development Goals
2. https://srmuniv.digimat.in/nptel/courses/video/109106200/L30.html
3. https://avcce.digimat.in/nptel/courses/video/109106200/L26.html

OUTCOMES:

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

1. Analyse and apply the concepts of sustainability,Rural environment,Gram panchayat and various government schemes to design innovative practical solutions that address real life rural challenges. (K2)
2. Compare MDG's,SDG's and LSDG's to analyse village topology and identify specific development targets to propose innovative rural solutions. (K4)
3. Analyse the attainment levels of SDG's and write a reflective report on local community.(K4)
4. Formulate problem statement based on local community needs and propose innovative ideas for community development. (K4)
5. Perform an individual presentation of field observation by mapping them with relevant SDG's and justify their significance for rural development. (K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	1	-	-	-	2	-	-	1	-	2
CO4	-	2	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	3	2	3	1

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SEMESTER - II

24BSMA201 - SDG NO. 4	DISCRETE STRUCTURES	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To understand the fundamental concepts of logic, rules of inference, and quantifiers.
- To learn the principles of mathematical induction, permutations, and combinations.
- To gain knowledge of groups and normal subgroups in abstract algebra.
- To develop graph algorithms using the foundational concepts of graph theory.
- To understand the concepts of lattices and Boolean algebra and their applications.

MODULE - I LOGICS 9

Basic Connectives – Truth Tables – Logical Equivalence - The Laws of Logic- Logical Implications - Normal Forms – Rules of Inference – The use of Quantifiers.

MODULE - II COMBINATORICS 9

The Principles of Mathematical Induction – Basic counting techniques – Inclusion and exclusion - Pigeonhole principle – Permutation – Combination.

MODULE - III ALGEBRAIC STRUCTURES WITH ONE BINARY OPERATION 12

Semi Groups– Monoids– Groups - Subgroups – Cosets- Normal subgroups –Lagrange's theorem.

MODUL - IV GRAPHS 12

Graphs - Definition -Special types of Graphs- Matrix representation of Graphs - Graph isomorphism- Path, Cycle, Connectivity - Eulerian and Hamiltonian Graphs.

MODULE- V LATTICES 9

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

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MODULE - VI BOOLEAN ALGEBRA 9

Boolean Algebra – Definition – Identities of Boolean Algebra -Demorgan's laws.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Discrete Mathematics and its Applications: with Combinatorics and Graph Theory, Kenneth H. Rosen, 7th Edition, Tata McGraw –Hill Education Pvt. Ltd., 2015.
2. Discrete Mathematical Structure with Applications to Computer Science", J.P. Tremblay and R. Manohar, Reprint, McGraw-Hill Education (India), 1997.

REFERENCES:

1. Discrete Mathematics with Applications, Susanna S. Epp, 4th edition, Brooks/Cole, Cengage Learning, 2010.
2. Discrete Mathematics, Norman L. Biggs, 2nd Edition, Oxford University Press, 2002.
3. Discrete Mathematics, Seymour Lipschutz, Marc Lipson, Schaum's Outlines Series, 3rd edition, McGraw-Hill Education, 2009.
4. Elements of Discrete Mathematics: A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 4th Edition, Tata McGraw –Hill Education Pvt. Ltd., 2012.

WEB REFERENCES:

1. https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
2. https://www.cs.cornell.edu/~rafael/discmath.pdf
3. http://home.iitk.ac.in/~arlal/book/mth202.pdf
4. https://drive.google.com/file/d/1-PqMUlqDim1-AHQK5_zL34I97zHV3W15/view

ONLINE RESOURSES:

1. https://nptel.ac.in/courses/106106183
2. https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20
3. https://www.youtube.com/watch?v=4LlTmsfDS4Y&list=PLEAYkSg4uSQ2Wfc_I4QEZUSRdx2ZcFziO&index=13
4. https://www.youtube.com/watch?v=jBsEKyx6Rj0&list=PLwdnzlV3ogoVxVxCTlI45pDVM1aoYoMHf
5. https://www.youtube.com/watch?v=rdXw7Ps9vxc&list=PLHXZ9OQGMqxersk8fUxiUMSIx0DBqsKZS

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COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

1. Construct mathematical arguments using logical connectives, quantifiers and verify the correctness of an argument using symbolic logic, truth tables. (K3)
2. Apply counting principle and mathematical induction to solve combinatorial problems. (K3)
3. Explain the fundamental concepts of algebraic structures such as groups and Boolean algebra. (K3)
4. Illustrate the concepts of graphs. (K3)
5. Apply the concepts of Lattices in the field of computer science. (K3)
6. Apply the concepts of Boolean algebra in logical circuits. (K3)

CO-PO, MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	-	-	-	-	-	-	-	-	3	2
CO3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2	3
CO5	3	-	-	-	-	-	-	-	-	-	-	3	3
CO6	3	-	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - II

24HSEN201 - SDG NO.4	PROFESSIONAL ENGLISH	L	T	P	CP	C
		2	0	0	2	2

OBJECTIVES:

- Acquire techniques for comprehending and critically analyzing passages
- Improve the communicative competence
- Enhance learners' ability to read and write complex texts, summaries, definitions and reports
- Write effective formal letters and reports
- Develop skills for preparing effective job application

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MODULE - I EFFECTIVE COMMUNICATION **6**

Listening – Listening to conversations – Speaking – making conversations in real life occurrences – Reading - short stories, happenings - Writing – autobiographical writing, preparation of checklist – communication and types of communication – Language Development -- subject - verb agreement, commonly confused words – spellings

MODULE - II BASICS OF TECHNICAL WRITING **5**

Listening – listening to advertisements and products – Speaking - creating greetings/wishes/excuses and thanks – Reading – articles/novels - Writing - summary of articles, writing modes, formats, compositions - Language Development - reported speech, numerical adjectives

MODULE - III REPORT WRITING **4**

Listening – listening to podcasts – Speaking - practicing telephonic conversations – observing and responding. Reading – regular columns of newspapers/magazines - Writing – reports – feasibility, accident, preparation of agenda and minutes – Language Development - cause & effect expressions, discourse markers

MODULE - IV DIVERSE WRITING SKILLS **5**

Listening – documentaries, anecdotes and short stories - Speaking – expressing opinions using verbal and non-verbal communication – Reading biographies/autobiographies, travelog, – Writing – formal letters – inviting guests – acceptance/declining letters - Language Development- degrees of comparison – embedded sentences - acronyms and abbreviations

MODULE - V CAREER COMPETENCIES **6**

Listening – expert talks – recommending suggestions & solutions – Speaking – Debate- participating in a group discussion – learning GD strategies – Reading – innovations, ideations - Writing – Job application, resume, – proposals – Language Development – verbal analogies – phrasal verbs

MODULE - VI LEXICAL ENHANCEMENT **4**

Listening - technical and general talks - Speaking - oral presentation with visual aids - Reading - successful stories/autobiographies - Writing - writing blogs - Language Development - common errors in English, idiomatic expressions

TOTAL: 30 PERIODS

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TEXT BOOKS:

1. Board of editors. Fluency in English: A Course book for Engineering and Technology. Orient Blackswan, Hyderabad 2016.
2. Raman, Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford University Press.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.
2. Raman, Meenakshi, Sharma, Sangeeta. Technical Communication. Principles and Practice. Oxford University Press, New Delhi, 2014.
3. Muralikrishnan & Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamil Nadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Vesilind Aarne P., Public Speaking and Writing Skills for Engineering Students (2nd Ed), Lakeshore press, 2007
5. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://takelessons.com/en-in/search?service=English&sort=1&utm_

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/improve-english?
2. https://www.fluentu.com/blog/educator-english/business-english-conversation-topics/

OUTCOMES:

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

1. Demonstrate an understanding of various types of communication and prepare effective checklists.(K2)
2. Summarize articles/ write ups (K2)
3. Construct feasibility reports, accident reports, survey reports and meeting minutes (K3)
4. Apply skills to compose official letters with emphasis and clarity (K3)

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5. Compose job applications and technical proposals (K3)
6. Demonstrate the ability to express opinions in both oral and written forms of communication (K2)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	1	3	-	3	-	-
CO6	-	-	-	-	-	-	-	1	3	-	3	-	-

SEMESTER - II

24BSPH203 - SDG NO. 4,7,9	PHYSICS FOR INFORMATION SCIENCE	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the essential principles of physics of conducting materials, superconducting and optical properties of materials
- To educate the basic principles of semiconductor device and electron transport properties
- To become proficient in magnetic materials
- To acquaint the basics of superconducting and optical materials
- To acquire the basic working of nanoelectronic devices
- To understand the basics of quantum computing

MODULE - I CONDUCTING MATERIALS 8

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity expression - Wiedemann-Franz law - Success and failures - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids – Electron effective mass - Concept of hole.

MODULE - II SEMICONDUCTOR MATERIALS 7

Direct and indirect band gap semiconductors - Intrinsic Semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors

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- Carrier concentration in N-type & P-type semiconductors - Variation of carrier concentration with temperature - Variation of Fermi level with temperature and impurity concentration - Carrier transport in Semiconductor: random motion, drift, mobility and diffusion - Hall effect and devices.

MODULE - III MAGNETIC PROPERTIES OF MATERIALS **8**

Magnetic dipole moment - atomic magnetic moments - magnetic permeability and susceptibility - Magnetic material classification: diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism - ferrimagnetism - Ferromagnetism: Domain Theory - M versus H behaviour - Hard and soft magnetic materials - applications – Magnetic principle in computer data storage - Magnetic hard disc - GMR sensor.

MODULE - IV SUPERCONDUCTING & OPTICAL PROPERTIES OF MATERIALS **7**

Superconductivity - Type-I and Type-II superconductors - Properties and applications - Classification of optical materials - Absorption and emission of light in metals, semiconductors and insulators - Carrier generation and recombination processes - Photo current in a P-N diode - Solar cell - LED - Organic LED - Optical data storage techniques and devices.

MODULE - V NANO DEVICES **8**

Introduction - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials - Tunneling: single electron phenomena and single electron transistor - Quantum dot laser - Carbon nanotubes: Properties and applications.

MODULE - VI QUANTUM COMPUTING **7**

Quantum system for information processing - quantum states – classical bits – quantum bits or qubits – multiple qubits – Bloch sphere - Superposition - Entanglement - quantum gates - CNOT gate - Types of Quantum Computer: Quantum Annealer- Analog Quantum- Universal Quantum.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley 2012.
2. Kasap, S.O., "Principles of Electronic Materials and Devices", McGraw- Hill Education, 2017.
3. Kittel, C., "Introduction to Solid State Physics", Wiley, 2018.

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4. S.O.Pillai, "Solid State Physics, New Academic Science", 2017.
5. D.K.Bhattacharya & Poonam Tandon., "Physics for Information Science and Electronics Engineering", Oxford Higher Education", 2017.

REFERENCES:

1. Garcia, N. & Damask, A., "Physics for Computer Science Students", Springer-Verlag, 2012.
2. Hanson, G.W., "Fundamentals of Nanoelectronics", Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S., "Nanotechnology: Understanding Small Systems", CRC Press, 2014.

OUTCOMES:

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

1. Explore the basic concepts of free electron theory of solids and apply it to determine the conducting properties, carrier concentration and effective mass of an electron in conductors (K3)
2. Analyze the band structures and carrier concentrations of semiconductors, study their variations with temperature, and examine carrier transport mechanisms (K4)
3. Have an insight into the different types of magnetic materials and magnetic data storage device (K3)
4. Analyze the properties of superconductors and optical interactions in materials and explain the working of optoelectronic and optical storage devices (K4)
5. Examine quantum confinement and quantum structures, analyze the working principles of quantum devices, and explore the applications of carbon nanotubes (K4)
6. Apply the basic concepts of quantum computing to demonstrate the operation of quantum gates and the formation of entangled states (K3)

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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

SEMESTER - II

24BSCY201 - SDG NO.4	CHEMISTRY FOR ENVIRONMENT AND SUSTAINABILITY	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To gain a comprehensive understanding of environmental science, the intricate relationships within ecosystems, and the crucial role of biodiversity conservation..
- To introduce the structure and components of the atmosphere, and provide an overview of the photochemical reactions involved.
- To foster a sound understanding of water quality parameters and water treatment techniques.
- To explore the various components of soil and understand the steps involved in Solid Waste Management (SWM).
- To advocate the benefits of renewable energy and promote awareness of sustainable energy practices. .
- To implement the principles of Green Chemistry in alignment with the Sustainable Development Goals (SDGs).

MODULE - I INTRODUCTION TO ENVIRONMENTAL SCIENCE 8

Environment: Definition, concept of environment and its components - scope and importance of environment – need for public awareness.

Ecosystem: Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, food chains and food webs. Biogeochemical cycles(C,N&P), Ecological succession.

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Biodiversity and its conservation: Definition, types, importance of biodiversity, values and threats to biodiversity. Endangered and endemic species - concept and basis of identification of 'Hotspots'; hotspots in India. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation.

MODULE - II ATMOSPHERIC CHEMISTRY 7

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect - role of greenhouse gases (CO_2, CH_4, N_2O, CFCs) on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures).

MODULE - III WATER CHEMISTRY 8

Importance and scope of water chemistry - Sources and impurities in water - Water Quality Parameters - Specifications as per WHO/BIS standards. Hardness of water, types, numerical problems on hardness of water. Softening of water - Internal treatment (Lime-soda, Phosphate, Calgon, Sodium Aluminate and Colloidal conditioning). External treatments: Ion exchange and Zeolite processes. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water by Reverse osmosis. Sustainable water management practices (water recycling and rainwater harvesting)

MODULE - IV SOIL CHEMISTRY AND SOLID WASTE MANAGEMENT 7

Soil Chemistry: Chemical composition of soil, Acid-Base and Ion-Exchange Reactions in Soil, Soil acidity and salinity. Importance of NPK in Soil Fertility. Modern agriculture - Impacts of both excessive and insufficient fertilizer use, alongside the effects of pesticides on soil chemistry and the environment. Sustainable agriculture - Approaches to improve soil salinity (leaching, soil amendments, crop rotation), Design and use of green pesticides for sustainable farming.

Solid Waste Management System: Sources and types of solid waste, Elements of solid waste management, Methods of residential and commercial waste collection, Treatment / processing - Incineration, Composting, Landfill - Dumpsite rehabilitation.

MODULE - V ENERGY AND ENVIRONMENT 8

Energy sources – Renewable and non-renewable energy sources. Principle and generation of solar energy (solar collectors, photo-voltaic modules, solar ponds), wind energy, geothermal energy; tidal energy, OTEC energy from

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biomass, biofuels, Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor – principles and types. Need for energy efficiency, Energy conservation and sustainability - action strategies for sustainable energy management from a future perspective.

MODULE - VI GREEN CHEMISTRY AND SUSTAINABILITY **7**

Green Chemistry: Introduction to green chemistry, Principles of Green Chemistry (12-principles), the concept of atom economy and chemical synthesis, Important techniques used in green chemistry. Application of green chemistry, viz. replacement of ozone depleting substances including CFCs, manufacture of biodegradable polymers, use of H2O2 as benign bleaching agents in the paper industry.

Sustainable Development: Definition and concepts of sustainable development, Need for sustainable development; Sustainable development goals – 17 SDG goals.

Sustainable practices: Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment and Environmental Impact Assessment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Ravikrishnan A, 'Environmental Science and Engineering', Sri Krishna Hitech Publishing Company Pvt. Ltd, Revised Edition 2020.
4. Vogel's Textbook of Quantitative Chemical Analysis (8th edition,2014).

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Chemistry for Environmental Engineering, Clair N. Sawyer, Perry L. Mc Carty, Gene F. Parkin, 4th Edition, McGraw-Hill.

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OUTCOMES:

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

1. Develop a foundational understanding of environmental science, the interactions within ecosystems, the significance of biodiversity, and the importance of conservation strategies for maintaining ecological balance. (K3)
2. Identify the primary components of the atmosphere, explain the causes of atmospheric pollution, and propose basic strategies to promote a sustainable and clean atmosphere. (K3)
3. Demonstrate complex water quality parameters, and develop innovative methods for producing cost-effective soft water suitable for both industrial use and potable consumption. (K3)
4. Describe the composition and functions of soil components, analyze the sources and characteristics of solid wastes, and evaluate the methods and strategies employed in solid waste management (SWM). (K3)
5. Explain renewable and non-renewable resources, describe various methods for harnessing energy from different sources and explain their applications in various contexts. (K3)
6. Illustrate a comprehensive understanding of green chemistry principles and their alignment with sustainable development goals, preparing them to contribute to environmentally friendly and sustainable practices in their future careers.(K3)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-
CO6	3	3	-	2	1	-	-	-	-	-	-

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SEMESTER - II

24HSTA201 - SDG NO. 4	TAMILS AND TECHNOLOGY	L	T	P	CP	C
		1	0	0	1	1

OBJECTIVES:

- Understand the techniques that help for a better livelihood
- Identify the methods used for scientific Tamil computing

அலகு-I நெசவு மற்றும் பானைத் தொழில்நுட்பம்

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

UNIT-I WEAVING AND POTTERY (CERAMIC) TECHNOLOGY 5

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

அலகு -II சங்ககாலவடிவமைப்புகள்

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள்ரூசங்க காலத்தில் வீட் டுப் பொருட் களில் வடிவமைப்பு -சங்க காலத்தில் கட் டுமான பொருட்களும்நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்.

UNIT-II SANGAM AGE DESIGNS 5

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

அலகு -III பழங்காலகட்டிடத் தொழில்நுட்பம்

மாமல்லபுரச்சிற்பங்களும், கோவில்களும் - சோழர்காலத்துப்பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத்தலங்கள் - நாயக்கர்காலக்கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டுவீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக்கட்டிடக் கலை.

UNIT-III ANCIENT CONSTRUCTION TECHNOLOGY 5

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.

அலகு- IV உற்பத்தித் தொழில்நுட்பம்

கப்பல் கட்டும் கலை -உலோகவியல் -இரும்புத் தொழிற்சாலை இரும்பை உருக்குதல், எஃகு - வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் சங்கு மணிகள் -எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

Recommended for Board of Studies of F&S dept. Meeting No. 6 Dated: 31/05/2024

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UNIT-IV MANUFACTURING TECHNOLOGY 5

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 beads - Archaeological evidences - Gem stone types described in Silappathikaram.

அலகு - V வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்குமுழித்தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காகவடிவமைக்கப்பட்டகிணறுகள்- வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள்- கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

UNIT-V AGRICULTURE AND IRRIGATION TECHNOLOGY 5

Dam, Tank, Ponds, Sluice, Significance of KumizhiThoompu of Chola Period> Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conch diving -Ancient Knowledge of Ocean - Knowledge Specific Society.

அலகு-VI அறிவியல்தமிழ்மற்றும்கணித்தமிழ்

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக்கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

UNIT-VI SCIENTIFIC TAMIL & TAMIL COMPUTING 5

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: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு — மக்களும் பண்பாடும் — கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்)
2. கணினித் தமிழ் — முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி — வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை — ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian> Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

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9. Keeladi - „Sangam City Civilization on the banks of river Vaigai... (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OUTCOMES:

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

1. சங்ககால நெசவு மற்றும் பானைத்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்
   To learn about the weaving and pottery (ceramic) technologies during the Sangam Age.(K2)
2. சங்ககாலவடிவமைப்புகள் மற்றும் கட்டுமானக்கலையைப் புரிந்து கொள்ளுதல்
   To understand the designs and structural constructions during the Sangam period.(K2)
3. பண்டைய கால கட்டிடக்கலையின்நுட்பங்கள் மற்றும் கட்டிடவடிவமைப்புகளை ஆராய்தல்.
   To explore the techniques and architectural patterns of ancient Tamil structures.(K2)
4. உற்பத்தி மற்றும் உலோகவியல்தொழில்நுட்பங்களைப் பற்றி அறிதல்.
   To gain knowledge on manufacturing and metallurgical technologies of ancient Tamils.(K3)
5. வேளாண்மை, நீர்ப்பாசனம் மற்றும் கடல்சார்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்.
   To understand agricultural> irrigation> and marine technologies of ancient Tamil society.(K3)
6. அறிவியல்தமிழ் மற்றும் கணித்தமிழின்வளர்ச்சியையும் அதன் கணினி பயன்பாடுகளையும் புரிந்து கொள்ளுதல்.
   To understand the development of Scientific Tamil and its applications in Tamil computing.(K3)

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Meeting No. 6 Dated: 31/05/2024

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CO-PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	1	2	2
CO2	3	3	3	2	-	-	-	-	-	-	1	2	1
CO3	3	3	3	3	-	-	-	-	-	-	1	2	1
CO4	3	2	3	3	-	-	-	-	-	-	1	2	2
CO5	3	3	3	3	-	-	-	-	-	-	1	2	1
CO6	3	3	3	3	-	-	-	-	-	-	1	2	2

SEMESTER - II

24ESGE101 – SDG NO. 4,6,7,9,12, 14 & 15	ENGINEERING GRAPHICS	L	T	P	CP	C
		1	2	0	3	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To visualize the job in three dimensions.
- To have a clear conception and appreciation of the shape, size, proportion and design.
- To expose the student community to existing national standards related to technical drawings.

MODULE - I PLANE CURVES **6+4**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – Drawing of tangents and normal to the above curves.

Recommended by
Board of Studies of Mech dept.
Meeting No. 08 Dated: 1.06.2024

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Mechanical Engineering

MODULE - II PROJECTION OF POINTS, LINES AND PLANES **6+4**

Projection of Points (Concept only). Projection (Elevation and Plan) of straight lines, inclined to both reference planes by rotating line method. Projection of plane surfaces, inclined to one of the reference planes by rotating object method.

MODULE - III PROJECTION OF SOLIDS **6+4**

Projection of regular solids (Prisms, Pyramids, Cylinder and cone) in first quadrant, by rotating object method when the axis is inclined to one of the reference planes.

MODULE - IV ORTHOGRAPHIC PROJECTION **6+4**

Orthographic Projection - Principles of orthographic projections, Orthographic projection of objects from pictorial view.

MODULE - V SECTION AND DEVELOPMENT OF LATERAL SURFACE **6+4**

Projection of sectioned solids (Prisms, Pyramids, Cylinder and cone) and true shape of the sections, when the axis of the solid is perpendicular to HP alone and cutting plane inclined to HP only. Development of lateral surfaces of sectioned regular vertical solids (Prisms, Pyramids, Cylinder and Cone) with cutting plane inclined to HP only.

MODULE - VI ISOMETRIC PROJECTIONS **6+4**

Isometric projection – Principle, isometric scale, Isometric views and Isometric projections of truncated solids - Prisms, Pyramids, Cylinder and Cone in simple vertical positions only.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

REFERENCES:

1. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

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Mechanical Engineering

WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/112/102/112102304/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/
2. https://nptel.ac.in/courses/112/103/112103019/

OUTCOMES:

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

1. Perform free hand drawing of conical sections and cycloids. (K3)
2. Sketch the orthographic projection of lines and plane surfaces of rectangle, square, pentagon and Hexagon. (K3)
3. Draw the orthographic projection of regular solids like prism, pyramids, cylinder and cone using change of position method. (K3)
4. Draw plan, elevation and side views for the 3dimensional isometric drawing by using the concepts of orthographic projection. (K3)
5. Draw the section and development of lateral surfaces for the regular solids like Prism, Pyramid, Cylinder and Cone for the axis perpendicular to HP. (K3)
6. Draw the isometric view, projection for regular and truncated solids like Prism, Pyramid, Cylinder and Cone. (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	-	-	-	3
CO2	3	-	-	-	-	-	-	-	2	-	-	-	3
CO3	3	-	-	-	-	-	-	-	2	-	-	-	3
CO4	3	-	-	-	-	-	-	-	3	-	-	-	3
CO5	3	-	-	-	-	-	-	-	2	-	-	-	3
CO6	3	-	-	-	-	-	-	-	3	-	-	-	3

Recommended by

Board of Studies of Mech dept.

Meeting No. 08 Dated: 1-06-2024

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Mechanical Engineering

SEMESTER - II

24HSNC201 - SDG NO. 4	NCC COURSE LEVEL 1	L	T	P	CP	C
		2	0	0	2	0

ARMY WING

NCC GENERAL 6

NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

NATIONAL INTEGRATION AND AWARENESS 4

NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1

PERSONALITY DEVELOPMENT 7

PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2

LEADERSHIP 5

L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2

SOCIAL SERVICE AND COMMUNITY DEVELOPMENT 8

SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

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NAVAL WING

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
		TOTAL: 30 PERIODS

ARMY WING

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

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NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	TOTAL: 30 PERIODS	

SEMESTER - II

24BSPL101 - SDG NO. 6,11,12,17	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	CP	C
		0	0	4	4	2

PHYSICS LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

- Demonstrate the wave nature of light using diffraction and interference properties.
- Study the thermal conductivity of a bad conductor.
- Verify experimentally the elastic properties of materials.

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Sl.No.	Name of the Experiment
1	(a) Determination of wavelength of Laser (b) Determination of numerical aperture and acceptance angle in an optical fiber. (c) Determination of particle size using laser source.
2	Determination of thermal conductivity of a bad conductor – Lee's Disc method.
3	Determination of Young's modulus by non-uniform bending method.
4	Determination of the period of oscillation of a given torsional pendulum for a fixed length and find the rigidity modulus of the wire.
5	Find out the thickness of the given wire by air wedge method.
6	Calculation of lattice cell parameter – X-ray diffraction method.
7	Determination of Planck's constant.
8	Determination of wavelength of mercury spectrum – spectrometer grating.
9	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
10	Determination of band gap of a semiconductor.
11	Determination of Hall coefficient by Hall Effect experiment.
12	Determination of solar cell characteristics.

CHEMISTRY LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

- To acquaint students with practical knowledge of the basic concepts of chemistry that they will encounter during their studies and in the industry and engineering fields.
- To acquaint students with the determination of the molecular weight of a polymer by viscometry.
- To develop and understand the basic concepts of acidic and basic nature using pH.

Sl.No.	Name of the Experiment
1	Conductometric titration of strong acid vs strong base.
2	Determination of chloride content of water sample by Argentometric method.
3	Determination of strength of acids in a mixture of acids using conductivity meter.

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4	Determination of total, temporary & permanent hardness of water by EDTA method.
5	Estimation of iron content of the given solution using potentiometer.
6	Determination of DO content of water sample by Winkler's method.
7	Determination of strength of given hydrochloric acid using pH meter.
8	Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).
9	Estimation of Sodium and Potassium in the given sample of water using Flame Photometer.
10	Determination of molecular weights of polymer samples using Ostwald's Viscometer.
11	Synthesis of nano-CdS by precipitation. (Demonstration only)
12	Corrosion experiment-weight loss method.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Engineering Physics Lab, Dr. G. SenthilKumar, VRB publishers. (2019)
2. Engineering Physics Practical, Dr. P. Mani, Dhanam Publications. (2020)

TEXTBOOK:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition,2014).
2. Practical Physical chemistry by B. Viswanathan, P. S. Raghavan (Vivabooks), 2009.
3. Foundation of Experimental Chemistry by Jubaraj B. Baruah, ParikshitGogoi, 2010.

OUTCOMES:

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

1. Apply the principles of elasticity and thermal physics to evaluate the various modulus of elasticity and conductivity of a bad conductor. (K3)
2. Explicate the properties of semiconductors by evaluating the band gap, I-V characteristics of solar cells and Hall effect of the materials. (K3)
3. Describe multiple measurement techniques, including volumetric titrations, conductivity, pH, redox potential and optical density measurements, used to estimate the amount of substance present in a solution. (K3)
4. Apply spectroscopic techniques, viscometry, synthesize nanoparticles, analyze the corrosion behavior of materials in different environments. (K3)

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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
CO1	3	3	-	-	2	-	-	-	-	-	2	
CO2	3	3	-	-	2	-	-	-	-	-	2	
CO3	3	3	-	-	2	-	-	-	-	-	2	
Co4	3	3	-	-	2	-	-	-	-	-	2	

SEMESTER - II

24AIPT201 106106212 SDG NO. 4 & 9	PYTHON FOR DATA SCIENCE LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To learn the core programming basics required for Data Science using Python language.
- To develop simple Python programs with conditionals and loops
- To gain knowledge on Data Science modules NumPy, SciPy and Matplotlib
- To acquire skills in data preparatory and preprocessing steps.

Module - I **BASICS OF PYTHON PROGRAMMING** **10**

Introduction to Python- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples,

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Meeting No. 6 Dated: 30/5/2024

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Artificial Intelligence and Data

Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

List of Experiments

1. Implement basic Python programs for reading input from console.
2. Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set

Module - II FILES, EXCEPTIONS,OOPS CONCEPTS 10

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts - Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance

List of Experiments

1. Create packages and import modules from packages.
2. Write a program to implement OOP concepts like Data hiding and Data Abstraction.

Module - III DATA SCIENCE AND DESCRIPTIVE STATISTICS 10

Need for data science-Benefits and uses- Facets of Data - Data science process- Setting the Research goal-Retrieving Data –Cleansing, integrating and transforming data-Exploratory Data analysis- Data measurement scale- Data descriptive statistics (Measures of central tendency, dispersion/variation, measure of location, Shape and symmetry)-Understanding Python's role in data science.

List of Experiments

1. Write a program to handle numerical operations using math and random number functions
2. Create user-defined functions with different types of function arguments.

Module - IV INTRODUCTION TO NUMPY 10

NumPy Basics: Arrays and Vectorized Computation - The NumPy ndarray- Creating ndarrays - Data Types for ndarrays - Arithmetic with NumPy Arrays - Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes.

Universal Functions: Fast Element -Wise Array Functions - Mathematical and Statistical Methods-Sorting- Unique and Other Set Logic

List of Experiments

1. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.

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2. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.

Module - V DATA MANIPULATION WITH PANDAS 10

Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping-Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.

List of Experiments

1. Create Pandas Series and DataFrame from various inputs.
2. Import any CSV file to Pandas DataFrame and perform the following:
   - A. Visualize the first and last 10 records
   - B. Get the shape, index and column details
   - C. Select/Delete the records (rows)/columns based on conditions.
   - D. Perform ranking and sorting operations.
   - E. Do required statistical operations on the given columns.
   - F. Find the count and uniqueness of the given categorical values.
   - G. Rename single/multiple columns

Module - VI DATA CLEANING, PREPARATION AND VISUALIZATION 10

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

List of Experiments

1. Import any CSV file to Pandas Data Frame and perform the following:

A. Handle missing data by detecting and dropping/ filling missing values.

B. Transform data using apply () and map() method.

C. Detect and filter outliers.

D. Perform Vectorized String operations on Pandas Series.

E. Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Y. Daniel Liang, Introduction to Programming using Python, Pearson, 2nd Edition, 2021.
2. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly, 2nd Edition, 2018.

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3. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, 2017.
4. Davy Cielen,Arno D.B.Meysman and Mohamed Ali,"Introducing Data Science",Manning Publications,2016.

REFERENCES:

1. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2006.
2. Mark Lutz, "Learning Python", O'Reilly, 4th Edition, 2009.

WEB REFERENCES:

1. https://www.edx.org/course/python-basics-for-data-science
2. https://www.edx.org/course/analyzing-data-with-python
3. https://www.coursera org/learn/python -plotting?specialization =data-science- python
4. https://www.programmer-books.com/introducing-data-science-pdf/

OUTCOMES:

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

1. Use Python built-in data types and their methods to solve basic data science problems and demonstrate the need for data-driven approaches. (K3)
2. Develop an application with user-defined modules and packages using OOP concept (K3)
3. Apply knowledge of data acquisition, cleaning, and transformation in practical tasks. (K3)
4. Use NumPy arrays to perform data manipulation tasks such as slicing, indexing, and reshaping.(K3)
5. Apply powerful data manipulations using Pandas. (K3)
6. Implement data preprocessing and visualization using Pandas.(K3)

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CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	3	2	-	-	3	-	-	-	-	-	-	2	2
CO5	3	2	-	2	3	-	-	-	-	-	-	-	-
CO6	3	3	2	2	3	-	-	-	-	-	2	-	-

SEMESTER - II

24ENTP201 - SDG NO. 4	DIGITAL DYNAMICS	L	T	P	CP	C
		1	0	1	2	0

OBJECTIVES:

- Explore online communication
- Master computer skills
- Use virtual platforms
- Understand digital ethics and cyber security
- Observe and follow do's and don'ts

MODULE - I DIGITAL CULTURE AND SOCIETY 6

Adapting to changes
Importance in today's digital landscape
Digital identity and self- presentation
Online communities and forums
Digital divide and consequences
Online collaboration and collective action

MODULE - II DIGITAL LITERACY AND ACCESS TO TECHNOLOGY 5

Computer skills
Social and cultural understanding
Social media campaign and Activism
Netiquettes
Trending Technologies
Digital tools and softwares

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MODULE - III DIGITAL ETHICS 3

Digital ethics and moral panics
The art of protecting secrets
Overview of digital tools

MODULE - IV CYBER SECURITY 3

Threats, vulnerability and consequences
Data making and usage practice
Importance of security

MODULE - V DIGITAL NETWORKING 7

Remote work and virtual teams
Authenticity in digital interactions
Engaging content creation
Tools and and techniques for insightful usage
Balancing online and offline interactions
Collaboration for research and innovation

MODULE - VI BUREAU OF INDIAN STANDARDS (BIS): BASIC CONCEPTS, STANDARDS FORMATION PROCESS AND CHALLENGES 6

Standardization –Basic Concepts:

Basic concepts of standardization

Purpose of standardization, marking and certification of articles and processes

Importance of standards to industry, policy makers, trade, sustainability and innovation

Standards Formulation Process and Challenges:

Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/ IEC Directives

WTO Good Practices for Standardization

World of Standards:

Important Indian and International Standards

TOTAL: 30 PERIODS

REFERENCES:

1. Communication Skills and Soft Skills – an Integrated Approach. Edited by E. Sureshkumar, P. Sreehari and J. Savithri, Pearson.

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Meeting No. 6 Dated: 31/05/2024

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2. Silvia. P.J.2007. How to Read a Lot. Washington DC, American Psychological Association.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. https://www.sscnasscom.com/ssc-projects/capacity-building-and-development/training/gbfs/

OUTCOMES:

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

1. Apply online communication techniques and collaboration skills (K3)
2. Enumerate the principles of digital ethics in online interactions (K2)
3. Understand the importance of Bureau of Indian Standards (BIS). (K2)

CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	3	2	-	2	-	-

SEMESTER - II

24ESID201 SDG NO. 1-17	IDEA ENGINEERING LAB - II	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

To impart the basics of technologies that are used to identify sustainable solutions to societal problems

- To Provide awareness on Printed Circuit Board (PCB) design using ORCAD software.
- To Raise awareness of at least three Internet of Things (IoT) projects and their applications.
- To Upskill learners through practical experience with 3D printing and scanning technologies.
- To prepare the learners to correctly align the ideas to SDGs
- To comprehensive knowledge on entrepreneurship and effective idea presentation techniques.
- To evaluate the effectiveness of SDGs and implementation strategy

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MODULE-1 BASICS OF DESIGN THINKING IN ELECTRICAL AND ELECTRONIC COMPONENTS 4

- Awareness Session on Basics of Design Thinking
- Study of Active & Passive Electronic Components
- Study of Basic AC & DC Electrical Circuits
- Study of Microprocessors & Microcontrollers
- Demonstration of Arduino Board, ESP 32 Board ,Raspberry Pi Board & PCB design software-Eagle
- Demonstration of PCB design using the software's Orcad, Eagle etc.

MODULE-2 EMBEDDED SYSTEMS, IOT AND ROBOTICS 4

- Study of sensors and transducers
- Study of embedded protocols, IOT Protocols & Embedded C
- Demonstration of Robotics & Drone models

MODULE-3 BASICS OF MECHANICAL ENGINEERING 4

- Study of Mechanical Modeling using Fusion 360
- Demonstration of 3D Scanner,3D Printer, Laser Cutter &RD Works Software
- Study of Slicer Software & Master Cam Software

MODULE 4 ALIGNMENT AND MAPPING OF IDEAS 4

- **Project Title:** Justification of SDG and SAP - Problem Statement & Solution

MODULE-5 ENTREPRENEURSHIP SKILLS 4

- Startup Awareness
- Entrepreneurship Opportunities
- Mock Presentations
- Innovation
- Novelty
- Feasibility
- Presentation Skills

MODULE-6 SCOUT for SDG IDEATHON 12

Evaluation Stages:

- First Round
- Second Round
- Idea Pitching

TOTAL: 30 PERIODS

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Board of Studies
Department of Humanities & Sciences

REFERENCES:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020
2. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
3. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
4. Basic Mechanical Engineering by Pravin Kumar, Pearson Education
5. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
6. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
7. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc24_ee112/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs115/preview
3. https://onlinecourses.nptel.ac.in/noc24_me104/preview
4. https://onlinecourses.nptel.ac.in/noc24_me88/preview

OUTCOMES:

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

1. Gain the knowledge on Basic Electronics & Electrical Circuits (K2)
2. Understand the Basics of Embedded systems,IOT & Robotics (K1)
3. Explore the the Basics of Mechanical Modeling (K2)
4. Interpret the mapping of SDGs to ideas. (K4)
5. Illustrate the ideas in the Ideathon event emphatically .(K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	1	-	-	-	-	-	-
CO2	1	-	-	-	1	-	-	-	-	-	-
CO3	1	-	-	-	1	-	-	-	-	-	-
CO4	-	-	-	-	-	2	-	3	3	-	2
CO5	-	-	-	-	-	3	-	3	3	-	2

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Meeting No. 6 Dated: 31/08/2024

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SEMESTER - III

24BSMA303 SDG NO. 4	PROBABILITY AND STATISTICAL MODELLING	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- The aim of this course is to provide a solid foundation in Probability and Statistics thereby students' master statistical tools and models that are of relevance to various fields of Engineering.

MODULE - I PROBABILITY AND RANDOM VARIABLES 12

Introduction to Probability and Conditional probability - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

MODULE - II TWO DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance – Central limit theorem (for independent and identically distributed random variables).

MODULE - III LINEAR REGRESSION MODELS AND ANALYSIS OF VARIANCE 9

Simple linear regression and correlation, multiple regression and multiple correlation. Test of hypothesis – concept and formulation, Type I and Type II errors, Neyman Pearson lemma (Statement only), Procedures of testing. Analysis of Variance (one-way, two-way with as well as without interaction).

MODULE - IV NON-PARAMETRIC INFERENCE 12

Comparison with parametric inference, use of order statistics, Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test, Spearman's and Kendall's test. Tolerance region.

MODULE - V ESTIMATION 9

Point estimation, criteria for good estimates (unbiasedness, consistency), Methods of estimation including maximum likelihood estimation.

MODULE - VI TIME SERIES ANALYSIS AND FORECASTING 9

Basics of Time Series: Stationary, ARIMA Models: Identification, Estimation and Forecasting.

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TOTAL: 60 PERIODS

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Department of Humanities & Sciences

TEXT BOOKS:

1. Probability and Statistics for Engineers, I. R. Miller, J. E. Freund and R. Johnson, 8th Edition, Prentice Hall India Learning Pvt. Ltd., 2011.
2. Introduction to Probability Models, S. M. Ross, 11th Edition, Academic Press Inc., 2014.
3. Probability and Statistics for Engineers and Scientists, Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., 8th Edition, Pearson Education, Asia, 2007.
4. The Analysis of Time Series: An Introduction, Chris Chatfield, 6th Edition, Chapman & Hall, 2003

REFERENCES:

1. A first course in Probability, S. M. Ross, 9th Edition, Pearson Education, India, 2013.
2. Introduction to the Theory of Statistics, A. M. Mood, F. A. Graybill and D.C. Boes, 3rd Edition, McGraw-Hill Education, 2017.
3. Introduction to Linear Regression Analysis, D. C. Montgomery and E. Peck., 5th Edition, Wiley, 2012.
4. Applied Regression Analysis, N. Draper and H. Smith., 3rd Edition, Wiley-Interscience, 1998.
5. Time Series Analysis, James D. Hamilton, 1st Edition, Princeton University Press, 1994.

WEB REFERENCES:

1. https://www.stat.berkeley.edu/~aldous/134/gravner.pdf
2. https://home.iitk.ac.in/~shalab/regression/Chapter2-Regression-SimpleLinearRegressionAnalysis.pdf
3. https://dl.icdst.org/pdfs/files3/22a131fac452ed75639ed5b0680761ac.pdf
4. https://otexts.com/fpp2/arima.html

ONLINE RESOURCES:

1. https://www.nptel.ac.in/courses/110107113/
2. https://nptel.ac.in/courses/103106123/
3. https://archive.nptel.ac.in/courses/111/102/111102111/

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COURSE OUTCOMES

Upon completion of the course, the student should be able to:

1. Apply fundamental concepts of probability, random variables, and probability distributions to solve practical problems. (K3)
2. Apply concepts of joint, marginal, and conditional distributions, covariance, and the Central Limit Theorem to solve problems involving two-dimensional random variables. (K3)
3. Analyze linear regression models and hypothesis testing procedures, including ANOVA, to evaluate data relationships. (K4)
4. Analyze non-parametric inference methods for hypothesis testing when parametric assumptions are violated. (K4)
5. Apply suitable point estimation methods, including maximum likelihood estimation, and evaluate estimators based on properties such as unbiasedness and consistency. (K3)
6. Apply time series data through ARIMA modelling for accurate forecasting and trend analysis. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	-	3	-	-	-	-	-	-	-	-	-	2	2
CO4	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	-	-	-	-	-	-	-	-	-	-	2	2
CO6	3	-	-	-	-	-	-	-	-	-	-	2	2

SEMESTER - III

24AIPC301 106106139 SDG NO. 4 & 9	INTRODUCTION TO MACHINE LEARNING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To Explain and understand the different types of Machine learning techniques.
- To Understand the Predictive, Descriptive and Prescriptive Analytics.
- To Apply different types of classification models in Supervised Machine learning.
- To Apply the different regression modeling and Optimization in Supervised learning

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Meeting No. 6 Dated: 31/08/2024

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- To understand clustering techniques such as K-Medoids, hierarchical, and density-based methods, and to learn association rule learning with the Apriori algorithm.
- To understand different types of learning techniques, such as reinforcement, semi-supervised, active learning, and ensemble learning, along with methods like auto encoders and KNN.

MODULE - I INTRODUCTION TO MACHINE LEARNING **8**

Introduction to Machine Learning – Types of Machine learning – Supervised –Unsupervised – Reinforcement Learning types – Applications of Machine learning techniques with Case study– Banking and Finance – Healthcare –Insurance – Issues in Machine learning

MODULE - II DATA MODELLING AND EVALUATION **8**

Basic Types of data in Machine Learning – Exploring structure Data – Numerical data – Categorical data – Data Quality and Remediation – Data Preprocessing – Modeling and Evaluation- Selecting a model -Training the models - Model Representation and Interpretability – Evaluating the performance of the model – Improving the performance of the model.

MODULE - III CLASSIFICATION ALGORITHM **8**

Introduction to Feature Engineering – Feature construction – Feature extraction – Feature subset selection – Classification learning models and steps - Classification Algorithms – KNN –Naive Bayes classifier- Decision Tree – Random Forest Model – Support Vector Machine.

MODULE - IV REGRESSION MODELLING **7**

Introduction to regression modeling – Simple Linear regression – Multiple Linear Regression-Multivariate regression – Improving Accuracy of Linear regression model - Polynomial Regression - Logistic regression – Maximum likelihood Estimation - Ridge, Lasso and Elastic Net regression modeling.

MODULE - V CLUSTERING ALGORITHM **7**

Introduction to Clustering – Different types of clustering techniques – Partitioning methods – K – Medoids: Object based technique – Hierarchical Clustering – Density based methods – Pattern Using Association Rules – Association Rule – Apriori algorithm for association rule learning – build the apriori principle rules.

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Meeting No. 7 Dated: 21/4/2024

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MODULE - VI OTHER TYPES OF LEARNING 7

Other types of learning – Types of learning beyond supervised and unsupervised – Overview of reinforcement and semi-supervised learning - Representation learning: Auto encoders, sparse coding – Active Learning: Query strategies, pool-based learning – Instance Based Learning: k-NN, case-based reasoning – Association Rules Learning – Ensemble Learning: Bagging, Boosting, Random Forest

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", Third Edition, McGraw Hill Education, 2017.

REFERENCES:

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
3. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014.
4. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", First Edition, Pearson, 2018.
5. Thomas P. Trappenberg, "Fundamentals of Machine Learning", Oxford University Press,2020

WEB REFERENCES:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/
2. https://developers.google.com/machine-learning/crash-course
3. https://scikit-learn.org/stable/documentation.html

ONLINE RESOURCES:

1. https://www.geeksforgeeks.org/machine-learning/
2. https://www.simplilearn.com/tutorials/machine-learning-tutorial?
3. https://machinelearningmastery.com/start-here/

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Meeting No. 7 Dated: 21/4/25

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OUTCOMES

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

1. Use the fundamental concepts of Machine Learning to identify different types and relate them to appropriate real-world applications. (K3)
2. Apply data preparation techniques to ensure higher accuracy and reliability in machine learning models. (K3)
3. Use classification algorithms like KNN, Naïve Bayes, Decision Tree, Random Forest, and SVM for predictions. (K3)
4. Apply an appropriate regression modeling technique and improve the performance of the technique for a given problem. (K3)
5. Use a relevant clustering algorithm to categorize data based on patterns. (K3)
6. Analyze and evaluate different types of Machine Learning models, identifying suitable use cases for each. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	2	2	-	-	-	-	-	-	-	-	-	3	3
CO3	2	2	3	-	-	-	-	-	-	-	-	2	2
CO4	2	3	-	-	-	-	-	-	-	-	2	3	2
CO5	2	2	3	-	-	-	-	-	-	-	2	3	3
CO6	2	3	3	-	-	-	-	-	-	-	2	3	3

SEMESTER - III

24AMPC302 106106145 SDG NO. 4 & 9	FOUNDATIONS OF DATA STRUCTURES AND ALGORITHM DESIGN	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To analyze algorithm efficiency using time, space and recurrence-solving methods.
- To understand and apply linear data structures like List, stacks, queues and their applications.
- To perform operations on tree-based data structures including binary trees, AVL trees, splay trees and red-black trees.
- To represent graphs and apply traversal, shortest path, and minimum spanning tree algorithms effectively.

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Board of Studies of CSE(AI&ML) dept.
Meeting No. 05 Dated: 17.04.2025

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(Artificial Intelligence and Machine Learning)

- To be able to incorporate various searching and sorting techniques in real time scenarios.
- To learn hashing, collision resolution, and rehashing techniques.

MODULE - I ALGORITHM ANALYSIS **7**

Importance of algorithms and data structures-Fundamentals of Algorithm Analysis: Space and Time complexity of an algorithm- Types of Asymptotic Notations and its properties – Analysis of non-recursive and recursive algorithms- Solving Recurrence Relations: Substitution method, Master method and recursive Tree method.

MODULE - II LINEAR DATA STRUCTURES **8**

Abstract Data Types (ADTs) – List ADT- Linked List Implementation: singly linked lists- circularly linked lists- doubly-linked lists –Applications of lists: Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal)-Stack ADT – Operations-Evaluating arithmetic expressions-Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Applications of Queues.

MODULE - III NON-LINEAR DATA STRUCTURES - TREES **7**

Tree ADT: Terminologies in Tree Data Structure - Operations in Tree ADT- Tree Traversals: Inorder, Preorder, Postorder –Binary Tree ADT– Operations in Binary Tree ADT - Binary Search Trees- Operations in Binary Search Tree - AVL Trees: Key Properties of AVL Trees- Operations in AVL Trees (Insertion, Deletion) –Splay Trees (Insertion, Deletion, Searching)-Red-Black Trees and its operations.

MODULE - IV NON-LINEAR DATA STRUCTURES - GRAPHS **8**

Graph Terminologies – Representation of Graph: Set, Linked and Matrix Representation – Graph Traversals: Breadth-first traversal (BFS), Depth first traversal (DFS) – Shortest Path Problem: Floyd-Warshall Algorithm, Dijkstra's Algorithm - Minimum Spanning Tree: Prim's Algorithm, Kruskal's Algorithm.

MODULE - V SEARCHING AND SORTING **7**

Searching: Linear Search, Binary Search. Sorting: Insertion sort, Selection sort, Bubble sort, Quick sort - Merge Sort - Analysis of Sorting Algorithms.

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Meeting No. 05 Dated: 17.04.2025

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(Artificial Intelligence and Machine Learning)

MODULE - VI HASHING **8**

Hashing: Hash Functions –Collision resolution strategies- Separate Chaining – Open Addressing: Linear Probing, Quadratic Probing, Double Hashing-Closed Hashing – Rehashing- Extendible Hashing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, Data Structures & Algorithms in Python, John Wiley & Sons Inc., 2021.
2. Anany Levitin, "Introduction to design and analysis of algorithms",3rd Edition, Pearson Education,2017.

REFERENCES:

1. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi, 2006.
2. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C++‖, Fourth Edition,Pearson Education, 2014.
3. Sara Baase and Allen Van Gelder, Computer Algorithms – Introduction to Design & Analysis, Third Edition, Pearson Education, New Delhi, 2000.

WEB REFERENCES:

1. https://www.geeksforgeeks.org/c-language-set-1-introduction/
2. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
3. https://www.w3schools.in/data-structures-tutorial/intro/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/
2. https://www.w3schools.in/data-structures-tutorial/
3. https://www.tutorialspoint.com/data_structures_algorithms/

OUTCOMES

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

1. Apply algorithmic analysis using time, space, and recurrence-solving methods to improve computational efficiency.(K3)
2. Use lists, stacks, and queues to develop efficient problem-solving programs.(K3)
3. Utilize tree structures to organize and retrieve hierarchical data effectively in programming tasks.(K3)

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4. Apply graph algorithms to determine connectivity and optimal paths in network problems.(K3)
5. Analyze searching and sorting algorithms to evaluate their efficiency for various data-handling scenarios in real-time applications. (K4)
6. Apply hashing, collision resolution, and rehashing techniques to ensure efficient data access and storage. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	2	3	2
CO2	3	2	-	-	-	-	-	-	-	-	2	3	2
CO3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO4	3	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	-	-	-	-	-	-	2	3	2
CO6	3	2	-	-	-	-	-	-	-	-	2	3	2

SEMESTER - III

24AIPW301 108105101 SDG NO. 4	BIOMEDICAL SIGNAL AND IMAGE PROCESSING WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To understand the types and characteristics of standard and biomedical signals
- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and transmitting these parameters
- To gain knowledge in removing the noise and artifacts in biomedical signals
- To provide fundamentals of the image in time and frequency domain
- To study different biomedical imaging techniques such as X-ray, CT, MRI, and ultrasound, and basic image enhancement methods.
- To understand techniques for biomedical image processing, including segmentation, feature extraction, and restoration.

MODULE - I INTRODUCTION TO SIGNALS AND BIOSIGNALS 8

Standard signals: Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids, Classification of signals – Continuous time (CT) and Discrete

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Time (DT) signals, Periodic & Aperiodic signals, Energy & Power signals, Sources of biomedical signals, Bio signals characteristics - Origin of biopotential and its propagation.

MODULE - II MEASUREMENT OF BIO SIGNALS **7**

Bio potential electrodes- classification of electrodes, Electrode configurations, Biological amplifiers: Need for bio-amplifier - Differential bio-amplifier – Single-ended amplifier, ECG, EEG, EMG, PCG, Typical waveforms and signal characteristics.

MODULE - III REMOVAL OF NOISE AND ARTIFACTS FROM BIOMEDICAL SIGNALS **8**

Random and Structured Noise, Physiological Interference, Stationary and Nonstationary Processes, Noises and Artifacts Present in ECG, Time-domain Filters - Synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency domain filters - Removal of High-Frequency noise, Removal of Low-Frequency noise.

MODULE - IV FUNDAMENTALS OF IMAGE PROCESSING **8**

Image perception: MTF of the visual system, Monochrome vision model, Image fidelity criteria, Colour vision model, Image sampling and quantization – Two-dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT, Sine, Cosine transforms.

MODULE - V BIOMEDICAL IMAGING TECHNIQUES **7**

X-ray based imaging, CT, MRI, and Ultrasound imaging – Basic principles and applications-Preprocessing – Noise removal, normalization. Image Enhancement operations – Contrast enhancement, smoothing. Histogram modeling – Histogram equalization and specification.

MODULE - VI BIOMEDICAL IMAGE PROCESSING AND FEATURE EXTRACTION **7**

Image restoration – Basic concepts, Inverse and Wiener filtering, Overview of image segmentation – Thresholding, region-based methods-Spatial feature extraction – Shape and texture features-Edge detection – Gradient-based methods, Canny edge detector-Feature extraction.

LIST OF EXPERIMENTS: **15**

1. Write a program to represent and plot basic discrete-time signals such as unit impulse, unit step, ramp, exponential, and sinusoidal signals.

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2. Develop a program to simulate common bio-signals such as ECG, EEG, and EMG using standard signal models or available datasets.
3. Write a program to load and analyze ECG signals to detect key waveform components such as P, QRS complex, and T waves. Plot the signal and annotate important features.
4. Write a program to analyze EEG signals by plotting raw EEG data, filtering noise, and identifying basic frequency bands such as delta, theta, alpha, and beta.
5. Develop a program to analyze EMG signals by applying signal rectification and envelope detection techniques. Visualize the time-domain features of the EMG signal.
6. Write a program to read and display a grayscale biomedical image and generate its negative image. Display both original and negative images side by side.
7. Develop a program to compute and display the histogram of a biomedical image. Perform histogram equalization to enhance the contrast of the image and display the result.
8. Write a program to perform image enhancement using intensity (gray-level) slicing techniques. Apply both binary and linear slicing and display the enhanced images.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Allan V. Oppenheim, S. Wilsky and S. H. Nawab, "Signals and System", Pearson, 2015
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.

REFERENCES:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, New Delhi, 2003.
2. John G. Webster, "Medical Instrumentation Application and Design", 3rd Edition, Wiley India , 2009
3. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2021, New Delhi
4. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2004.
5. Anil J Jain, "Fundamentals of Digital Image Processing", PHI, 2006.
6. Dhawan, Atam P. Medical Image Analysis. Wiley-Interscience Publication, New Jersey.

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7. Sridhar, S. Digital Image Processing. Oxford University Press, Second Edition,2016, New Delhi.
8. Alasdair Mc Andrew, "Introduction to Digital Image Processing with Matlab", Cengage Learning 2011, India
9. John L. Semmlow, "Bio signal and Biomedical Image Processing Matlab Based applications", Marcel Dekker Inc., New York,2004

WEB REFERENCES:

1. http://digimat.in/nptel/courses/video/108105101/L01.html
2. http://digimat.in/nptel/courses/video/117105135/L01.html
3. https://www.physio-pedia.com/Medical_Imaging

ONLINE RESOURCES:

1. http://digimat.in/nptel/courses/video/105107160/L01.html
2. http://digimat.in/nptel/courses/video/117105079/117105079.html

LAB REQUIREMENTS:

1. MATLAB/Equivalent compiler- 30 NOs

OUTCOMES

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

1. Apply the fundamental concepts of various signals and biomedical signals to interpret real-world examples and practical applications. (K3)
2. Use appropriate methods to identify and explain the amplitude and frequency features of ECG, EEG, EMG, and PCG bio-signals. (K3)
3. Apply appropriate time domain and frequency domain filters on biomedical signals and biomedical images to remove artifacts and to enhance images. (K3)
4. Use fundamental concepts of image processing and various transformation techniques to analyze and enhance digital images. (K3)
5. Apply appropriate image enhancement techniques to improve biomedical images for better visualization and diagnosis. (K3)
6. Analyze the effectiveness of different feature extraction methods in biomedical image processing tasks. (K4)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	3	3
CO3	2	3	2	-	2	-	-	-	-	-	-	3	3
CO4	3	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	3	2	3	-	-	-	-	-	-	3	2
CO6	3	2	2	2	3	-	-	-	-	-	3	3	3

SEMESTER - III

24HSMC301 - SDG NO. 4 & 9	UNIVERSAL HUMAN VALUES – II UNDERSTANDING HARMONY	L	T	P	CP	C
		2	1	0	3	3

OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Developing clarity with harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.
- Recognizing the potential of excellence than competition

SYLLABUS:

The course has 28 lectures and 14 practice sessions in 6 modules:

MODULE - I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION (5+2)

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario

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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

MODULE - II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF (5+2)

6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

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 program for ensuring health vs dealing with disease

MODULE - III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY HARMONY IN HUMAN-HUMAN RELATIONSHIP (6+2)

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 ofrelationship
13. Understanding the meaning of Trust; Difference between intention and competence
14. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
15. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Include practice sessions to reflect on relationships in family, hostel and institute as 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.

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MODULE - IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE (6+2)

16. Understanding the harmony in the Nature
17. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature
18. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
19. 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 ofresources and role of technology etc.

MODULE - V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS (4+4)

20. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family
21. Natural acceptance of human values
22. Definitiveness of Ethical Human Conduct
23. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
24. 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.

MODULE - VI UNIVERSAL HUMAN ORDER (4+3)

25. Programs to ensure Sanyam and Health
26. Case studies of typical holistic technologies, management models and production systems
27. 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
28. 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

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

REFERENCES:

1. AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology)Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values,A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence-JC Kumarappa
8. Bharat Mein Angreji Raj- Pandit Sunderlal
9. Rediscovering India- by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda- Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

OUTCOMES

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

1. Express the harmony of relationship among human being, family, society, nature and existence with right understanding and right feeling. (K2)
2. Develop the responsibility of handling problems by finding holistic and sustainable solutions based on the natural acceptance for maintaining mutual human relationships. (K2)
3. Develop a holistic perspective of life based on self-exploration about self, family, society and nature/existence. (K2)
4. Elucidate a critical ability for dedicative commitment towards human values, relationships and society. (K2)
5. Implement the process of verification and validation of learning in daily life. (K2)
6. Develop self reflection, commitment and courage to act in life chailenging situations. (K2)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	3	3	2	-	-	3
CO2	-	1	-	-	-	3	3	2	-	-	-
CO3	-	-	3	-	-	3	3	2	-	-	-
CO4	-	-	-	-	-	3	3	2	-	2	3
CO5	-	-	-	-	-	3	3	-	-	-	3
CO6	-	-	-	-	-	3	3	-	-	3	2

SEMESTER - III

24HSNC301 - SDG NO. 4	NCC COURSE LEVEL 2	L	T	P	CP	C
		3	0	0	3	0

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Change your mindset, Time Management, Social Skills 6

PD 5 Public Speaking 3

LEADERSHIP **7**

L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965 7

DISASTER MANAGEMENT **13**

DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation 3

DM 2 Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters 9

DM 3 Fire Service & Fire Fighting 1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

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GENERAL AWARENESS		**4**
GA 1	General Knowledge	4
ARMED FORCES 6		
AF 1	Armed Forces, Army, CAPF, Police	6
ADVENTURE 1		
AD 1	Introduction to Adventure Activities	1
BORDER & COASTAL AREAS		**2**
BCA 1	History, Geography & Topography of Border/Coastal areas	2
		TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3
LEADERSHIP 7		
L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7
DISASTER MANAGEMENT		**13**
DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1
ENVIRONMENTAL AWARENESS & CONSERVATION		**3**
EA 1	Environmental Awareness and Conservation	3
GENERAL AWARENESS		**4**
GA 1	General Knowledge	4
NAVAL ORIENTATION 6		
AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3

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ADVENTURE **1**

AD 1 Introduction to Adventure Activities 1

BORDER & COASTAL AREAS **2**

BCA 1 History, Geography & Topography of Border/Coastal areas 2

TOTAL: 45 PERIODS

AIR FORCE WING

PERSONALITY DEVELOPMENT 9

PD 3 Group Discussion: Change your mindset, Time Management, Social Skills 6

PD 5 Public Speaking 3

LEADERSHIP **7**

L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965 7

DISASTER MANAGEMENT **13**

DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation 3

DM 2 Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters 9

DM 3 Fire Service & Fire Fighting 1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS **4**

GA 1 General Knowledge 4

GENERAL SERVICE KNOWLEDGE **6**

GSK 1 Armed Forces & IAF Capsule 2

GSK 2 Modes of Entry in IAF, Civil Aviation 2

GSK 3 Aircrafts - Types, Capabilities & Role 2

ADVENTURE **1**

AD 1 Introduction to Adventure Actitivities 1

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BORDER & COASTAL AREAS 2

BCA 1 History, Geography & Topography of Border/Coastal areas 2

TOTAL :45 PERIODS

SEMESTER - III

24AIPT301 106105214 SDG NO. 4 & 9	OPERATING SYSTEMS LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To understand a fundamental understanding of operating systems and its functionalities
- To understand processes, CPU scheduling techniques, and threading models, along with the challenges involved in multithreading.
- To learn about process synchronization and different methods for handling and recovering from deadlocks.
- To learn about memory management methods, including paging, segmentation, and virtual memory, and to understand issues like fragmentation and thrashing.
- To understand the structure and management of file systems, including disk scheduling, file access methods, and free space management.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

MODULE - I OPERATING SYSTEM OVERVIEW 10

Computer System Overview - Elements and organization; Introduction to Operating System - Objectives and functions, Evolution of Operating Systems - Types of Operating Systems; System Calls - Types of system calls, System programs.

List of Experiments:

1. Perform the installation of a Windows Operating System (e.g., Windows 10/11) on a physical machine or virtual environment.
2. Demonstrate the use of basic UNIX/Linux commands related to file handling, process management, and directory operations.

MODULE - II PROCESS MANAGEMENT - CONCEPTS & SCHEDULING 10

Processes - Process Concept, Process Scheduling, Operations on Processes; CPU Scheduling: Scheduling criteria, FCFS, SJF, Priority, RR, Multilevel Queue

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Scheduling , Multilevel Feedback Queue; Threads - Multithreading models, Threading issues.

List of Experiments:

1. Write and execute a C program in a Linux environment to demonstrate process management using the following system calls:

fork() – to create a new process

exit() – to terminate a process

getpid() – to get the process ID

wait() – to make the parent wait for the child to finish

close() – to close a file descriptor

2. Write a C program to simulate and implement multiple CPU scheduling algorithms. Your program should allow the user to input the number of processes, their relevant attributes (such as burst time, arrival time, and priority), and simulate the scheduling of these processes using different algorithms. The output should display essential performance metrics for each process and optionally the average performance values.

MODULE - III PROCESS SYNCHRONIZATION & DEADLOCKS **10**

Process Synchronization - The critical-section problem, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Critical regions, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

List of Experiments:

1. Write a C program to simulate the Banker's Algorithm for deadlock avoidance. The program should take input for the number of processes, resource types, allocation matrix, maximum matrix, and available resources. It should calculate the need matrix and determine if the system is in a safe state. If safe, display the safe sequence; otherwise, indicate that the system is unsafe.

2. Write a C program to simulate the Banker's Algorithm for deadlock prevention. The program should take input for the number of processes, resource types, allocation matrix, maximum matrix, and available resources. It should calculate the need matrix and determine if the system is in a safe state. If safe, display the safe sequence; otherwise, indicate that the system is in an unsafe state.

MODULE - IV MEMORY & STORAGE MANAGEMENT **10**

Main Memory - Background, Swapping, Contiguous & Non-Contiguous Allocation, Fragmentation (Internal & External), Compaction, Paging- Structure of a page table- Segmentation- Virtual Memory- Demand Paging- Performance of Demand Paging- Page Replacement Algorithms- Allocation of

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Frames- Thrashing.

List of Experiments:

1. Write a C program to implement the following Memory Allocation Methods

a. First Fit b. Worst Fit c. Best Fit

2. Write a C program to simulate the following page replacement algorithms

a. FIFO b. LRU c. LFU

MODULE - V FILE SYSTEMS **10**

Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, RAID Structure; File-System Interface - File concept, Access methods, Directory Structure, Directory organization- File System Implementation - Allocation Methods, Free Space Management.

List of Experiments:

1. Implement the following file allocation strategies in C:

a. Sequential Allocation: Allocate files in contiguous memory blocks.

b. Indexed Allocation: Use an index block to point to the file's data blocks.

c. Linked Allocation: Store files as a linked list of blocks.

2. Develop a C program to simulate multiple disk scheduling algorithms. The program should implement FCFS, SSTF, SCAN, and C-SCAN, and demonstrate how these algorithms handle disk requests in terms of seek times and request order.

MODULE - VI CASE STUDY **10**

Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management; Mobile OS - iOS and Android - Architecture and SDK Framework; Comparison of UNIX and Windows.

List of Experiments:

1. Use VMware to install a Linux operating system as a guest on a virtual machine. Ensure the virtual machine is configured with suitable resources like CPU, memory, and storage to successfully run the Linux OS in a virtualized environment.

TOTAL : 60 PERIODS

LAB REQUIREMENTS

1. Standalone desktops with C / C++ / Java / Equivalent compiler 30 Nos. with Linux OS

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TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons Inc., 2021.
2. William Stallings, "Operating Systems –internals and Design Principles", Pearson 7th Edition, 2012.

REFERENCES:

1. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson Education, 2015.
4. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.
5. Harvey M. Deitel, "Operating Systems", Third Edition, Pearson Education, 2004.
6. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.
7. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106144/
2. https://www.coursera.org/courses?query=operating%20system
3. https://www.computerhope.com/jargon/o/os.html
4. https://www.os-book.com/OS9/slide-dir/
5. http://web.iitd.ac.in/~minati/MTL458.html

ONLINE RESOURCES:

1. https://www.udacity.com/course/introduction-to-operating-systems--ud923
2. https://freevideolectures.com/course/3670/introduction-to-operating-systems

OUTCOMES

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

1. Apply the knowledge of operating system concepts, structure, and types to implement system calls and interact with system programs. (K3)
2. Apply various CPU scheduling algorithms and process/thread management concepts to solve scheduling-related problems in operating

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systems. (K3)

3. Analyze process synchronization mechanisms and develop solutions to avoid or recover from deadlocks using appropriate algorithms. (K4)
4. Apply memory management techniques, including paging, segmentation, and allocation strategies, to efficiently manage main memory. (K3)
5. Implement file allocation strategies and disk scheduling algorithms to understand file system management and storage structures. (K3)
6. Examine the internal architecture and features of Linux, iOS, and Android operating systems, and compare their functionalities with Windows/UNIX systems. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2
CO6	3	3	2	2	-	-	-	-	-	-	2	2	2

SEMESTER - III

24AMPT301 106104135 SDG NO. 4 & 9	DATABASE MANAGEMENT SYSTEMS LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To design a database using ER diagrams, convert them to Relational Databases and to write SQL Queries.
- To learn SQL and normalization techniques for efficient database design.
- To understand the fundamental concepts of Transaction Processing, Concurrency Control techniques, and Recovery procedures.
- To understand file organization, indexing, and hashing techniques for efficient data storage and retrieval

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- To explore distributed and object-oriented databases, focusing on architecture, data storage, and advanced query languages
- To study query processing, optimization techniques, and explore XML databases, including XML schema and Xquery.

MODULE - I DATABASE DESIGN **10**

Purpose of Database System – Views of Data – Database System Architecture – Data Models – Entity Relationship Model – ER Diagrams – Enhanced ER Model – Introduction to Relational Databases – Relational Model – ER-to-Relational Mapping – Keys – Relational Algebra.

List of Experiments:

a) Data Definition Language - Create, Describe, Alter, Truncate, Drop

i) Create the employee table with the following columns (EMP ID, EMP NAME, EMP AGE)

ii) Use a command to describe the structure of the employee's table.

iii) Write an SQL statement to alter the employees table to add a new column salary.

iv) Use a command to truncate the employees table, removing all rows but keeping the structure intact.

v) Write a command to drop the employees table completely from the database.

b) Data Manipulation Language - Insert, Select, Update, Delete

i) Write an SQL command to insert a new student with (ID, NAME and GRADE)

ii) Write a select query to retrieve all records from the student's table.

iii) Write an SQL command to update the grade of the student with ID.

iv) Write an SQL command to delete the student record with their NAME.

c) Transaction Control Language - Commit, Rollback, and Savepoint

i) Insert a new ID and name and Set a SAVEPOINT after the insertion.

ii) Insert another ID and name. Note that the second insertion was a mistake, so ROLLBACK to the savepoint.

iii) COMMIT the transaction to make the first insertion permanent in the database.

MODULE - II RELATIONAL DATABASES **10**

SQL Fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL- Functional Dependencies – Non-loss Decomposition – First – Second - Third Normal Forms- Dependency Preservation – Boyce/Codd Normal Form – Multi Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

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List of Experiments:

Database Querying:

a) Write simple SQL queries to perform the following

i) Retrieve all the records from the student's table.

ii) Display only the name and grade of each student.

iii) Select all students who have scored more than 80.

iv) Display all student records sorted by grade in descending order.

v) Retrieve only the first two records from the table.

b) Nested Queries

i) Retrieve the employee(s) who earn the highest salary in the company using a subquery.

ii) Display the names and salaries of employees whose salary is above the average salary of all employees.

iii) Find the department(s) where the lowest salary is paid, using a nested query.

iv) List all employees whose department_id is found in a list of departments where at least one employee earns more than 100000, using a multi-row subquery.

c) Joins (Inner Join, Left Join, Right Join, Full Join, Cross Join)

i) Write a SQL query to list the names of all employees along with their department names, only for those employees who have a corresponding department in the departments table. Use an INNER JOIN.

ii) Write a SQL query to retrieve a list of all employees and their department names. If an employee does not belong to any department, show the department name as NULL. Use a LEFT JOIN.

iii) Write a SQL query to list all departments along with the names of employees working in those departments. If a department has no employees, display NULL for employee names. Use a RIGHT JOIN.

iv) Write a SQL query to list all employees and all departments, even if some employees are not assigned to a department and some departments have no employees. Use a FULL OUTER JOIN.

v) Write a SQL query to list all possible combinations of employee names and department names from the employees and departments tables. Use a CROSS JOIN

MODULE - III TRANSACTIONS **10**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two-Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

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List of Experiments:

a) Write a SQL program for adding two numbers and displaying the sum.
b) Write a SQLprogram to print a series of "n" numbers using a for loop.
c) Write a SQL program to print a series of "n" numbers using a while loop.

MODULE - IV IMPLEMENTATION TECHNIQUES **10**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ Tree Index Files – B Tree Index Files – Static Hashing – Dynamic Hashing

List of Experiments:

a) Write a SQL program for debiting an amount from an entry in a table
b) Write a SQL program to determine the sum of a series of n numbers.
c) Write a SQL program to determine the factorial of the given number.

MODULE - V DATABASE MODELS **10**

Distributed Databases – Architecture – Data Storage – Transaction Processing – Object-Based Databases – Object Database Concepts – Object Relational Features – ODMG Object Model –ODL – OQL

List of Experiments:

a) Write a SQL program for reversing a string using the for loop.
b) Write a SQL program to implement Fibonacci series.
c) Write a SQL program for displaying a particular attribute from a table.

MODULE - VI ADVANCED TOPICS **10**

Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics - Cost Estimation - XML Databases - XML Hierarchical Model–DTD-XML Schema–XQuery.

List of Experiments:

a) Mini Project (Banking System) Connect Oracle Database from Visual Basic for Banking System.

TOTAL: 60 PERIODS

LAB REQUIREMENTS

Front end: VB/VC ++/JAVA or Equivalent

Back end: Oracle / SQL / MySQL/ Postgres / DB2 or Equivalent

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2020.

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2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2022.

REFERENCES:

1. Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Seventh Edition, McGraw-Hill Education,2019.
2. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, McGraw-Hill Education,2015.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs46/
2. http://www.nptelvideos.in/2012/11/database-management-system.html
3. https://www.classcentral.com/course/swayam-database-management-system-9914
4. https://www.w3schools.com/sql/default.asp
5. https://www.khanacademy.org/computing/computer-programming/sql

OUTCOMES

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

1. Apply database concepts to design ER models, map entities to relational schemas, and implement the design using SQL. (K3)
2. Select and apply normalization techniques and functional dependencies to enhance and optimize relational database design. (K3)
3. Utilize SQL queries for transaction processing and apply concurrency control mechanisms based on ACID properties. (K3)
4. Apply query processing and optimization strategies, including relational algebra and heuristic rules to improve SQL execution efficiency. (K3)
5. Identify appropriate indexing and hashing methods, such as B-Tree and B+ Tree, for efficient organization and retrieval of database records. (K3)
6. Analyze query optimization and XML database concepts to enhance the design and performance of applications like a banking system. (K4)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	2	3	2
CO2	3	2	2	3	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	2	3	3
CO5	3	2	-	-	-	-	-	-	-	-	2	3	2
CO6	3	3	2	2	-	-	-	-	-	-	2	3	2

SEMESTER - III

24AITP301 - SDG NO. 4	APTITUDE SKILLS - I	L	T	P	CP	C
		0	0	2	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enrich students on quantitative ability, reasoning ability, and verbal ability
- Build a strong foundation for solving recruitment-based problems with speed and accuracy.
- Enhance creative thinking skills and Strengthen problem-solving skills.

MODULE - I QUANTITATIVE ABILITY 22

Number Properties, Speed Math, HCF and LCM, Percentages, Time and Work, Time Speed and Distance, Ratio Proportion and Variations, Averages Mixtures and Alligation

MODULE - II QUANTITATIVE ABILITY REASONING ABILITY 16

Profit and Loss, Simple Interest and Compound Interest, Blood Relation, Directions, Coding and Decoding, Series, Ranking and Arrangements

MODULE - III VERBAL ABILITY 7

Subject-Verb Agreement, Tenses, Prepositions - Concepts, Error Spotting, Sentence Correction, Fill in the Blanks

TOTAL: 45 PERIODS

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REFERENCES:

1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal
2. A Modern Approach to Logical Reasoning – R.S. Aggarwal
3. High School English Grammar & Composition – Wren & Martin
4. Word Power Made Easy – Norman Lewis.
5. Fast Track Objective Arithmetic – Rajesh Verma

LIFE SKILLS, RANGER AND ROVER & BIS STANDARDS – PHASE 2

OBJECTIVES:

- Familiarize the team and leadership skills.
- Gain Scouting spirit
- Understand the standards relevant to AI&DS.

MODULE - I JEEVAN KAUSHAL 2.0 – TEAM SKILLS AND LIFE SKILLS 12

Trust and Collaboration: Importance of Trust in Creating a Collaborative Team- Agree to Disagree and Disagree to Agree – Spirit of Teamwork - Understanding Fear of Being Judged and Strategies to Overcome.

Brainstorming: Basics and the process – Effective technique for ideation – Types – Importance and Benefits

Internal Communication: Internal Communication – Meaning and the Need, Use of Various Channels for Transmitting Information to Team Members including Digital and Physical.

Leadership Skills: Leadership concept - Leadership skills – Leadership moralities – Leadership models

MODULE - II RANGER AND ROVER 10

Four Bonds of BSG: Sign, Salute, Left Handshake, Moto and Good Turn.

Discipline and Uniform: Uniform of Rovers and Rangers, 14 Programme ideals.

Knowledge of Merit: Know about Knowledge of Merit Badges (Proficiency Badge).

Sustainability E-learning: (Online Course Available in WOSM Learning Zone).

Activating the Earth Tribe Initiative in your Community.

MODULE - III ELECTROMAGNETIC COMPATIBILITY (EMC) AND ELECTROMAGNETIC INTERFERENCE 8

Introduction to the concept of Electromagnetic compatibility of electrical and/or electronic equipment, between themselves and with electrical power networks including electromagnetic interference and measurement and

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calculation methods to assess human exposure to electric, magnetic and electromagnetic fields. Discussion on IS 14700/ IEC 61000 series of Standards.

TOTAL: 45 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

ONLINE RESOURCES

1. https://www.cambridgeenglish.org/learning-english
2. https://lms.scout.org/course_items/show/1172182?course_id=214307#course-item-id=1172182
3. https://lms.scout.org/courses/show/214123?force_course_hub=true

OUTCOMES

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

1. Apply quantitative aptitude for solving numerical problems [K3]
2. Describe logical reasoning to tackle emotional challenges. [K2]
3. Use verbal communication and comprehension skills through grammar and language exercises. [K3]
4. Apply critical thinking and problem-solving skills in various cognitive scenarios. [K3]
5. Interpret language nuances in diversified situations and exhibit scouting spirits amidst communities. [K2]
6. Explain the basic principle of BIS Standards relevant to EMC and EMI. [K2]

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CO – PO, PSO MAPPING:

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CO1	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	2	-	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	1	-	-
CO4	-	2	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	2	3	-	1	-	-
CO6	-	-	-	-	-	3	-	-	-	-	1	-	-

SEMESTER - III

24AIID301 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - I	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To provide opportunities for students to develop an entrepreneurial mindset and explore real-world problem-solving through a startup-centric approach.
- To enable hands-on experience in identifying market needs
- To enable development of skill sets for designing, validating, and realizing a Minimum Viable Product (MVP) for an entrepreneurial venture.
- To guide students in validating market opportunity, and formulating a solution with realistic constraints.
- To inculcate ethical research practices, foster a commitment to lifelong learning, and promote the development of socially responsible and sustainable innovations aligned with relevant Sustainable Development Goals (SDGs).
- To prepare students to design sustainable business models and present entrepreneurial ideas through structured, outcome-driven business pitches using core startup frameworks.

COURSE METHODOLOGY:

1. This initiative is designed to inculcate ethical principles of research and to get involved in a life-long learning process for the students, specifically through the lens of entrepreneurship and innovation.
2. The project work must involve identifying a problem, validating market opportunity, and developing a solution with realistic constraints, culminating in a business plan and prototype/MVP. It must also include

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appropriate elements of the following: market research, competitive analysis, value proposition design, business model development, financial feasibility, go-to-market strategy, and potentially software/hardware development for the MVP.

3. Project can be individual work or a group project, with a maximum of 3 students. In case of a group project, the individual project report of each student should specify the individual's contribution to the group project. The roles and responsibilities of all team members must be well-defined and documented.
4. On completion of the project, the student shall submit a detailed project report outlining their entrepreneurial journey, solution development, and business plan. The project should be reviewed and the report shall be evaluated, and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION:

1. First evaluation (Milestone 1 - Week 4): 20 marks (Focus on Problem Identification, Opportunity Discovery, Customer & Markets, Value Proposition)
2. Second evaluation (Milestone 2 - Week 8): 30 marks (Focus on Competitive Advantage, Business Model, and MVP Development)
3. Final evaluation (Milestone 3 & 4 - Last week of the semester): 50 marks (Focus on Financial Feasibility, Go-to-Market Strategy, Growth and Scale, Funding Strategy, and Overall Project Report & Viva-Voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

1. Apply entrepreneurial thinking to identify and articulate real-world problems and explore market needs using structured approaches. (K3)
2. Develop skill sets to design potential solutions and validate market opportunities within realistic constraints. (K4)
3. Evaluate sustainable, ethical, and responsible innovation strategies, and communicate business models effectively. (K5)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	-	-	-	2	2
CO2	3	3	2	-	-	-	-	2	-	-	-	2	2
Co3	3	3	3	-	-	-	-	2	-	-	-	2	2

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SEMESTER - IV

24BSMA407 - SDG NO. 4	LINEAR ALGEBRA AND ITS APPLICATIONS	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To learn about solving system of linear equations using matrices.
- To learn about vector spaces, sub spaces, basis and dimension of Vector Spaces.
- To learn about the Linear transformation and the matrix representation and diagonalizability.
- To learn about the inner product Spaces, orthogonalization and Least Square Approximations.
- To learn about the applications of singular value decomposition and principal component analysis in data science.

MODULE - I SOLUTION OF SYSTEM OF LINEAR EQUATIONS 9

Rank of a matrix - Solution of systems of Linear Equations using Gaussian elimination and LU Decomposition.

MODULE - II VECTOR SPACES 9

Field (definitions and examples) - Vector Spaces (definitions and examples) - Subspaces (definitions and examples) - Linear Combinations and system of linear equations - Linear Dependence and Linear Independence of Vectors - Bases and Dimensions.

MODULE - III LINEAR TRANSFORMATIONS 12

Linear Transformations - Null spaces and ranges - Dimension Theorem (Statement Only) - Matrix of a Linear Transformation - Eigen Values and Eigen Vectors - Diagonalizability - Test for Diagonalization.

MODULE - IV INNER PRODUCT SPACES 12

Introduction - Inner Product Spaces - orthogonality – Gram Schmidt Orthogonalization Process (without proof) - QR decomposition.

MODULE - V ADJOINT OPERATORS 9

Adjoint of a linear operator - Least Square Approximation - Normal and Self-Adjoint operators

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MODULE - VI APPLICATIONS OF LINEAR ALGEBRA 9

Singular value decomposition - Principal component analysis – Introduction to their applications in Data Science.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 40th Edition, Khanna Publishers, New Delhi, 2007.
2. Linear Algebra, Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence, 5th Edition, Pearson, 2018.

REFERENCES:

1. Advanced Engineering Mathematics, Peter V. O'Neil. 7th Edition, Cengage Learning, 2011.
2. Advanced Engineering Mathematics, Michael. D. Greenberg, 2nd Edition, 1998.
3. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Wellesley - Cambridge Press, 2016.
4. Applied Mathematics (Vol. I & II), by P. N. Wartikar & J. N. Wartikar., 1st Edition, Pune Vidyarthi Griha Prakashan, 1985.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111106135/
2. https://swayam.gov.in/nd1_noc20_ma08/preview

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3382/linear-algebra-i
2. Linear Algebra | Khan Academy
3. Singular Value Decomposition (SVD), Demystified | Towards Data Science
4. Principal Component Analysis Made Easy: A Step-by-Step Tutorial | Towards Data Science

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

1. Solve the system of linear equations using LU decomposition and Gauss Elimination Method (K3)
2. Identify the bases and dimension of vector spaces and subspaces. (K3)
3. Calculate matrix representations, null spaces, ranges, eigenvalues, eigenvectors, and determine diagonalizability of linear transformations. (K3)

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4. Construct an orthonormal basis using Gram-Schmidt Orthogonalization process and use it for QR decomposition of a matrix. (K3)
5. Apply the least squares approximation method to compute minimal solutions and use the concepts of adjoint and self-adjoint operators in linear transformations. (K3)
6. Apply singular value decomposition and principal component analysis to interpret data and explore their applications in data science. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	2	2
CO3	-	3	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	-	3	-	-	-	-	-	-	-	-	-	3	3
CO6	3	-	-	-	3	-	-	-	-	-	-	3	3

SEMESTER - IV

24AIPC401 - SDG NO. 4, 9	DATA COMMUNICATION AND COMPUTER NETWORKS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand fundamental concepts of networking models, architectures, and protocols.
- To analyze data transmission techniques and network performance.
- To design and implement routing algorithms and network protocols.
- To explore network security mechanisms and troubleshooting techniques.

MODULE - I INTRODUCTION TO NETWORKS AND DATA TRANSMISSION 8

Data Communications: Components–Direction of Dataflow–Networks–Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame

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Relay, ISDN Physical layer: Transmission modes, Multiplexing, Transmission Media, switching techniques – Circuit, Packet and Virtual Circuit Switching. Network performance metrics – Delay, throughput, Jitter and Bandwidth.

MODULE - II DATA LINK LAYER AND MAC PROTOCOLS **8**

Data link layer – Framing, Error Detection and Correction (CRC, Hamming code), Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – MAC protocols – ALOHA, CSMA/CD, CSMA/CA, Ethernet (IEEE 802.3), Wireless LAN (IEEE 802.11) – Switching techniques -Hubs, Bridges, Switches, VLAN.

MODULE - III NETWORK LAYER AND ROUTING **8**

Network layer – Functions of the Network Layer – IPv4 and IPv6 – IP Addressing and Subnetting – ARP, RARP, and DHCP – Static and Dynamic Address Assignment – NAT and its types–Routing Algorithms: Distance Vector and Link State – Routing Protocols: RIP, OSPF, BGP – Basics of MPLS – Comparison of Routing Techniques.

MODULE - IV TRANSPORT LAYER **7**

Transport layer protocols – Functions of the Transport Layer – TCP: Features and Segment Structure– UDP: Characteristics and Use Cases – SCTP Basics – TCP Flow Control using Sliding Window – Congestion Control Techniques – AIMD – Slow Start Algorithm – Fast Retransmit and Fast Recovery.

MODULE - V APPLICATION LAYER **7**

Application Layer Protocols: WWW and HTTP–FTP–Email–Telnet–SSH–DNS–SNMP.

MODULE - VI NETWORK SECURITY AND SIMULATION **7**

Network security – Firewalls –Types: Packet Filtering, Stateful, Proxy-IDS/IPS–VPN–SSL/TLS– Basics of Network simulation tools–NS2–NS3–Mininet–Packet Tracer–Case study: Network attacks-Types: Phishing, Spoofing, MITM- Prevention techniques.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking", Fifth Edition, TMH,2017.
2. Larry L.Peterson, Bruce S.Davie, Computer Networks: A Systems Approach, Sixth Edition, Morgan Kaufmann, 2021.

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Meeting No. 07 Dated: 2.11.25

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REFERENCES:

1. William Stallings, Data and Computer Communications, Tenth Edition, Pearson, 2013.
2. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, Sixth Edition, Pearson, 2013.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105081
2. https://www.wireshark.org/
3. https://www.netacad.com/courses/networkingbasics

ONLINE RESOURCES:

1. https://www.geeksforgeeks.org/computer-network-tutorials/
2. https://www.sanfoundry.com/computer-network-tutorial/
3. https://www.lifewire.com/packet-sniffers-explained-8734167

OUTCOMES

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

1. Use basic concepts of data communication and computer networks to identify network components, transmission methods, switching techniques, OSI model layers, and evaluate network performance. (K3)
2. Apply data link layer concepts and MAC protocols to perform framing, error control, link-layer addressing, and analyze Ethernet, WLAN, and switching devices. (K3)
3. Apply network layer concepts to perform IP addressing and subnetting, analyze IPv4/IPv6, address resolution mechanisms, NAT, routing algorithms, and routing protocols. (K3)
4. Implement transport layer mechanisms using TCP, UDP, SCTP, and congestion control techniques. (K3)
5. Apply application layer protocol concepts to analyze the working of HTTP, FTP, Email, Telnet, SSH, DNS, and SNMP. (K3)
6. Analyze network security mechanisms and simulation tools to evaluate firewalls, IDS/IPS, VPN, SSL/TLS, network attacks, and their prevention techniques. (K4)

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Artificial Intelligence and Data Science

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-		-	-	-	-	-	-	3	2
CO2	3	2	2	-	2	-	-	-	-	-	-	2	3
CO3	3	3	2	1	2	-	-	-	-	-	-	2	2
CO4	3	2	2	-	2	-	-	-	-	-	-	2	3
CO5	2	2	1	-	2	-	-	-	-	-	-	2	2
CO6	2	3	2	2	3	2	-	-	-	-	-	2	2

SEMESTER - IV

24AIPC402 - SDG NO. 4,8,9	DATA EXPLORATION AND VISUALIZATION	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To outline an overview of exploratory data analysis.
- To implement data visualization using Matplotlib.
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data.
- To work with multiple variables and time-based data.

MODULE - I INTRODUCTION TO EXPLORATORY DATA ANALYSIS (EDA) 8

EDA fundamentals – Definition and purpose of EDA – Role of EDA in the data science workflow – Types of data (categorical, numerical, time series) – Techniques for data summarization and visualization – Understanding data distributions and outliers – Significance of EDA in model building – Comparing EDA with Classical and Bayesian analysis – Strengths and limitations of each approach.

MODULE - II SOFTWARE TOOLS AND DATA TRANSFORMATION FOR EDA 8

Software tools for EDA – Introduction to Python libraries (pandas, numpy, matplotlib, seaborn) – Visual aids for EDA – Importance of data visualization in EDA – Types of visualizations: histograms, scatter plots, box plots, heat maps-

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Data transformation techniques: merging databases, reshaping and pivoting data – Grouping datasets and data aggregation – Pivot tables and cross-tabulations.

MODULE - III DATA VISUALIZATION USING MATPLOTLIB & SEABORN 7

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

MODULE - IV UNIVARIATE ANALYSIS 7

Introduction to Single variable: Types of univariate data – Understanding distributions and variables – Numerical summaries: Measures of central tendency (mean, median, mode) and spread (range, variance, standard deviation) – Scaling and standardizing data – Inequality measures: Gini index, Lorenz curve – Smoothing time series: Moving averages, exponential smoothing.

MODULE - V BIVARIATE ANALYSIS 8

Relationships between Two Variables – Understanding correlation and causality-Percentage tables and contingency tables – Analyzing associations using Chi-square tests – Handling multiple batches – Scatter plots and fitting resistant lines – Transformations: Log, square root, other variable transformations.

MODULE - VI MULTIVARIATE AND TIME SERIES ANALYSIS 7

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2016.

REFERENCES:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.

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2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization:
4. Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.
5. Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008.

WEB REFERENCES:

1. Data Exploration - A Complete Introduction | HEAVY.AI
2. https://learn.microsoft.com/en-us/fabric/data-science/tutorial-data-science-explore-notebook
3. Visual Data Exploration · UC Business Analytics R Programming Guide

ONLINE RESOURCES

1. https://www.simplilearn.com/tutorials/data-analytics-tutorial/exploratory-data-analysis
2. https://www.kaggle.com/code/imoore/intro-to-exploratory-data-analysis-eda-in-python
3. https://www.geeksforgeeks.org/exploratory-data-analysis-in-python/
4. https://www.analyticsvidhya.com/blog/2021/08/how-to-perform-exploratory-data-analysis-a-guide-for-beginners/

OUTCOMES

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

1. Use basic EDA methods to identify patterns, trends, and anomalies in data.(K3)
2. Apply data transformation techniques such as merging, reshaping, and pivoting.(K3)
3. Implement various plotting methods with Matplotlib and Seaborn to explore and communicate data insights. (K3)
4. Apply exploratory techniques on a univariate variable to analyze and interpret its key characteristics. (K3)
5. Analyze relationships between two variables using bivariate data exploration techniques to identify patterns and correlations. (K4)
6. Use Data exploration and visualization techniques for multivariate and time series data.(K3)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3
CO3	3	2	2	-	3	-	-	-	-	-	-	3	2
CO4	3	3	2	-	2	-	-	-	-	-	2	2	2
CO5	3	3	-	-	2	-	-	-	-	-	2	3	3
CO6	3	3	-	-	2	-	-	-	-	-	3	2	3

SEMESTER - IV

24AIPC403 106106184 SDG NO. 3, 4, 11	DEEP LEARNING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the basics of deep neural networks
- To understand CNN and RNN architectures of deep neural networks
- To implement different deep learning algorithms
- To explore autoencoders for feature extraction and dimensionality reduction.
- To understand generative models like VAEs, GANs, and Deep Belief Networks.
- To learn advanced architectures, including RBMs, contrastive learning, and emerging trends like federated learning and Neural Architecture Search (NAS).

MODULE - I DEEP NETWORKS BASICS 8

Linear Algebra: Scalars – Vectors – Matrices and tensors; Probability Distributions –McCulloch Pitts Neuron-Thresholding Logic- Perceptrons-Perceptron Learning Algorithm-Bayesian learning, decision surfaces, and linear classifiers-Overfitting and underfitting-Bias and variance- Deep Networks: Deep feedforward networks; Regularization – Optimization.

MODULE - II CONVOLUTIONAL NEURAL NETWORKS 8

Convolutional Neural Networks-Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization-LeNet –AlexNet -ZF- Net-VGGNet-GoogLeNet- ResNet- Guided Back propagation- Deep Dream- Deep Art - Fooling Convolutional Neural Networks.

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MODULE - III RECURRENT NEURAL NETWORKS 8

RNN Design Patterns: Acceptor – Encoder – Transducer-– Bidirectional RNN – Sequence to Sequence RNN-Deep Recurrent Networks – Recursive Neural Networks – Long Term Dependencies; Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTM.

MODULE - IV AUTO ENCODERS 7

Under complete Auto encoder - Regularized Autoencoder- sparse autoencoders- denoising autoencoders-Representational power, layer, size, and depth of autoencoders- stochastic Encoders and Decoders-Contractive Encoders-Applications:Dimensionality Reduction,Anomaly Detection,Image Denoising- Comparison with PCA.

MODULE - V GENERATIVE MODELS 7

Introduction to Generative Models-Comparison with discriminative models-Probabilistic Generative Models-Variational Autoencoders -Deep Belief networks, Boltzmann Machines, Deep Boltzmann Machine, Generative Adversarial Networks: Momentum Optimizer, RMSProp, Adam

MODULE - VI ADVANCED ARCHITECTURE 7

Advanced Architectures:Restricted Boltzmann machines (RBMs), deep belief networks (DBNs).Contrastive learning (SimCLR, MoCo).Recent Trends: Reinforcement learning with deep networks, federated learning, and neural architecture search (NAS)

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

REFERENCES

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.
2. Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.

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3. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.
4. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.
5. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

WEB REFERENCES:

1. Dive into Deep Learning — Dive into Deep Learning 1.0.3 documentation
2. Generative Adversarial Networks (GANs) | Coursera
3. Practical Deep Learning for Coders - Practical Deep Learning
4. https://onlinecourses.nptel.ac.in/noc20_cs62/preview

ONLINE REFERENCES:

1. https://www.geeksforgeeks.org/deep-learning-tutorial/
2. https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-algorithm
3. https://sites.google.com/view/cs502project/deep-learning-for-biology-a-tutorial/deep-learning-models-dnns-cnns-rnns-autoencoders
4. https://en.wikipedia.org/wiki/Types_of_artificial_neural_networks

OUTCOMES

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

1. Use neural network concepts to develop and train simple models for classification or prediction tasks. (K3)
2. Examine convolutional and pooling operations to analyze images and identify patterns for classification. (K4)
3. Apply Recurrent Neural Network and its variants for text analysis (K3)
4. Apply autoencoders for dimensionality reduction and feature extraction in real-world applications. (K3)
5. Implement generative models like VAEs, DBNs, and GANs for data generation and representation learning. (K3)
6. Analyze advanced deep learning architectures and emerging trends such as reinforcement learning and neural architecture search. (K4)

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CO4	3	3	2	-	2	-	-	-	-	-	2	3	2
CO5	3	3	3	-	2	-	-	-	-	-	2	3	2
CO6	3	3	3	-	2	-	-	-	-	-	2	2	2

SEMESTER - IV

24HSNC401 - SDG NO. 4	NCC COURSE LEVEL 3	L	T	P	CP	C
		3	0	0	3	0

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Team Work 2

PD 4 Career Counselling, SSB Procedure & Interview Skills 3

PD 5 Public Speaking 4

BORDER & COASTAL AREAS **4**

BCA 2 Security Setup and Border/Coastal management in the area 2

BCA 3 Security Challenges & Role of cadets in Border management 2

ARMED FORCES 3

AF 2 Modes of Entry to Army, CAPF, Police 3

COMMUNICATION **3**

C 1 Introduction to Communication & Latest Trends 3

INFANTRY **3**

INF 1 Organisation of Infantry Battalion & its weapons 3

MILITARY HISTORY **23**

MH 1 Biographies of Renowned Generals 4

MH 2 War Heroes - PVC Awardees 4

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MH 3	Study of Battles - Indo Pak War 1965, 1971 & Kargil	9
MH 4	War Movies	6

TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT **9**

PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

LEADERSHIP 7

L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT **13**

DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS **4**

GA 1	General Knowledge	4

NAVAL ORIENTATION 6

AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

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AIR FORCE WING		
PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Team Work	2
PD 4	Career Counselling, SSB Procedure & Interview Skills	3
PD 5	Public Speaking	4
BORDER & COASTAL AREAS		**4**
BCA 2	Security Setup and Border/Coastal management in the area	2
BCA 3	Security Challenges & Role of cadets in Border management	2
AIRMANSHIP		**1**
A 1	Airmanship	1
BASIC FLIGHT INSTRUMENTS		**3**
FI 1	Basic Flight Instruments	3
AERO MODELLING		**3**
AM 1	Aero Modelling Capsule	3
GENERAL SERVICE KNOWLEDGE		**2**
GSK 4	Latest Trends & Acquisitions	2
AIR CAMPAIGNS		**6**
AC 1	Air Campaigns	6
PRINCIPLES OF FLIGHT		**6**
PF 1	Principles of Flight	3
PF 2	Forces acting on Aircraft	3
NAVIGATION		**5**
NM 1	Navigation	2
NM 2	Introduction to Met and Atmosphere	3
	TOTAL :45 PERIODS	

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SEMESTER - IV

24AIPL401 - SDG NO. 4	DEEP LEARNING LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To understand the theoretical foundations, algorithms and methodologies of Neural Network.
- To design and develop an application using specific deep learning models.
- To provide practical knowledge in handling and analyzing real world applications.

List of Experiments:

1. Write a program to perform basic image processing operations such as histogram equalization, thresholding, edge detection (e.g., Canny or Sobel), morphological operations (e.g., dilation, erosion), and apply basic data augmentation techniques (e.g., rotation, flipping, scaling) on a sample image.
2. Write a Python program using TensorFlow/Keras or PyTorch to create and train a simple feedforward neural network on the MNIST dataset. Evaluate its performance and visualize the loss and accuracy curves.
3. Implement a Convolutional Neural Network (CNN) to recognize handwritten characters using a dataset such as EMNIST. Train, evaluate, and display predictions on test data with confidence scores.
4. Develop a deep learning-based face recognition system using Convolutional Neural Networks. Use a dataset like LFW or your custom dataset to train the model and test it on new images.
5. Write a Python program to implement a character-level or word-level language model using Recurrent Neural Networks (RNN). Train it on a text corpus (e.g., Shakespeare, news articles) and generate sample text.
6. Build and deploy a sentiment analysis model using LSTM on a dataset like IMDb or Twitter sentiment dataset. Use a simple web interface (optional) to input text and get sentiment output.
7. Implement a Sequence-to-Sequence (Seq2Seq) model to perform Part-of-Speech (POS) tagging on sentences. Use a labeled corpus like the Penn Treebank for training and testing.
8. Create a language generation model using an Encoder-Decoder neural network architecture. Train it on bilingual sentence pairs for a translation task or on English text for summarization.

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9. Implement a Generative Adversarial Network (GAN) to generate new images from a given dataset (e.g., fashion-MNIST or CIFAR-10). Use the generated images to augment the original dataset and visualize the improvement in classification accuracy.
10. Build a recommendation system using deep learning from a sales dataset (e.g., transactional data from an e-commerce platform). Implement collaborative filtering or neural matrix factorization to suggest products to users.
11. Implement an image captioning system that generates textual descriptions of images using a combination of Convolutional Neural Networks (CNNs) for feature extraction and Long Short-Term Memory (LSTM) networks for sequence generation. Train the model on a dataset like MS COCO or Flickr 8k and evaluate it using BLEU or METEOR scores.
12. Use PyTorch to implement MoCo v2 or use a pre-trained MoCo model. Train it on a small image dataset (e.g., STL-10) and demonstrate how the learned embeddings improve classification accuracy when fine-tuned.

TOTAL : 45 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

Stand alone desktops with Python 30Nos.

OUTCOMES

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

1. Apply neural networks and deep learning concepts to solve real-world problems such as data prediction, feature learning, and image-related tasks using tools like TensorFlow/Keras. (K3)
2. Analyze and evaluate various deep learning architectures and optimization techniques for different machine learning tasks and practical applications. (K4)
3. Analyze and adapt deep learning solutions for complex, domain-specific tasks by integrating theoretical understanding with practical implementation techniques. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	2	2	2
CO2	3	3	2	2	2	-	-	-	-	-	2	3	2
Co3	3	3	3	3	3	-	-	-	-	-	3	2	2

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SEMESTER - IV

24AIPT401 - SDG NO. 4, 9	INTRODUCTION TO ARTIFICIAL INTELLIGENCE LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To examine the architecture and working of Expert Systems and their application areas.
- To know about the various applications of AI.

MODULE - I INTRODUCTION **12**

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI Problems – Search Strategies- Uninformed- Heuristics- Informed.

List of Experiments:

1. Print all the nodes reachable from a given starting node in a digraph using the BFS method. Check whether a given graph is connected or not using the DFS method.
2. Write and implement an algorithm determining articulation points and the bi connected components in the given graph.
3. Developing Best first search and A* Algorithm for real world problems

MODULE - II PROBLEM SOLVING METHODS **10**

Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.

List of Experiments:

1. Implementation of a minmax algorithm for an application.
2. Write a program to solve the 4-Queen problem.
3. Write a program to solve an 8-puzzle problem.
4. Write a program to solve the water jug problem.

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MODULE - III REPRESENTATION OF KNOWLEDGE **10**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

List of Experiments:

1. Implementation of unification and resolution for real world problems.
2. Implementation of uncertain methods for an application.

MODULE - IV PLANNING **10**

Planning- Planning problems, Simple planning agent, Planning languages, Blocks world ,Goal stack planning, Mean Ends Analysis, Non-linear Planning, Conditional planning, Reactive planning, Implementation of block world problem

List of Experiments:

1. Implementation of block world problem
2. Implementation of constraint satisfaction problems

MODULE - V EXPERT SYSTEMS **10**

Overview of an Expert System, Structure of an Expert System; Different Types of Expert Systems – Rule-Based, Model-Based, Case-Based, and Hybrid Expert Systems; Knowledge Acquisition and Validation Techniques, Expert System Shells, Fuzzy Expert Systems.

List of Experiments:

1. Expert System case study
2. Write a program to solve missionaries and Cannibal problems.

MODULE - VI APPLICATIONS **8**

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Robot – Hardware – Perception – Planning – Moving

List of Experiments:

1. Write a program to implement a Library management system.
2. Case Study: AI-Based Smart Campus Assistant Robot

TOTAL : 60 PERIODS

LAB REQUIREMENTS

1. Standalone desktop with SWI Prolog and Python IDE-30 Nos.

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TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach||, Prentice Hall, Third Edition, 2009.
2. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS, 1ST EDN, Paperback – 6 January 2015 ,Author: Patterson

REFERENCES:

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.

WEB REFERENCES:

1. https://books.google.co.in/books?id=uSvYmki2yg0C&printsec=frontcover&dq=Supervised+Learning&hl=en&sa=X&ved=0ahUKEwigkNa1xN3oAhWawjgGHe8hAzoQ6AEIKDAA#v=onepage&q=Supervised%20Learning&f=false

OUTCOMES

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

1. Examine AI problems and build intelligent agents. (K4)
2. Apply appropriate searching techniques to solve a real-world problem.(K3)
3. Apply AI problems and inference knowledge using suitable knowledge representation schemes.(K3)
4. Develop planning and apply learning algorithms on real-world problems.(K5)
5. Design an expert system and implement natural language processing techniques.(K5)
6. Analyze simple expert systems based on rule-based, model-based, and hybrid approaches and explain the use of expert system shells (K4).

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
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CO5	3	2	3	1	3	-	-	-	2	1	-	2	3
CO6	2	3	1	2	1	-	-	-	-	1	-	2	2

SEMESTER - IV

24AITP401 - SDG NO. 4	APTITUDE SKILLS - II	L	T	P	CP	C
		0	0	2	2	0

PROBLEM SOLVING USING JAVA - PHASE 1

OBJECTIVES:

- Develop strong algorithmic problem-solving skills using Java
- Enable students to analyze problems and design efficient solutions
- Familiarize students with coding patterns used in technical interviews and prepare students for competitive programming and placement coding rounds

MODULE - I FOUNDATIONS OF JAVA PROBLEM SOLVING **16**

Competitive programming mindset, Understanding problem statements and constraints, Java input and output handling, Time and space complexity, Asymptotic notations, Loop and recursion analysis, Arrays and strings problem patterns, Prefix sum, Sliding window, Two-pointer techniques.

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MODULE - II SEARCHING, SORTING AND ADVANCED TECHNIQUES 15

Binary search patterns, Search on answer technique, Sorting-based problem solving, Stack and queue applications, Monotonic stack, Simulation problems, Recursion templates, Backtracking framework, Constraint-based problem solving.

MODULE - IIIDYNAMIC PROGRAMMING, GREEDY AND GRAPH BASICS14

Dynamic programming principles, Memorization and tabulation, One-dimensional and two-dimensional DP problems, Greedy strategies, Interval problems, Graph traversal basics – BFS and DFS, Competitive coding strategies.

TOTAL: 45 PERIODS

REFERENCES:

1. Herbert Schildt, Java: The Complete Reference, McGraw Hill.
2. E. Balagurusamy, Programming with Java, McGraw Hill Education

ONLINE RESOURCES

1. LeetCode – https://leetcode.com
2. HackerRank – https://www.hackerrank.com
3. GeeksforGeeks – Java and DSA Track

LIFE SKILLS, RANGER AND ROVER & BIS STANDARDS - PHASE 2

OBJECTIVES:

- Explore core domain BIS standards related to Information security and AI.
- Implement strategies to learn career and managerial skills for career growth.

MODULE - I JEEVAN KAUSHAL 2.0 – CAREER SKILLS AND MANAGERIAL SKILLS 14

Group Discussion Skills - Meaning and Methods of Group Discussion - Procedure of Group Discussion - Group Discussion - Simulation - Group Discussion - Common Errors.

Managerial Skills - Basic Managerial Skills - Planning for effective management - How to organize teams? - Recruiting and retaining talent - Delegation of tasks - Learn to coordinate - Conflict management - Self-management Skills - Understanding self-concept - Developing self-awareness - Self-examination - Self-reflection and Introspection - Self-regulation.

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Meeting No. 67 Dated: 21/4/25

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Entrepreneurial Skills - Basics of Entrepreneurship - Meaning of entrepreneurship – Classification and types of entrepreneurships - Traits and competencies of entrepreneur -. Creating Business Plan - Problem identification and idea generation - Idea validation - Pitch making.

Managing Personal Finance - Budgeting - Setting personal goals - Estimate likely expenses Monitor spending to obtain the most value for the available funds - Saving and Investing - Advantages of saving money - Concept of present and future value of money.

MODULE - II RANGER AND ROVER **10**

Scouting for Boys: Scout Craft, Campaigning.

Knots: Managing of rope, types of ropes and uses, Basic Knots: - Clove Hitch, Reef Knot, Fisherman knot, Sheet bend, Bowline, Sheep shank, whippings.

Growing Together: Understanding the growth context.

Intergenerational Dialogue: How to enhance learning and cooperation across generations.

MODULE - III INFORMATION SECURITY & ARTIFICIAL INTELLIGENCE 6

Information security, network security and privacy protection: Introduction to the standards and concepts related to security [CIA (Confidentiality, Integrity, and Availability)] and privacy.

Software - Quality Assurance, Life Cycle & Testing: Introduction to Software life cycle processes and Software Testing (IS 16124 and IS 11291).

Artificial Intelligence: Introduction to the concepts of Artificial Intelligence and related standards:

- Overview of trustworthiness in artificial intelligence.
- Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML).
- AI system life cycle processes.
- Data life cycle framework.

TOTAL: 30 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

Recommended by
Board of Studies of AI DS dept.
Meeting No. 07 Dated: 21/06/25

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ONLINE RESOURCES

1. https://lms.scout.org/courses/show/214175?force_course_hub=true
2. https://lms.scout.org/courses/show/214194?force_course_hub=true

OUTCOMES

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

1. Interpret problem statements and develop Java programs with appropriate complexity analysis.
2. Apply array, string, searching, sorting, stack, and queue based problem-solving techniques.
3. Design solutions using recursion, backtracking, and dynamic programming approaches.
4. Solve real-time and placement-oriented problems using greedy techniques and graph traversal basics.
5. Demonstrate career and managerial skills. (K2)
6. Understand BIS standards for Information security and AI domain. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	2	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	2	1	3	-	-
CO5	-	-	-	-	-	3	-	-	1	-	2	2	2
CO6	-	-	-	-	-	3	-	-	1	-	2	2	2

SEMESTER - IV

24AIID401 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - II	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To empower students to transform innovative ideas into viable venture blueprints through structured entrepreneurial exploration and opportunity framing.
- To provide experiential learning in adaptive product evolution by focusing on user-centric redesign, iterative testing, and technical refinement.

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- To develop proficiency in assessing market traction, decoding customer behavior, and aligning product strategy with investment-readiness metrics.
- To instill a foundation of ethical entrepreneurship by integrating inclusive design principles, sustainability values, and responsible leadership.
- To enable data-driven innovation by leveraging field research, applying performance analytics, and integrating emerging technologies for solution optimization.
- To facilitate multidisciplinary problem-solving through advanced engineering integration, MVP systemization, and standards-compliant validation.

COURSE METHODOLOGY:

1. This initiative is designed to inculcate ethical principles of research and to get involved in a life-long learning process for the students, focusing on the practical execution and refinement of entrepreneurial ventures.
2. The project work must involve the continuous development, iterative enhancement, and potential launch of an entrepreneurial solution. It must also include appropriate elements of the following: compliance with advanced engineering standards, iterative design analysis, enhanced prototyping, robust experimentation, real-world user feedback collection, data correlation, and advanced software/hardware development for the solution.
3. Projects can be individual work or group projects, with a maximum of Three students. In case of a group project, each student must submit an individual project report clearly specifying their unique contributions to the collective work.
4. On completion of the project, the student shall submit a detailed project report encompassing the evolution of their venture, technical implementation, market validation, and future roadmap. The project shall undergo a formal review process, after which the report will be evaluated. Students shall appear for a mandatory viva-voce examination on the project, approved jointly by the Coordinator and the respective project guide.

EVALUATION:

1. First evaluation (Immediately after first internal examination): 20 marks (Focus on refined problem statement, advanced MVP design, and detailed development plan)

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2. Second evaluation (Immediately after second internal examination): 30 marks (Focus on prototype/MVP implementation, initial testing, and preliminary market validation results)
3. Final evaluation (Last week of the semester): 50 marks (Focus on the complete refined solution, comprehensive market validation, growth strategy, final project report, and viva-voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

1. Apply structured entrepreneurial exploration to convert innovative ideas into venture blueprints, incorporating user-centric and iterative design approaches. (K4)
2. Assess customer behavior and market traction to align product strategies with ethical and sustainable entrepreneurship principles. (K5)
3. Integrate multidisciplinary knowledge, field data, and emerging technologies to optimize and validate engineered solutions. (K6)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	-	-	-	2	2
CO2	3	3	2	-	-	-	-	2	-	-	-	2	2
Co3	3	3	3	-	-	-	-	2	-	-	-	2	2

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SEMESTER V

COURSE CODE: 24AIPC501	IOT AND SENSORS TECHNOLOGIES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105166	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPC401, 24AIPT201					

OBJECTIVES:

- To understand the basic concepts, characteristics, and applications of the Internet of Things (IoT).
- To learn IoT architectures, communication models, and frameworks used in IoT systems.
- To understand IoT communication protocols, networking, and security mechanisms.
- To develop skills in interfacing sensors, actuators, and embedded devices using IoT hardware platforms.
- To learn IoT data collection, cloud integration, edge computing, analytics, and device management.
- To apply IoT technologies in developing smart solutions for real-world applications such as smart homes, healthcare, agriculture, transportation, and industry.

MODULE - I INTRODUCTION TO IOT 7

Introduction to IoT- Characteristics- benefits, Components- Sensors, Actuators, Communication Modules- Enabling Technologies- IoT Design Methodology- M2M Communication- Smart Cities- Smart Homes- Healthcare- RFID, Bluetooth- ZigBee- Wi-Fi and LoRaWAN.

MODULE - II IOT ARCHITECTURES AND MODELS 8

IoT reference Architecture-Functional, Information- Deployment and Operational Views-ETSI- IETF and OGC Architectures- Communication Models- API-based and SOA-based Architectures.

MODULE - III IOT COMMUNICATION PROTOCOLS 8

TCP- UDP- MQTT- HTTP- CoAP- XMPP- WebSocket-SCADA- 6LoWPAN- RPL- IEEE 802.15.4 and Authentication Protocols.

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MODULE - IV IOT PROGRAMMING AND DEVICE INTEGRATION 7

Sensors- Actuators- Arduino- Esp8266- Embedded Programming- Bluetooth- USB- Ethernet And Internet Connectivity.

MODULE - V IOT DATA PROCESSING AND CLOUD INTEGRATION 7

Data Acquisition- Edge/Cloud Computing- IoT Analytics- Dashboards- Device Management- Security and Privacy.

MODULE - VI IOT APPLICATIONS AND CASE STUDIES 8

Smart Home- Agriculture- Healthcare- Industrial IoT- Transportation- Weather Monitoring- Air Quality Monitoring and Traffic Monitoring.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", VPT Publisher, 2015.
2. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
3. Tsiatsis, V., Karnouskos, S., Holler, J., Boyle, D., and Mulligan, C., Internet of Things: Technologies and Applications for a New Age of Intelligence, 2nd Edition, Academic Press (Elsevier), 2018.

REFERENCES:

1. Boswarthick,Omar Elloumi., The Internet of Things: Applications and Protocols, Wiley publications., 2012.
2. Marco Schwatrz Internet of Things with Arduino Cookbook, Packt Publications, 2016.
3. Jean-Philippe Vasseur and Adam Dunkels "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kaufmann Publishers, 2010.
4. Charalampos Doukas, "Building Internet of Things with the Arduino", Create space, April 2002.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc21_cs17/preview.
2. https://onlinecourses.nptel.ac.in/noc21_ee85/preview.

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ONLINE RESOURCES

1. https://www.digimat.in/nptel/courses/video/106105166/L01.html.
2. https://www.digimat.in/nptel/courses/video/106105166/L02.html.

OUTCOMES

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

1. Apply fundamental concepts of the Internet of Things (IoT), including components, enabling technologies, communication modules, and design methodologies to develop connected systems. (K3)
2. Analyse IoT architectures, functional models, deployment views, operational frameworks, and service-oriented architectures for designing scalable IoT solutions. (K4)
3. Apply IoT communication protocols, networking standards, and authentication mechanisms to enable reliable and secure communication among connected devices. (K3)
4. Utilize embedded programming techniques to interface sensors, actuators, Arduino, ESP8266, and communication modules for IoT application development. (K3)
5. Infer IoT data acquisition, edge and cloud computing platforms, analytics, device management, security, and privacy mechanisms for efficient IoT deployments. (K4)
6. Examine the implementation of IoT-based smart applications in healthcare, agriculture, transportation, industrial automation, environmental monitoring, and smart home systems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2	2
CO4	2	2	3	-	-	-	-	-	-	-	-	2	2
CO5	2	3	2	-	-	-	-	-	-	-	-	2	2
CO6	2	2	3	-	-	-	-	-	-	-	-	2	2

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SEMESTER V

COURSE CODE: 24AIPC502	BIG DATA ANALYTICS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106104189	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AMPT301, 24AIPC402					

OBJECTIVES:

- To learn big data and Hadoop platform.
- To provide an overview of NoSQL databases.
- To understand HDFS concepts and interfacing with HDFS.
- To examine data processing operators and compare with traditional databases.

MODULE - I INTRODUCTION TO BIG DATA AND HADOOP 7

Introduction to Big Data and Characteristics - Types of Analytics: Descriptive, Diagnostic, Predictive and Prescriptive - Structured vs Unstructured Data - Big Data Applications and Industry Examples - Overview of Big Data Technologies - Cloud and Big Data - Mobile Business Intelligence - Crowd Sourcing Analytics- Hadoop ecosystem-Hadoop streaming- IBM Big Data Strategy and applications.

MODULE - II NOSQL DATABASES AND DATA MANAGEMENT 8

No SQL databases: Mongo DB: Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export. Cassandra: Introduction – Features – Data types – CQLSH – Key spaces – CRUD operations – Collections – Counter – TTL – Alter commands – Import and Export – Querying System tables.

MODULE - III BIG DATA STORAGE AND DISTRIBUTED PROCESSING 8

HDFS Architecture and Data Storage – Hadoop I/O Operations – Compression Techniques – Serialization and Avro – MapReduce Programming Model and Execution – YARN Components and Resource Management – YARN Scheduling Algorithms.

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MODULE - IV HADOOP ECOSYSTEM TECHNOLOGIES 7

Apache Pig and Pig Architecture – Pig Latin Data Flow Language – User-Defined Functions (UDFs) – Hive Architecture and Components – Hive Data Model – HiveQL Queries and Operations – Big SQL Concepts and Applications.

MODULE - V DATA VISUALIZATION AND BIG DATA ANALYTICS 7

Visualization Frameworks – Data Visualization Principles – Charts and Graphs – Dashboard Creation and Reporting – Visual Analytics Techniques – Decision Support for Business Intelligence.

MODULE - VI BIG DATA APPLICATIONS AND CASE STUDIES 8

Application Evolution- Big Data Analysis Fields - Structured Data Analysis- Text Data Analysis- Web Data Analysis- Multimedia Data Analysis- Network Data Analysis- Mobile Traffic Analysis- Key Applications - Application of Big Data in Enterprises- Application of IoT Based Big Data- Application of Online Social Network-Oriented Big Data- Applications of Healthcare and Medical Big Data- Collective Intelligence- Smart Grid

TOTAL : 45 PERIODS

TEXT BOOK:

1. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley Publication, 2015.
2. Arshdeep Bahga, Vijay Madisetti, Big Data Science & Analytics, VPT Publisher, 2016.
3. David Loshin, Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, Morgan Kaufmann/Elsevier Publishers, 2013.
4. Tom White, Hadoop: The Definitive Guide, O'Reilly, 4th Edition, 2015.
5. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014.

REFERENCES:

1. Provost, F., and Fawcett, T., Data Science for Business, 2nd Edition,O'Reilly Media, 2023. ISBN: 9781098114633.
2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
4. Data Science and Big Data Analytics, EMC2 Education Services, 2013.

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WEB REFERENCES:

1. NPTEL – Big Data Analytics
2. NPTEL Archive – Big Data Analytics

ONLINE RESOURCES:

1. https://hadoop.apache.org/docs/
2. https://spark.apache.org/docs/latest/
3. https://www.coursera.org/specializations/big-data

OUTCOMES

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

1. Apply the concepts, characteristics, and ecosystem components of Big Data and Hadoop. (K3)
2. Apply NoSQL database concepts using MongoDB and Cassandra for large-scale data management. (K3)
3. Analyze HDFS, MapReduce, and YARN frameworks for distributed data storage and processing. (K4)
4. Utilize Hadoop ecosystem tools such as Pig and Hive for big data analysis.(K3)
5. Develop effective data visualization solutions for interpreting large datasets.(K3)
6. Examine real-world Big Data applications and implement analytics solutions using modern big data technologies. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	3	-	-	-	-	-	-	2	2
CO3	2	3	-	-	-	-	-	-	-	-	-	2	2
CO4	2	3	-	-	3	-	-	-	-	-	-	2	2
CO5	3	2	-	-	3	-	-	-	-	-	-	2	2
CO6	2	2	-	-	-	-	-	-	-	-	-	3	3

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SEMESTER V

COURSE CODE: 24AIPW501	NATURAL LANGUAGE PROCESING WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4
NPTEL CODE: 106105158	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA303, 24AMPC302, 24AIPT401					

OBJECTIVES:

- To introduce the fundamental concepts and levels of Natural Language Processing.
- To understand text preprocessing techniques and feature extraction methods used in NLP.
- To learn language modelling and syntactic parsing techniques for natural language understanding.
- To study semantic analysis and discourse processing methods.
- To explore machine translation approaches including statistical and neural methods.
- To apply deep learning models for real-world NLP applications such as chatbots, sentiment analysis, and text summarization.

MODULE - I INTRODUCTION TO NLP 7

Introduction to Natural Language Processing-Applications of NLP- Levels of NLP-NLP Libraries- Stages in NLP-Challenges of NLP- Regular Expressions-Morphological Analysis-Tokenization-Stemming-Lemmatization- Feature extraction: Term Frequency (TF)- Inverse Document Frequency (IDF)-Modeling using TF-IDF- Parts of Speech Tagging-Named Entity Recognition.

MODULE - II LANGUAGE MODELLING 6

Language Modelling: Unigram Language Model - Bigram – Trigram - N-gram - Advanced smoothing Models - Empirical Comparison of Smoothing Techniques - Applications of Language Modelling.

MODULE - III SYNTAX ANALYSIS 8

Context Free Grammars- Grammar Rules for English- Top-Down Parsing-Bottom-Up Parsing-Ambiguity- CKY Parsing- Dependency Parsing- Earley Parsing - Probabilistic Context-Free Grammars.

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MODULE - IV SEMANTIC AND DISCOURSE ANALYSIS 8

Representing Meaning- Lexical Semantics- Word Senses, Relation between Senses- Word Sense Disambiguation- Word Embeddings,- Word2Vec- CBOW-Skip-gram and GloVe-Discourse Segmentation- Text Coherence- Discourse Structure- Reference Resolution- Pronominal Anaphora Resolution-Coreference Resolution.

MODULE - V MACHINE TRANSLATION 7

Need of MT - Problems of Machine Translation - MT Approaches – Direct Machine Translation - Rule-Based Machine Translation – Knowledge-Based MT System - Statistical Machine Translation (SMT) - Parameter learning in SMT (IBM models) using EM) - Encoder-decoder architecture – Neural Machine Translation.

MODULE - VI DEEP LEARNING LANGUAGE MODELS and NLP APPLICATIONS 9

Deep Learning Language Models: Recurrent Neural Networks (RNN)-Long Short-Term Memory (LSTM)- Attention Mechanism- Transformer Based Models- Self-attention-Multi-Headed Attention- BERT- RoBERTa. Applications: Introduction to Chatbot Applications-Information Retrieval-Question Answering system-Text Categorization- Text Summarization-Sentiment Analysis-Named Entity Recognition-Spam Filter- Speech Recognition.

LIST OF EXPERIMENTS 15

1. Develop a Python program using the NLTK library to perform text preprocessing on a given text corpus by carrying out sentence tokenization, word tokenization, stop word removal, stemming, and lemmatization.
2. Develop a Python program to calculate Term Frequency–Inverse Document Frequency (TF-IDF) values for a given set of documents.
3. Develop a Python program to extract and display all unigrams, bigrams, and trigrams from a given text corpus.
4. Develop a Python program to implement CYK Parsing (Cocke–Younger–Kasami Parsing) or Chart Parsing for sentence analysis.
5. Develop a Python program to train CBOW and Skip-gram Word2Vec models on a text corpus. Analyze semantic word relationships by identifying similar words and visualizing word embeddings.

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6. Develop a Python program to perform language translation using a Statistical Machine Translation (SMT) approach and analyze the translated output.
7. Develop a Python-based language translation system to translate text from one language to another using any NLP library.
8. Develop a Python program to build a next-word prediction model using a given text corpus.
9. Develop a Python program to design and implement a spam filtering system using NLP techniques.
10. Develop a Python program to design and implement a chatbot using Natural Language Processing techniques.

TOTAL : 60 PERIODS

LABORATORY REQUIREMENTS:

Standalone desktop with Python 3.10 or above, Jupyter Notebook, NLTK, spaCy, Gensim, Scikit-learn, TensorFlow/PyTorch, NumPy, and Pandas-30 Nos

TEXT BOOK:

1. Jurafsky, D., & Martin, J. H.Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd Edition (Draft Version), Pearson/Prentice Hall, 2025.A
2. Manning, C. D., & Schütze, H.Foundations of Statistical Natural Language Processing, 1st Edition, MIT Press, 1999. ISBN: 9780262133609.
3. Allen, J.Natural Language Understanding, 2nd Edition, Benjamin/ Cummings Publishing Company, 1995. ISBN: 9780805303346.

REFERENCES:

1. McTear, M., Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots, 1st Edition, Morgan & Claypool Publishers, 2020. ISBN: 9781681738413.
2. Bird, S., Klein, E., and Loper, E., Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit, 1st Edition, O'Reilly Media, 2009. ISBN: 9780596516499.
3. Tunstall, L., von Werra, L., and Wolf, T., Natural Language Processing with Transformers: Building Language Applications with Hugging Face, 1st Edition, O'Reilly Media, 2022. ISBN: 9781098103248.
4. Jurafsky, D., and Martin, J. H., Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, 3rd Edition (Draft), 2025.

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WEB REFERENCES:

1. https://nptel.ac.in/courses/106106211
2. https://nptel.ac.in/courses/106105158

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3739/natural-language processing-with-deep-learning
1. https://freevideolectures.com/course/4050/nptel-applied-natural language-processing
3. https://freevideolectures.com/course/2272/arti_icial-intelligence/39

OUTCOMES

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

1. Apply text preprocessing techniques such as tokenization, stemming, and lemmatization for NLP tasks. (K3)
2. Implement language modelling techniques including N-gram models and smoothing methods. (K3)
3. Analyse syntactic parsing techniques using context-free grammars and parsing algorithms. (K4)
4. Implement embedding models to identify semantic relationships and perform word sense disambiguation for given words and contexts. (K3)
5. Compare machine translation approaches including rule-based, statistical, and neural methods. (K4)
6. Analyse deep learning models such as RNN, LSTM, and Transformer for NLP applications. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	2	3
CO2	3	-	-	-	3	-	-	-	-	-	-	3	3
CO3	2	3	-	-	3	-	-	-	-	-	-	2	3
CO4	3	-	-	-	3	-	-	-	-	-	-	2	2
CO5	2	3	-	-	3	-	-	-	-	-	-	2	2
CO6	2	3	-	-	3	-	-	-	-	-	-	3	2

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SEMESTER V

COURSE CODE: 24MGMC501	CONSTITUTION OF INDIA	L	T	P	CP	C
		2	0	0	2	0
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To know about Indian constitution.
- To know about central government functionalities in India.
- To know about state government functionalities in India.
- To know about Constitution function.
- To Know about Constitutional remedies

MODULE - I INTRODUCTION 5

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties.

MODULE - II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 5

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

MODULE - III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 5

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

MODULE - IV CONSTITUTION FUNCTIONS 5

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

MODULE - V CONSTITUTIONAL REMEDIES 5

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces.

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MODULE - VI CONSTITUTIONAL GOVERNANCE IN THE DIGITAL ERA AND CONTEMPORARY ISSUES 5

Constitutional Values and Good Governance – Right to Information (RTI) and Citizen Participation – Digital Governance and e-Governance Initiatives in India – Constitutional Perspectives on Artificial Intelligence (AI) and Emerging Technologies.

TOTAL : 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, Introduction to the Constitution of India, 27th Edition (2024), LexisNexis Butterworths Wadhwa.
2. M. V. Pylee, An Introduction to the Constitution of India, Latest Revised Edition (2024), Vikas Publishing House.
3. P. M. Bakshi, The Constitution of India, 18th Edition (2025), Universal LexisNexis
4. Brij Kishore Sharma, Introduction to the Constitution of India, 15th Edition (2024), PHI Learning

REFERENCE BOOKS:

1. D. D. Basu, Shorter Constitution of India, Latest Revised Edition, LexisNexis
2. Subhash C. Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, Latest Edition, National Book Trust
3. M. Laxmikanth, Indian Polity, 7th Edition (2025), McGraw Hill Education
4. J. N. Pandey, Constitutional Law of India, Latest Edition (2024), Central Law Agency.
5. V. N. Shukla, Constitution of India, Revised by Mahendra Pal Singh, 14th Edition / Latest Available Edition, Eastern Book Company

ONLINE REFERENCES

1. https://iasexamportal.com/ebook/the-constitution-of-india
2. https://eclass.cc/courses/udemy_basics_of_indian_constitution_a_refresher_course
3. https://ox.libguides.com/c.php?g=422964&p=2888489
4. https://mylaw.net/litigation/constitutional-law-course
5. www.tutorialspoint.com/indian_polity/indian_polity_sources_consitution.htm
6. www.drishtiias.com/gs-special/gs-special-polity/important-sources-of-the-indian-constitution

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7. www.india.gov.in/my-government/constitution-india/constitution-india-full-text
8. http://legislative.gov.in/constitution-of-india

MOOC REFERENCES

1. https://www.mooc-list.com/tags/law
2. https://www.udemy.com/course/polity-and-constitution/
3. https://swayam.gov.in/nd2_cec19_hs13/preview
4. https://www.udemy.com/course/basics-of-indian-constitution-a-refresher-course/

OUTCOMES:

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

1. Explain the historical evolution, philosophy and fundamental principles of the Constitution of India. (K2)
2. Describe the structure, powers and functions of the Union Government under the Constitution. (K2)
3. Interpret the structure and functioning of State Governments and the judicial system in India. (K2)
4. Analyze federal relations, constitutional amendments and constitutional functionaries. (K4)
5. Examine constitutional remedies and mechanisms for protection of fundamental rights. (K4)
6. Apply constitutional values and principles to contemporary governance, digital rights, AI ethics and emerging societal challenges. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	-	-	-	2	1	2	-	-	-	2	2
CO2	-	2	-	-	-	2	2	2	-	-	-	2	2
CO3	-	2	-	-	-	2	2	2	-	-	-	2	2
CO4	-	2	1	-	-	2	2	2	-	-	-	2	2
CO5	-	2	1	-	-	2	2	2	-	-	-	2	2
CO6	-	2	1	-	-	2	2	2	-	-	-	2	2

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SEMESTER V

COURSE CODE: 24AIPL501	IOT AND SENSORS TECHNOLOGIES LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24AIPT201,24AIPC401					

OBJECTIVES:

- To develop practical skills in interfacing sensors, actuators, and peripheral devices with Arduino and Raspberry Pi for real-time data acquisition and control.
- To design and implement embedded and IoT-based applications such as environmental monitoring, home automation, traffic control, health monitoring, and motion detection using Arduino and Raspberry Pi.
- To analyze, test, and troubleshoot embedded hardware and software systems for developing reliable and efficient smart solutions to real-world engineering problems.

LIST OF EXPERIMENTS:

1. Interface an LED and DHT11 Temperature and Humidity Sensor using Arduino and display sensor readings.
2. Interface Ultrasonic and PIR Sensors using Arduino for distance measurement and motion detection applications.
3. Design and implement a Traffic Light Simulator using Arduino.
4. Develop a Water Flow Detection System using an Arduino board and a water flow sensor.
5. Interface an LED and Push Button with Raspberry Pi and control them using Python programming.
6. Design and implement a Motion Sensor Alarm System using a PIR Sensor and Raspberry Pi.
7. Interface a DHT11 Temperature and Humidity Sensor with Raspberry Pi and monitor environmental parameters.
8. Interface a DS18B20 Temperature Sensor with Raspberry Pi and display temperature readings.
9. Implement DC Motor and Stepper Motor Control using Raspberry Pi.
10. Develop a Smartphone-Controlled Home Automation System using Raspberry Pi.

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11. Design and implement a Smart Traffic Light Controller using IoT technologies.
12. Develop a Smart Health Monitoring System for real-time monitoring of physiological parameters.

TOTAL : 30 PERIODS

LAB REQUIREMENTS :

HARDWARE:

1. Arduino basic kit or Raspberry Pi starter kit

SOFTWARE:

1. Raspbian OS
2. Arduino IDE
3. Cloud Apps: AWS

OUTCOMES:

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

1. Apply Arduino and Raspberry Pi programming to interface sensors, actuators, and peripheral devices for IoT applications. (K3)
2. Develop IoT-based monitoring and automation systems using embedded hardware, communication modules, and control mechanisms. (K3)
3. Analyze real-world IoT solutions for smart home, healthcare, environmental monitoring, and traffic management applications. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	3
CO2	3	3	3	2	3	-	-	-	-	-	-	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-	2	2

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SEMESTER V

COURSE CODE: 24AITP501	SKILL ENHANCEMENT	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Educate and enrich students on quantitative ability, reasoning ability, and verbal ability.
- Build a strong foundation for solving recruitment-based problems with speed and accuracy.
- Enhance creative thinking skills.
- Enhance logical problem-solving skills.

MODULE - I QUANTITATIVE ABILITY 22

Number Properties, Speed Math, HCF and LCM, Percentages, Time and Work, Time Speed and Distance, Ratio Proportion and Variations, Averages Mixtures and Alligation

MODULE - II QUANTITATIVE ABILITY REASONING ABILITY 16

Profit and Loss, Simple Interest and Compound Interest, Blood Relation, Directions, Coding and Decoding, Series, Ranking and Arrangements

MODULE - III VERBAL ABILITY 7

Subject-Verb Agreement, Tenses, Prepositions - Concepts, Error Spotting, Sentence Correction, Fill in the Blanks

TOTAL : 45 PERIODS

REFERENCES

1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal
2. A Modern Approach to Logical Reasoning – R.S. Aggarwal
3. High School English Grammar & Composition – Wren & Martin
4. Word Power Made Easy – Norman Lewis.
5. Fast Track Objective Arithmetic – Rajesh Verma

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BIS STANDARDS, RANGER AND ROVER, LIFE SKILLS – PHASE 2

OBJECTIVES

To enable students to,

- Familiarize the team and leadership skills.
- Understand the standards relevant to ECE.

MODULE - I JEEVAN KAUSHAL 2.0 - COGNITIVE SKILLS, INNOVATIVE LEADERSHIP AND DESIGN THINKING, ETHICS AND INTEGRITY 14

Cognitive and Non-cognitive Skills - Cognitive Skills: Meaning, Types of Cognitive Skills, Strategies to Develop Cognitive Skills- Critical Thinking Skills- Problem-solving skills - Ability to Learn, Non-cognitive Skills: Meaning and Types of Non-cognitive Skills, Strategies to Develop Non-cognitive Skills- Empathy- Creativity- Teamwork- Collaboration- Resilience - Interpersonal Skills- Perseverance- Social Control- Social Skill, Peer Pressure – Stress and Stress Management.

Innovative Leadership and Design Thinking- Concept of emotional and social intelligence, Concept of emotional and social intelligence, Innovative Leadership- Synthesis of human and artificial intelligence, Why does culture matter for today's global leaders? Design Thinking- What is design thinking?, Key elements of design thinking, How to transform challenges into opportunities?, How to develop human-centric solutions for creating social good?

Ethics and Integrity - Learning through Biographies - What makes an individual great?, Understanding the persona of a leader for deriving holistic inspiration, Drawing insights for leadership, How leaders sail through difficult situations? Ethics and Conduct - Importance of ethics, Ethical decision making, Personal and professional moral codes of conduct, creating a harmonious life

MODULE - II RANGER AND ROVER 10

Scouting for Boys: Camp Life, Trekking Wood Craft.

Community Service: Meaning, Types of Community Service & duration, difference between Community Service and Community Development.

WOSM / WAGGGS / Govt. of India Initiatives (One Event At least) - Surf Smart, Free Being Me, Messengers of Peace, Scouts of the World Award

Messengers of Peace and Scouts

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MODULE - III INTERNET OF THINGS AND ENVIRONMENTAL TESTING OF ELECTRONIC EQUIPMENT PROCEDURES 6

Internet of Things: Brainstorming about the standards pertaining to IoT & Digital Twins, including maritime and underwater IoT i.e; IS/ISO/IEC TR 22417:2017, IS/ISO/IEC 21823 series.

Environmental Testing of Electronics Equipment: Introduction to Standards pertaining to Environmental Test Procedures i.e. IS/IEC 60068 series, IS 9000, IS 9001 and IS 9002 series that are used extensively in the testing of all electronics products.

TOTAL :30 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

ONLINE RESOURCES

1. https://lms.scout.org/courses/show/214209?force_course_hub=true
2. https://free-being-me.com/wp-content/media/ABC_OLDER-2.pdf
3. https://www.wagggs.org/en/what-we-do/surf-smart-20/surf-smart-get-involved/

OUTCOMES

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

1. Demonstrate improved quantitative aptitude for solving numerical problems. [K2]
2. Apply logical reasoning to tackle reasoning-based challenges. [K2]
3. Enhance verbal communication and comprehension skills through grammar and language exercises. [K2]
4. Use ethical principles, emotional intelligence, and leadership insights from biographies to practice responsible decision-making and professional conduct. (K3)
5. Illustrate the objectives and practices of WOSM/WAGGGS and Government of India initiatives such as Messengers of Peace, Surf Smart, and Scouts of the World Award. (K3)
6. Apply the concepts of IoT, Digital Twins, and related standards in identifying applications of connected systems in modern technologies. (K3)

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CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	2	-	-
CO2	2	2	2	2	1	-	-	-	1	-	2	-	-
CO3	2	2	2	2	-	-	-	-	1	-	2	-	-
CO4	-	-	-	-	-	2	-	3	3	3	-	2	2
CO5	-	-	-	-	-	3	2	2	2	2	1	2	2
CO6	3	2	2	-	3	1	-	-	-	-	-	2	2

SEMESTER V

COURSE CODE: 24AIID501	PROTOTYPE DEVELOPMENT LAB- I	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESID101, 24ESID201, 24AIID301, 24AIID401					

OBJECTIVES:

- To enable students to transform innovative ideas into feasible prototype solutions through structured problem identification, design thinking, and concept development.
- To provide experiential learning in prototype design and development by focusing on user-centric requirements, iterative design, and technical validation.
- To develop proficiency in problem analysis, feasibility assessment, requirement engineering, and prototype implementation.
- To instill a foundation of innovation and entrepreneurship by integrating ethical design principles, sustainability values, and responsible technology development.
- To enable data-driven solution development through literature survey, user feedback analysis, and technology exploration.
- To facilitate multidisciplinary problem-solving through engineering design, prototype realization, testing, validation, and technical communication.

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COURSE METHODOLOGY

- This course is designed to develop innovation-oriented thinking and practical problem-solving abilities through prototype development activities focusing on real-world challenges.
- The project work shall involve the identification of a problem, requirement analysis, feasibility study, solution design, prototype development, testing, validation, and documentation. Students shall apply design thinking principles throughout the development cycle.
- Projects may be carried out individually or in groups with a maximum of three students. In the case of group projects, each student shall submit an individual project contribution report clearly specifying their role and responsibilities.
- Students shall maintain a detailed project portfolio containing problem statements, literature survey findings, design documents, prototype iterations, testing results, and validation reports.
- Periodic reviews shall be conducted to assess progress in prototype development, implementation, testing, and refinement. Students shall demonstrate prototype functionality during review evaluations.
- At the end of the semester, students shall submit a comprehensive project report and present a working prototype for evaluation by the course coordinator and project review committee.

EVALUATION

1. First Evaluation (Immediately after first internal examination): 20 Marks
   (Problem Identification and Validation, Literature Survey, Requirement Analysis, Initial Design Proposal)
2. Second Evaluation (Immediately after second internal examination): 30 Marks
   (Prototype Design Completion, Prototype Development Progress, Initial Testing and Validation Results)
3. Final Evaluation (Last week of the semester): 50 Marks
   (Functional Prototype Demonstration, Innovation and Creativity, Technical Implementation, Project Report, Viva-Voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL : 30 PERIODS

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OUTCOMES:

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

1. Analyze real-world problems, user requirements, and design constraints to formulate innovative prototype solutions using design thinking methodologies. (K4)
2. Evaluate alternative technologies, development approaches, and feasibility aspects for prototype design and implementation. (K5)
3. Create functional prototypes by integrating appropriate tools, technologies, and engineering principles to address identified problems. (K6)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	2	3
CO2	3	3	3	--	3	-	-	-	-	-	-	2	3
CO3	3	3	3	-	3	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL507	AI PLANNING AND SEARCH ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106226	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA201, 24AIPT401, 24BSMA303, 24AIPT201					

OBJECTIVES:

- To introduce the historical foundations, philosophical perspectives, and computational principles of Artificial Intelligence.
- To enable students to understand and apply uninformed, heuristic, and optimal search algorithms for problem-solving in AI.
- To familiarize learners with population-based optimization techniques such as Genetic Algorithms and Ant Colony Optimization for solving complex search problems.
- To develop knowledge in game playing strategies, automated planning, and problem decomposition techniques used in intelligent systems.
- To provide a strong foundation in logical reasoning, expert systems, and knowledge representation techniques.
- To expose students to constraint processing methods and intelligent problem-solving applications in real-world AI systems.

MODULE - I FOUNDATIONS OF ARTIFICIAL INTELLIGENCE AND UNINFORMED SEARCH 8

Introduction to Artificial Intelligence - History of AI - Turing Test - Winograd Schema Challenge - Language and Thought - Wheels & Gears. Philosophical Foundations - Philosophy of Mind - Reasoning - Computation - Dartmouth Conference - The Chess Saga - Epiphenomena. State Space Search Techniques - Depth First Search (DFS) - Breadth First Search (BFS) - Depth First Iterative Deepening (DFID).

MODULE - II HEURISTIC AND POPULATION-BASED SEARCH TECHNIQUES 8

Heuristic Search Methods - Best First Search - Hill Climbing - Solution Space - Travelling Salesman Problem (TSP) - Escaping Local Optima - Stochastic Local Search. Population-Based Optimization Techniques - Genetic Algorithms - SAT Problems - Emergent Systems - Ant Colony Optimization (ACO).

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MODULE - III OPTIMAL PATH FINDING AND ADVANCED SEARCH STRATEGIES 8

Optimal Search Techniques - Branch and Bound - A* Algorithm - Admissibility of A* - Informed Heuristic Functions. Space Saving Variants of A* - Weighted A* - Iterative Deepening A* (IDA*) - Recursive Best First Search (RBFS) - Monotone Condition - Sequence Alignment - Beam Stack Search.

MODULE - IV GAME PLAYING AND AUTOMATED PLANNING 7

Game Playing Strategies - Game Theory - Board Games and Game Trees - Minimax Algorithm - Alpha-Beta Pruning - SSS* Algorithm. Automated Planning - Domain Independent Planning - Blocks World - Forward and Backward Search - Goal Stack Planning - Plan Space Planning.

MODULE - V PROBLEM DECOMPOSITION, LOGIC AND EXPERT SYSTEMS 7

Problem Decomposition Techniques - Means Ends Analysis - Graphplan Algorithm - AO* Algorithms. Rule-Based Expert Systems - Production Systems - Inference Engine - Match-Resolve-Execute Cycle - Rete Network. Deduction as Search - Logic - Soundness - Completeness - First Order Logic - Forward Chaining - Backward Chaining.

MODULE - VI CONSTRAINT PROCESSING AND INTELLIGENT SYSTEMS 7

Constraint Processing - Constraint Satisfaction Problems (CSPs) - Consistency-Based Diagnosis - Backtracking Algorithm - Arc Consistency - Forward Checking Algorithm. Introduction to Intelligent Systems and Knowledge-Based Problem Solving Applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021.
2. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, 3rd Edition, McGraw Hill Education, 2017.
3. Deepak Khemani, Artificial Intelligence, McGraw Hill Education (India), 2013.
4. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th Edition, Pearson Education, 2009.

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REFERENCES:

1. Nils J. Nilsson, Principles of Artificial Intelligence, Morgan Kaufmann Publishers, 2014.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education, 2015.
3. Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Pearson Education, 2011.
4. Judea Pearl, Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 2014.
5. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2017.
6. Michael Wooldridge, An Introduction to MultiAgent Systems, 2nd Edition, Wiley, 2009.

ONLINE RESOURCES:

1. NPTEL – Artificial Intelligence - https://onlinecourses.nptel.ac.in
2. SWAYAM – Artificial Intelligence Search Methods for Problem Solving https://swayam.gov.in
3. IIT Madras Online Degree – AI and Machine Learning Courses https://onlinedegree.iitm.ac.in

WEB REFERENCES:

1. Stanford Encyclopedia of Philosophy – Artificial Intelligence - https://plato.stanford.edu
2. Google Developers – Machine Learning Crash Course - https://developers.google.com/machine-learning
3. Scikit-Learn Documentation -https://scikit-learn.org
4. Towards Data Science – AI and Search Algorithms Articles - https://towardsdatascience.com
5. Khan Academy – Probability and Statistics - https://www.khanacademy.org/math/statistics-probability
6. GeeksforGeeks – Artificial Intelligence Tutorials https://www.geeksforgeeks.org/artificial-intelligence/
7. MIT OpenCourseWare – Artificial Intelligence - https://ocw.mit.edu
8. Coursera – Machine Learning and AI Courses -https://www.coursera.org

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OUTCOMES:

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

1. Apply state-space representation and uninformed search algorithms to solve Artificial Intelligence problems. (K3)
2. Analyze population-based optimization techniques including Genetic Algorithms and Ant Colony Optimization for combinatorial problem solving. (K4)
3. Demonstrate heuristic and optimal search strategies for intelligent path-finding and decision-making applications. (K3)
4. Develop game playing and automated planning solutions using adversarial and goal-oriented AI algorithms. (K3)
5. Evaluate logical inference methods, knowledge representation models, and expert system frameworks for intelligent reasoning. (K4)
6. Implement constraint processing and intelligent system solutions for real-world Artificial Intelligence applications. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	2	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	3	3
CO6	3	-	-	-	-	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL508	COMPUTABILITY AND COMPLEXITY THEORY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106104357	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA201, 24AMPC302, 24BSMA303, 24ESCS101					

OBJECTIVES:

- To introduce fundamental computational complexity classes and NP-completeness theory.
- To analyze space complexity, hierarchy theorems, and completeness notions.
- To understand advanced complexity classes such as PSPACE and Polynomial Hierarchy.
- To study randomized computation and circuit complexity.
- To explore counting complexity and communication complexity.
- To examine interactive proof systems and modern developments in computational complexity.

MODULE - I FOUNDATIONS OF COMPUTATIONAL COMPLEXITY 8

Introduction to computational complexity- Polynomial time reductions- Complexity classes P and NP- NP-hard and NP-complete problems- Review of NP-completeness- Cook-Levin Theorem- P versus NP problem- Basic NP-complete problems.

MODULE - II HIERARCHIES AND SPACE COMPLEXITY 7

Basics of probability- Conditional probability and independence- Bayes' theorem- Random variables (discrete & continuous)- Probability distributions: Binomial, Poisson, Normal.

MODULE - III PSPACE AND RELATIVIZATION 8

PSPACE and PSPACE-completeness- Space Hierarchy Theorem- Ladner's Theorem- Oracle Machines- Relativization-Baker-Gill-Solovay Theorem- Limitations of relativizing techniques.

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MODULE - IV RANDOMIZED AND CIRCUIT COMPLEXITY 8

Randomized Complexity Classes- RP- co-RP- ZPP- BPP- Relationship between BPP and Polynomial Hierarchy- Circuit Complexity- Circuit Hierarchy Theorem- P/poly Complexity Class- NC and AC Classes-Karp-Lipton Theorem.

MODULE - V COUNTING COMPLEXITY AND PARALLEL COMPUTATION 7

Parity Function and AC^0 Lower Bounds- Adleman's Theorem-Polynomial Identity Testing- Perfect Matching in RNC^2- Bipartite Perfect Matching in RNC- Isolation Lemma- Valiant-Vazirani Theorem- #P and #P-completeness- Permanent and its Complexity.

MODULE - VI ADVANCED COMPLEXITY TOPICS 7

Toda's Theorem- Communication Complexity- Lower Bound Techniques- Monotone Depth Lower Bounds for Matching- Interactive Proof Systems- IP Class, #3-SAT in IP- Private Coin and Public Coin Interactive Proofs- Course Summary and Emerging Research Directions.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Arora, S., & Barak, B. Computational Complexity: A Modern Approach. 1st ed., Cambridge University Press, 2009.
2. Papadimitriou, C. H. Computational Complexity. 1st ed., Addison-Wesley, 1994.
3. Goldreich, O. Computational Complexity: A Conceptual Perspective. 1st ed., Cambridge University Press, 2008.

REFERENCES:

1. Sipser, M. Introduction to the Theory of Computation. 3rd ed., Cengage Learning, 2012.
2. Wegener, I. Complexity Theory: Exploring the Limits of Efficient Algorithms. 1st ed., Springer, 2005.
3. Hromkovic, J. Theoretical Computer Science: Introduction to Automata, Computability, Complexity, Algorithmics, Randomization, Communication and Cryptography. 2nd ed., Springer, 2010.

WEB REFERENCES:

1. .https://theory.cs.princeton.edu/complexity/book.pdf
2. https://ocw.mit.edu/
3. https://cs278.org/

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ONLINE RESOURCES:

1. NPTEL – Theory of Computation and Computational Complexity Courses
2. MIT Open Course Ware – Computational Complexity
3. Stanford Complexity Theory Resources
4. Complexity Zoo
5. Electronic Colloquium on Computational Complexity (ECCC)

OUTCOMES:

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

1. Apply polynomial-time reductions and classify computational problems into complexity classes such as P, NP, and NP-complete. (K3)
2. Apply hierarchy theorems and space complexity concepts to analyze computational resources required for problem solving. (K3)
3. Infer PSPACE-complete problems, oracle constructions, and relativization techniques in computational complexity theory. (K4)
4. Compare randomized algorithms and circuit complexity models for evaluating computational efficiency and limitations. (K4)
5. Utilize counting complexity concepts and parallel computation techniques to solve advanced computational problems. (K3)
6. Examine interactive proof systems, communication complexity models, and advanced complexity-theoretic results. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2	2
CO6	2	3	-	-	-	-	-	-	-	-	-	-	-

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL512	RESPONSIBLE AI	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106472	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24BSMA201, 24AIPT401, 24BSMA303, 24AIPT201					

OBJECTIVES:

- To understand the principles of Responsible and Safe AI systems.
- To identify risks, biases, and security threats in AI applications.
- To learn techniques for fairness, privacy, transparency, and explainability.
- To study AI safety, governance, regulations, and ethical practices.
- To explore the deployment of trustworthy AI systems in real-world domains.

MODULE - I FUNDAMENTALS OF RESPONSIBLE AI 8

Introduction to AI and recent advancements – Deep Learning, Language and Vision Models – Principles of Responsible AI: Transparency, Accountability, Fairness, Privacy, Safety, Reliability, and Human-Centered AI – Trustworthy AI Systems.

MODULE - II AI RISKS AND SAFETY CHALLENGES 8

Bias and Toxicity in AI Systems – Goal Mis-specification – Adversarial Examples – Risks in Generative AI – Long-term Risks: Misuse, Misgeneralization, and AGI Concerns – AI Safety Fundamentals.

MODULE - III ADVERSARIAL MACHINE LEARNING AND INTERPRETABILITY 7

Adversarial Attacks in Vision and NLP – Data Poisoning and Trojan Attacks – Explainable AI (XAI) – Transparency Techniques – Mechanistic Interpretability – Model Analysis and Probing.

MODULE - IV FAIRNESS, PRIVACY AND ROBUSTNESS 7

Fairness and Bias Mitigation – Privacy-Preserving AI – Security and Robustness in AI Systems – Explainability Tools (LIME, SHAP, Grad-CAM) – AI Auditing and Evaluation Metrics.

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MODULE - V AI GOVERNANCE AND REGULATIONS 7

AI Ethics and Governance – DPDP Act (India) – GDPR – EU AI Act – Informed Consent – Participatory Design – Future of Work and AI – Introduction to AGI and Instrumental Convergence.

MODULE - VI TRUSTWORTHY AI APPLICATIONS 8

Responsible AI in Healthcare – Legal and Judicial Systems – Education – Smart Cities and Public Services – Policy Issues in AI – Case Studies of Safe AI Deployment – Emerging Trends in Responsible AI.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Chip Huyen (2022). Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications. O'Reilly Media.
2. Kohavi, R., Tang, D., and Xu, Y. (2020). Trustworthy Online Controlled Experiments: A Practical Guide to A/B Testing. Cambridge University Press. (Selected chapters on Responsible AI Evaluation)
3. Russell, S., and Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. (Relevant chapters on AI Ethics and Safety)

REFERENCES:

1. Brian Christian (2020). The Alignment Problem: Machine Learning and Human Values. W.W. Norton & Company.
2. Russell, S. (2019). Human Compatible: Artificial Intelligence and the Problem of Control. Penguin Random House.
3. Dignum, V. (2019). Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way. Springer.
4. Molnar, C. (2022). Interpretable Machine Learning (2nd ed.). Lulu.com.
5. Barocas, S., Hardt, M., and Narayanan, A. (2023). Fairness and Machine Learning: Limitations and Opportunities (2nd ed.). MIT Press.

WEB REFERENCES:

1. https://www.nist.gov/itl/ai-risk-management-framework
2. https://ai.google/responsibilities/responsible-ai-practices/
3. https://oecd.ai/en/ai-principles

ONLINE RESOURCES:

1. https://www.elementsofai.com
2. https://www.deeplearning.ai/courses/

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3. https://www.coursera.org/learn/ai-for-everyone
4. https://developers.google.com/machine-learning/crash-course

OUTCOMES:

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

1. Apply the principles and requirements of Responsible and Safe AI in the development of AI systems. (K3)
2. Analyze risks, vulnerabilities, and safety challenges associated with AI technologies.(K4)
3. Apply explainability, transparency, and interpretability techniques to AI models.(K3)
4. Examine AI systems using fairness, privacy, robustness, and security measures.(K4)
5. Infer AI governance frameworks, regulations, and ethical requirements for trustworthy AI.(K4)
6. Design and assess Responsible AI solutions for real-world applications considering societal impact.(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3
CO2	2	3	-	-	-	-	-	-	-	-	-	3	3
CO3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO4	2	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	3	3
CO6	3	2	-	-	-	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL513	INFORMATION SECURITY AND PRIVACY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106248	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24AMPT301, 24AIPT201, 24AIPC401, 24AIPT301					

OBJECTIVES:

- To introduce the fundamental principles of cyber security and information assurance.
- To understand governance, risk management, compliance, and security policy frameworks.
- To analyze cyber threats, vulnerabilities, attacks, and defense mechanisms.
- To study cryptographic techniques and access control mechanisms used in modern systems.
- To examine privacy concepts, privacy regulations, and data protection frameworks.
- To evaluate the economic, strategic, legal, and ethical dimensions of privacy and cyber security.

MODULE - I FOUNDATIONS OF CYBER SECURITY AND INFORMATION ASSURANCE 7

Introduction to Cyber Security- Information Security versus Cyber Security- Confidentiality-Integrity- Availability (CIA)- Security Goals- Threats- Vulnerabilities- Risk- Cyber Attacks- Security Breaches- Case Study: Target Data Breach.

MODULE - II SECURITY GOVERNANCE, COMPLIANCE AND POLICY MANAGEMENT 8

Security Management Concepts- Governance- Risk and Compliance (GRC)- GRC Framework- Security Standards-Enterprise Information Security Policy- Issue- Specific Security Policy-System- Specific Security Policy.

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MODULE - III RISK MANAGEMENT AND CONTINGENCY PLANNING 7

Cyber Risk Identification- Risk Assessment- Risk Analysis- Risk Treatment and Control- Incident Response Planning- Disaster Recovery Planning- Business Continuity Planning-Cyber Crisis Management- Business Impact Analysis (BIA).

MODULE - IV CYBER SECURITY TECHNOLOGIES AND DEFENSE MECHANISMS 8

Cyber Threat Landscape- Malware- Exploits- Defense Technologies- Network Security Technologies- Access Control Models- Authentication and Authorization- Security Standards and Protocols.

MODULE - V CRYPTOGRAPHY AND PRIVACY FOUNDATIONS 7

Introduction to Cryptography- Symmetric and Asymmetric Cryptography- Cryptographic Applications- Information Privacy Concepts- Privacy Theories- Privacy Measurement Approaches.

MODULE - VI PRIVACY REGULATIONS, ECONOMICS AND STRATEGIC PERSPECTIVES 8

Privacy Laws and Ethics- GDPR, Digital Personal Data Protection Act 2023- Aadhaar Privacy Issues-Data Breach Regulations- Economic Value of Privacy- Business Strategy and Privacy.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Whitman, M. E., & Mattord, H. J. Principles of Information Security, 7th Edition, Cengage Learning, Boston, USA, 2021.
2. Stallings, W. Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson Education, New York, USA, 2023.
3. Peltier, T. R. Information Security Policies and Procedures: A Practitioner's Reference, 2nd Edition, Auerbach Publications (CRC Press), Boca Raton, Florida, USA, 2004.

REFERENCES:

1. Anderson, Ross Security Engineering: A Guide to Building Dependable Distributed Systems, 3rd Edition, Wiley Publishing, Indianapolis, USA, 2020.
2. Schneier, Bruce Applied Cryptography: Protocols, Algorithms, and Source Code in C, 20th Anniversary Edition, Wiley Publishing, Indianapolis, USA, 2015.

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3. Bishop, Matt Computer Security: Art and Science, 2nd Edition, Addison-Wesley Professional, Boston, USA, 2018.
4. Solove, Daniel J. Understanding Privacy, 1st Edition, Harvard University Press, Cambridge, Massachusetts, USA, 2008.

WEB REFERENCES:

1. https://csrc.nist.gov/
2. https://www.nist.gov/cyberframework
3. https://csrc.nist.gov/pubs/sp/800/61/r2/final

ONLINE RESOURCES:

1. https://www.cisa.gov
2. https://www.nist.gov/cyberframework
3. https://owasp.org
4. https://gdpr-info.eu
5. https://www.meity.gov.in

OUTCOMES:

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

1. Apply cyber security principles, security objectives, and threat assessment concepts to identify and address security requirements in information systems and digital environments. (K3)
2. Demonstrate governance, risk, compliance, and security policy frameworks to support secure decision-making and organizational cyber security management. (K3)
3. Analyze cyber risks, security incidents, and organizational vulnerabilities to develop appropriate risk mitigation and contingency planning strategies. (K4)
4. Examine cyber defense technologies, access control mechanisms, and security solutions to safeguard digital infrastructure against evolving cyber threats. (K4)
5. Compare cryptographic techniques and privacy-preserving mechanisms to ensure secure communication, data confidentiality, and protection of personal information. (K4)
6. Utilize privacy regulations, legal frameworks, and the strategic implications of cyber security and data protection in organizational and societal contexts. (K3)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	2
CO2	2	3	-	-	2	-	-	-	-	-	-	-	-
CO3	2	3	-	2	2	-	-	-	-	-	-	-	2
CO4	3	2	2	-	3	-	-	-	-	-	-	2	2
CO5	2	2	-	-	2	-	-	-	-	-	-	2	2
CO6	2	3	-	-	-	-	-	-	-	-	-	-	-

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL514	EMBEDDED SENSOR NETWORKS AND MIDDLEWARE ARCHITECTURES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105160	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 9				
PRE-REQUISITE COURSES	24AMPT301, 24AIPT201, 24AIPC401					

OBJECTIVES:

- To understand the architecture and characteristics of wireless ad hoc networks.
- To analyze routing, MAC, transport, and multicasting protocols in MANETs.
- To study opportunistic networks and UAV-based communication systems.
- To understand wireless sensor network architecture and deployment.
- To analyze routing, congestion control, and security mechanisms in WSNs.
- To explore real-world applications and emerging trends in sensor networks.

MODULE - I FUNDAMENTALS OF AD HOC NETWORKS 8

Introduction to Wireless Ad Hoc Networks – Characteristics and Challenges of Ad Hoc Networks – Self-Organizing Behaviour of Wireless Ad Hoc Networks – Cooperation in Mobile Ad Hoc Networks – Architecture and Applications of MANETs – Design Issues in Embedded Wireless Networks

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MODULE - II PROTOCOLS IN MANETs 8

MAC Protocols in MANETs- Routing Protocols in MANETs- Proactive Routing- Reactive Routing, Hybrid Routing- Multicasting in MANETs- Mobility Models- Transport Protocols for MANETs.

MODULE - III ADVANCED MOBILE AD HOC NETWORKS 7

Opportunistic Mobile Networks- Delay Tolerant Networking- Store-Carry-Forward Communication- UAV Network Architecture- Communication Models- Applications of UAV Networks- Integration with Embedded Sensor Systems.

MODULE - IV UAV NETWORKS AND WIRELESS SENSOR NETWORKS 7

Introduction to Wireless Sensor Network- Sensor Node Architecture- Embedded Sensing Platforms- Coverage and Placement Strategies- Mobile Wireless Sensor Networks-Middleware Concepts- Middleware Services for Resource Management and Data Integration.

MODULE - V WIRELESS SENSOR NETWORKS 8

Coverage and Placement Strategies- Mobile Wireless Sensor Networks- Medium Access Control in Wireless Networks- Routing Protocols in WSNs- Congestion and Flow Control Mechanisms.

MODULE - VI ADVANCED WSN APPLICATIONS AND SECURITY 7

Underwater Sensor Networks – Security Issues in Wireless Sensor Networks – Secure Communication Mechanisms – Hardware Design of Sensor Nodes – Real-Life Deployment of Wireless Sensor Networks – Emerging Embedded Sensor Network Applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Carlos de Morais Cordeiro and Dharma P. Agrawal, Ad Hoc and Sensor Networks: Theory and Applications, 2nd Edition, World Scientific Publishing, 2011.
2. C. Siva Ram Murthy and B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, 1st Edition, Pearson Education (Prentice Hall PTR), 2004.
3. Kazem Sohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, 1st Edition, John Wiley & Sons, 2007.

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REFERENCES:

1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
2. Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, Wiley.
3. Mohammad Ilyas, The Handbook of Ad Hoc Wireless Networks, CRC Press.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105160
2. https://datatracker.ietf.org/wg/manet/about/
3. https://www.sciencedirect.com/topics/computer-science/wireless-ad-hoc-network
4. https://owasp.org/www-project-internet-of-things/

ONLINE RESOURCES:

1. NPTEL – Wireless Ad Hoc and Sensor Networks
2. IEEE Communications Society Digital Library
3. https://www.cisco.com
4. https://www.sciencedirect.com

OUTCOMES:

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

1. Apply the concepts and characteristics of wireless ad hoc networks and self-organizing systems. (K3)
2. Utilize routing, MAC and transport protocols for efficient communication in MANETs. (K3)
3. Analyze opportunistic mobile networks and UAV network architectures for various applications. (K4)
4. Apply wireless sensor network architectures, deployment strategies and medium access mechanisms. (K3)
5. Infer routing, congestion control and performance issues in wireless sensor networks. (K4)
6. Examine security mechanisms, underwater sensor networks and real-life WSN deployments. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	2	3	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	2	2
CO6	2	3	-	-	-	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL518	IoT BASED SMART SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105166	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPC401, 24AIPT401					

OBJECTIVES:

- To understand the fundamental concepts, architecture, and enabling technologies of the Internet of Things (IoT).
- To learn IoT communication protocols, networking technologies, sensors, and actuators used in smart systems.
- To design and develop IoT solutions using embedded platforms, microcontrollers, and rapid prototyping techniques.
- To explore cloud computing, edge/fog computing, data analytics, machine learning, and security aspects in IoT environments.
- To develop and evaluate IoT-based smart applications for domains such as smart cities, healthcare, agriculture, transportation, and Industry 4.0.

MODULE - I INTRODUCTION TO INTERNET OF THINGS 8

Introduction to IoT – Evolution of IoT – Characteristics of IoT – IoT Architecture – Physical Design of IoT – Logical Design of IoT – IoT Enabling Technologies – Sensors and Actuators – IoT Communication Models – IoT Applications and Challenges.

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MODULE - II IoT NETWORKS AND COMMUNICATION PROTOCOLS 8

Network Fundamentals – IPv4 and IPv6 – TCP/IP Protocol Suite – Wireless Sensor Networks – RFID and NFC – ZigBee – Bluetooth Low Energy (BLE) – Wi-Fi – LoRaWAN – MQTT – CoAP – AMQP – IoT Gateway Concepts.

MODULE - III IoT SYSTEM DESIGN AND DEVELOPMENT 7

IoT Design Methodology – Embedded Systems for IoT – Microcontrollers and Single Board Computers – Arduino and Raspberry Pi Overview – Sensor Interfacing – Actuator Control – Data Acquisition Systems – IoT Software Frameworks – Rapid Prototyping of IoT Solutions.

MODULE - IV CLOUD, DATA ANALYTICS AND SECURITY IN IoT 7

Cloud Computing for IoT – IoT Data Management – Edge and Fog Computing – Data Analytics for IoT – Machine Learning in IoT – IoT Security Requirements – Authentication and Authorization – Privacy Preservation – Secure Communication Protocols – Cybersecurity Challenges in Smart Systems.

MODULE - V SMART SYSTEMS AND INDUSTRIAL IoT 7

Smart Home Systems – Smart Buildings – Smart Agriculture – Smart Healthcare – Smart Transportation – Smart Grid Applications – Industrial IoT (IIoT) – Industry 4.0 Concepts – Predictive Maintenance – Digital Twin Technology.

MODULE - VI IoT APPLICATION DEVELOPMENT AND CASE STUDIES 8

IoT Application Development Life Cycle – Smart City Solutions – Environmental Monitoring Systems – Intelligent Energy Management – Connected Vehicles – Wearable IoT Devices – AI-enabled Smart Systems – Recent Trends in IoT – Case Studies and Future Directions.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015.
2. Raj Kamal, Internet of Things: Architecture and Design Principles, 2nd Edition, McGraw Hill Education (India), 2021, ISBN: 978-9390727384.
3. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley Publications, 2014.

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REFERENCES:

1. Maciej Kranz, Building the Internet of Things, Wiley, 2016.
2. Dieter Uckelmann, Architecting the Internet of Things, Springer, 2018.
3. Samuel Greengard, The Internet of Things, MIT Press, 2021.
4. Brian Russell and Drew Van Duren, Practical Internet of Things Security, Packt Publishing, 2018.

WEB REFERENCES:

1. https://www.geeksforgeeks.org/electronics-engineering/internet-of-things-iot-enabling-technologies/
2. https://www.ibm.com/think/topics/internet-of-things
3. https://www.pcbonline.com/blog/iot-protocols.html
4. https://www.google.com/search?q=https://www.libelium.com/iot-case-studies/

ONLINE RESOURCES:

1. http://onlinecourses.nptel.ac.in
2. http://www.netacad.com
3. http://www.coursera.org
4. http://www.edx.org
5. http://thingspeak.com

OUTCOMES:

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

1. Apply IoT architectures, components, and communication models to develop IoT solutions. (K3)
2. Analyze IoT networking technologies and communication protocols used in smart systems. (K4)
3. Utilize IoT design methodologies to develop smart applications using sensors and actuators. (K3)
4. Examine cloud-based IoT systems with data analytics and security mechanisms. (K4)
5. Analyze Industrial IoT and smart system applications in various domains. (K4)
6. Discover IoT-enabled smart solutions for real-world challenges using emerging technologies. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	2	3	-	-	-	-	-	-	-	-	-	2	2
CO3	2	2	3	-	-	-	-	-	-	-	-	3	3
CO4	2	3	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	2	3
CO6	3	2	3	-	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL501	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106103224	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301 ,24AMPC302					

OBJECTIVES:

- To understand the fundamental concepts of graphics and multimedia.
- To understand the Two/Three Dimensional Graphics and their Transformations
- To get knowledge about various Object representation methods and Visible Surface Detection methods
- To study the Multimedia concepts and various I/O technologies

MODULE - I OUTPUT PRIMITIVES 7

Output Primitives: Points and Lines – Line-Drawing algorithms: DDA and Bresenham's Algorithm – Loading frame Buffer – Line function – Circle-Generating algorithms: Midpoint Circle Generating Algorithm – Ellipse-generating algorithms. Attributes of Output Primitives: Line Attributes – Curve attributes – Color and Grayscale Levels – Area-fill attributes – Character Attributes.

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MODULE - II 2D GRAPHICS 7

Basic Transformations – Matrix Representations – Composite Transformations – Other Transformations. 2D Viewing: The Viewing Pipeline – Viewing Co-ordinate Reference Frame – Window-to-Viewport Co-ordinate Transformation - 2D Viewing Functions – Clipping Operations.

MODULE - III 3D GRAPHICS 7

3D Geometric and Modeling Transformations – Translation - Rotation - Scaling- Composite Transformations - 3D Viewing – Viewing Pipeline - Viewing Coordinates - Projections - Clipping - Visible Surface Detection Methods.

MODULE - IV ILLUMINATION, COLOR MODELS AND ANIMATION 8

Light Sources - Basic Illumination Models – Halftone Patterns and Dithering Techniques- Properties of Light - Standard Primaries and Chromaticity Diagram; Intuitive Colour Concepts - RGB Colour Model - YIQ Colour Model - CMY Colour Model - HSV Colour Model - HLS Colour Model - Colour Selection- Virtual Reality - Animation.

MODULE - V MULTIMEDIA SYSTEMS DESIGN AND FILE HANDLING 8

Multimedia Basics – Multimedia Applications – Multimedia System Architecture - Defining Objects for Multimedia Systems – Multimedia Data Interface Standards – Multimedia Databases - Compression and Decompression – Data and File Format Standards – Digital Voice and Audio – Video Image and Animation – Full Motion Video – Storage and Retrieval Technologies.

MODULE - VI HYPERMEDIA 6

Multimedia Authoring and User Interface - Hypermedia Messaging -Mobile Messaging – Hypermedia Message Component – Creating Hypermedia Message – Integrated Multimedia Message Standards – Integrated Document Management – Distributed Multimedia Systems - Case Study: Blender Graphics -Blender Fundamentals–Drawing Basic Shapes – Modelling-Shading & Textures

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi,2007
2. Andleigh, P. K and KiranThakrar, "Multimedia Systems and Design", PHI, 2003

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Information Technology

REFERENCES:

1. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, "Computer Graphics: Principles and Practice", 2nd Edition, Pearson Education, 2003.
3. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers,2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan , 1990.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, "Fundamentals of Computer Graphics", CRC Press, 2010.
6. William M. Newman and Robert F.Sproull, "Principles of Interactive Computer Graphics", McGraw Hill 1978.

ONLINE RESOURCES:

1. https://www.blender.org/support/tutorials
2. http://www.doc.ic.ac.uk/~dfg/graphics/graphics.html
3. http://www.nptelvideos.in/2012/11/computer-graphics.html
4. http://cs.wellesley.edu/~cs110/lectures/M01-color/graphics.pdf
5. www.scratchapixel.com
6. http://dl.finebook.ir/book/9e/11032.pdf
7. https://www.blender.org/support/tutorials
8. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2012/download-course-materials

OUTCOMES:

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

1. Implement output primitives and drawing algorithms to create basic graphical objects with attributes. (K3)
2. Perform 2D transformations, viewing and clipping techniques using matrix representations. (K3)
3. Illustrate 3D transformations, projections and visible surface detection methods for object representation. (K3)
4. Utilize illumination models, color models and animation techniques for realistic graphics. (K3)
5. Apply multimedia system design concepts including architecture, databases and file handling techniques. (K3)

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6. Construct hypermedia applications and create basic 3D scenes using Blender. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	2	-	-	-	-	-	2	2	2
CO5	3	2	-	-	2	-	-	-	-	-	2	2	2
CO6	3	2	2	-	3	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL502	GRAPH THEORY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105847	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301 ,24AMPC402					

OBJECTIVES:

- Enable learners to apply graph theory concepts to solve real-world and computational problems.
- To introduce fundamental concepts of graph theory, including vertices, edges, paths, and connectivity.
- To utilize graph theory to model and solve practical problems in logistics, biology, and computer science.
- To apply algorithms for finding shortest paths, spanning trees, and network flow.

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MODULE - I FUNDAMENTALS OF GRAPHS 8

Introduction to graphs - Basic properties of graphs - Definition and types of graphs (simple, multigraph, directed, weighted) - Graph representation (adjacency matrix, adjacency list) - Degree of vertices, Handshaking Lemma -Sub graphs and induced graphs - Complete and bi-partite graphs - Isomorphism of graphs.

MODULE - II PATHS AND CONNECTIVITY 7

Paths and circuits - Walks, paths, trails, circuits - Connected and disconnected graphs - Open and closed walks - Simple paths and cycles - Length of a path - Components of a graph - Cut vertices and bridges - Circuits and cycles in graphs - Directed and undirected cycles - Detection of cycles in graphs.

MODULE - III EULER AND HAMILTONIAN GRAPHS 7

Euler paths and circuits (Fleury's Algorithm) - Hamiltonian paths and cycles - Necessary and sufficient conditions - Eulerian Graphs - Hamiltonian cycles - Matrix representation of graphs - Chordal graphs - Weighted graphs.

MODULE - IV TREES AND SPANNING TREES 9

Definition and properties of trees - Spanning trees and minimal spanning trees - Algorithms: Prim's and Kruskal's - Independence sets and covering in graphs - Minimum Spanning Trees (MST) - Concept of weighted graphs - Definition and significance of MST Applications (network design, cost minimization)- Algorithms for MST - Prim's Algorithm- Greedy approach - Step-by-step construction - Implementation logic..

MODULE - V GRAPH COLORING AND PLANARITY 7

Vertex coloring and chromatic number - Applications of graph coloring (scheduling, map coloring) - Planar graphs and Euler's formula – Cut Vertices and Cut edges - Edge connectivity - Vertex Colouring of graphs - Edge Colouring of graphs - The four-colour and five-colour theorems..

MODULE - VI APPLICATIONS OF GRAPH THEORY 7

Perfect graphs – applications of graph in switching theory –Directed graphs or (Digraphs) - Shortest path algorithms (Dijkstra's Algorithm) Network flows (basic idea) - Applications in computer science, transportation, and social networks.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. R. Balakrishnan & K. Ranganathan, "A Textbook of Graph Theory", 2012, (Springer edition).
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall, 2017.
3. Douglas B. West, "Introduction to Graph Theory",2nd Edition, 2001.

REFERENCES:

1. R. Balakrishnan, K. Ranganathan, "A Textbook of Graph Theory", 1st Edition, Volume 1, 2012.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, 2017
3. Douglas B. West, "Introduction to Graph Theory", 2nd Edition, Prentice Hall,2001.
4. Frank Harary, "Graph Theory", 1st Edition, Addison-Wesley,1969.
5. Jonathan L. Gross, Jay Yellen, Ping Zhang , "Handbook of Graph Theory", 2nd Edition, Volume 1, CRC Press, 2014.
6. J.A. Bondy, U.S.R. Murty, "Graph Theory–Graduate Texts in Mathematics", Springer, 2008.
7. Alan Gibbons, "Algorithmic Graph Theory", 1st Edition,Cambridge University Press, 1985.

ONLINE RESOURCES:

1. https://www.geeksforgeeks.org/dsa/graph-data-structure-and-algorithms/
2. https://www.geeksforgeeks.org/dsa/eulerian-path-and-circuit/
3. https://www.geeksforgeeks.org/quizzes/minimum-spanning-tree/
4. https://www.geeksforgeeks.org/dsa/graph-coloring-applications/
5. ONLINE REFERENCES:
6. https://www.getyoureducation.net/course/advanced-graph-theory
7. https://www.coursera.org/learn/graphs?utm_source=chatgpt.com
8. https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-graph-theory
9. https://nptel.ac.in/courses/111106050
10. https://nptel.ac.in/courses/111107058
11. https://ocw.mit.edu/courses/18-225-graph-theory-and-additive-combinatorics-fall-2023/

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OUTCOMES:

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

1. Apply graph representations and basic properties to model problems (K3)
2. Analyze connectivity and solve problems involving paths and circuits (K3)
3. Apply Euler and Hamiltonian concepts to real-world problems (K3)
4. Construct and optimize spanning trees using standard algorithms (K3)
5. Apply graph coloring and planarity concepts in practical scenarios (K3)
6. Use graph algorithms to solve real-world applications (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	3	1
CO2	3	3	-	1	1	-	-	-	-	-	-	3	2
CO3	3	3	1	1	1	-	-	-	-	-	-	3	2
CO4	3	3	2	1	2	-	1	-	-	-	1	3	3
CO5	3	2	2	1	1	-	1	-	-	-		2	2
CO6	3	3	2	2	2	1	1		1	1	1	3	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL511	DISTRIBUTED SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106168	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24AIPT301 ,24AIPC401 ,24AMPC302					

OBJECTIVES:

- To understand foundations of Distributed Systems
- To introduce the idea of peer to peer services and file system

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- To understand in detail the system level and support required for distributed system
- To understand the issues involved in studying process and resource management

MODULE - I INTRODUCTION 5

Introduction – Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – Challenges. Case study: World Wide Web.

MODULE - II COMMUNICATION IN DISTRIBUTED SYSTEM 9

System Model – Inter process Communication - the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction - Request-reply protocols - Remote procedure call - Remote method invocation. Case study: Java RMI - Group communication - Publish-subscribe systems - Message queues - Shared memory approaches -Distributed objects - Case study: Enterprise Java Beans - from objects to components

MODULE - III PEER TO PEER SERVICES AND FILE SYSTEM 9

Peer-to-peer Systems – Introduction - Napster and its legacy - Peer-to-peer – Middleware - Routing overlays. Overlay case studies: Pastry, Tapestry-Distributed File Systems –Introduction - File service architecture – Andrew File system. File System: Features-File model -File accessing models - File sharing semantics. Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

MODULE - IV SYNCHRONIZATION AND REPLICATION 9

Introduction - Clocks, events and process states - Synchronizing physical clocks- Logical time and logical clocks - Global states – Coordination and Agreement – Introduction - Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control - Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda

MODULE - V PROCESS & RESOURCE MANAGEMENT 6

Process Management: Process Migration: Features, Mechanism - Threads: Models, Issues, Implementation. Resource Management: Introduction-Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

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MODULE - VI DISTRIBUTED ALGORITHMS 7

Synchronous network model - Algorithms: leader election, maximal independent set -Asynchronous system model: I/O automata, operations on automata, fairness - Asynchronous shared memory model - Mutual exclusion: model, the problem, stronger conditions, lockout-free mutual exclusion algorithms, lower bound on the number of registers - Asynchronous network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2. Nancy A. Lynch, "Distributed Algorithms", Hardcourt Asia Pvt. Ltd., Morgan Kaufmann, 2000.

REFERENCES:

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
4. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

ONLINE RESOURCES:

1. https://www.cs.helsinki.fi/u/jakangas/Teaching/DistSys/DistSys-08f-1.pdf
2. https://www.vidyarthiplus.com/vp/attachment.php?aid=43022

OUTCOMES:

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

1. Apply the use of distributed system with architecture, trends, and resource sharing in World Wide Web. (K3)
2. Articulate various communication mechanisms in distributed systems, like RPC, RMI, multicast, message-oriented middleware, and network virtualization (K3)
3. Sketch the design and operation of peer-to-peer systems and distributed file systems. (K3)

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4. Examine synchronization, coordination, and replication techniques with logical clocks, mutual exclusion, elections, transactions, and concurrency control mechanisms (K3)
5. Determine the key process and resource management strategies. (K3)
6. Re-enact the use of distributed algorithms for synchronous and asynchronous systems (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2
CO5	2	2	2	2	-	-	-	-	-	-	-	2	2
CO6	2	2	2	2	-	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEP502	VISUAL PERCEPTION AND INTELLIGENT SYSTEMS LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 106105216	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPC301, 24BSMA303					

OBJECTIVES:

- To understand foundational visual processing operations, image representations, and projective geometry transformations.
- To master camera modelling parameters, calibration methodologies, and multi-view stereoscopic geometry principles.
- To evaluate feature detection mathematical operators and robust geometric model fitting algorithms.
- To study color space metrics and range data processing techniques for multidimensional vision pipelines.

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- To implement classification, clustering, and dimensional reduction techniques for machine vision applications.
- To build intelligent system solutions utilizing state-of-the-art deep learning architectures.

MODULE - I FOUNDATIONS OF VISUAL PROCESSING AND PROJECTIVE GEOMETRY 8

Image Representation - Digital Sampling - Quantization Formats - Fundamental Intensity Transformations - Mathematical Frameworks for 2D Projective Spaces - Affine Mappings - Geometric Transformations - Homogeneous Coordinates - Homography Matrix Properties - Estimation Methodologies for Homography Calculation - Homography in Planar Environments.

LIST OF EXPERIMENTS:

1. Implementation of basic spatial image filtering, histogram equalization, and affine transformations utilizing Python and OpenCV libraries.
2. Formulation and estimation of a 2D homography matrix between separate planar viewpoints to execute image warping and perspective rectification.

MODULE - II CAMERA MODEL PHYSICS AND STEREOSCOPIC GEOMETRY 8

Pinhole Camera Model Structures - Intrinsic Camera Parameters - Extrinsic Orientation Configurations - Radial Distortion Dynamics - Camera Calibration Frameworks - Mathematical Foundations of Multi-View Epipolar Geometry - Essential Matrices - Fundamental Matrices - Stereo Correspondence Matching - 3D Depth Reconstruction Metrics.

LIST OF EXPERIMENTS:

1. Execute camera calibration routines using standard planar checkerboard targets to calculate intrinsic parameter arrays and eliminate lens distortion artifacts.
2. Build a depth-extraction pipeline via disparity map calculation from rectified stereoscopic pairs.

MODULE - III FEATURE EXTRACTION, MODEL FITTING AND MATCHING 7

Mathematical Operations for Edge Detection - Structural Corner Localizers - Scale-Space Representations - Advanced Local Descriptor Frameworks - Scale-Invariant Feature Transform (SIFT) - Speeded-Up Robust Features (SURF) -

Oriented FAST and Rotated BRIEF (ORB) - Feature Matching Evaluation Metrics - Outlier Rejection Mechanics - Random Sample Consensus (RANSAC) Algorithm - Geometric Model Fitting Parameters.

LIST OF EXPERIMENTS:

1. Extract robust local keypoints using SIFT or ORB operators and execute feature matching across variable baseline viewpoints.
2. Develop an automated image-stitching application (panoramas) using mapped feature pairs optimized via RANSAC outlier elimination.

MODULE - IV MULTIDIMENSIONAL AND RANGE IMAGE PERCEPTION 8

Color Perception Physics - Mathematical Color Space Transformations - RGB Color Space - HSI Color Space - YCbCr Color Space - Color-Based Object Segmentation Algorithms - Vector-Space Color Processing - Range Data Acquisition Techniques - Depth Sensor Physics - 3D Point Cloud Representations - Coordinate Transformations - Surface Normal Extraction Geometries.

LIST OF EXPERIMENTS:

1. Design a real-time object tracking and location mapping algorithm utilizing color threshold masks and morphological processing in HSI space.
2. Build a 3D point cloud visualizer to compute and project local surface normals from raw depth datasets.

MODULE - V PATTERN CLUSTERING AND DIMENSIONALITY REDUCTION 7

Supervised Statistical Learning Models for Image Analysis - Unsupervised Statistical Learning Models for Image Analysis - Implementation Strategies for K-Means Clustering - Implementation Strategies for Mean-Shift Clustering - Classical Object Categorization Paradigms - Dimensionality Reduction Theory - Principal Component Analysis (PCA) - Linear Discriminant Analysis (LDA) - Sparse Representations for Optimized Visual Features.

LIST OF EXPERIMENTS:

1. Program an image segmentation workflow using K-Means and Mean-Shift clustering methods to separate structural regions.
2. Implement an automated face-recognition architecture using the Eigenfaces paradigm powered by PCA dimensionality reduction.

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MODULE - VI INTELLIGENT DEEP LEARNING ARCHITECTURES 8

Foundations of Neural Computational Layers - Multi-Layer Perceptrons (MLPs) - Convolutional Neural Networks (CNNs) for Spatial Vision - State-of-the-Art Architectures for Deep Object Detection - You Only Look Once (YOLO) - Single Shot Detector (SSD) - Semantic Pixel Labeling and Image Segmentation - Autonomous Visual Perception - Visual Perception Decision Matrices.

LIST OF EXPERIMENTS:

1. Build, train, and validate a custom multi-layer CNN configuration using a modern deep learning framework to categorize standard datasets.
2. Deploy an optimized, pre-trained object tracking system (e.g., YOLO framework) to parse and locate spatial classes within real-time streaming video inputs.

TOTAL : 45 PERIODS

LABORATORY REQUIREMENTS:

Standalone desktop with Ubuntu Linux, Python, Anaconda, Jupyter Notebook, OpenCV, NumPy, SciPy, Matplotlib, Scikit-image, Scikit-learn, Open3D, PyTorch/TensorFlow, and YOLO-30Nos.

TEXT BOOKS

1. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2nd Edition, 2022.
2. D. A. Forsyth and J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2nd Edition, 2012.
3. R. Hartley and A. Zisserman, "Multiple View Geometry in Computer Vision", Cambridge University Press, 2nd Edition, 2004.

REFERENCES:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Education, 4th Edition, 2018.
2. E. Trucco and A. Verri, "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1st Edition, 1998.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2016.

WEB REFERENCES:

1. NPTEL Computer Vision Course Portal (Course Code: 106105216).
2. OpenCV Open Source Computer Vision Documentation Library.

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ONLINE RESOURCES:

1. https://opencv-python-tutroals.readthedocs.io
2. https://nptel.ac.in

OUTCOMES:

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

1. Apply fundamental spatial filtering operations and affine transformations to solve 2D projective geometry problems. (K3)
2. Analyze camera physics matrices and compute stereoscopic epipolar geometry configurations for 3D estimation. (K4)
3. Select robust local feature extractors and iterative model-fitting algorithms for scene alignment tasks. (K3)
4. Examine multidimensional color channels and structured 3D point cloud datasets to segment regional features. (K4)
5. Utilize statistical clustering algorithms and linear dimensionality reduction models for structural recognition. (K3)
6. Analyze and train intelligent deep learning neural network architectures for complex real-time target localizations. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	3
CO2	2	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	-	2	-	-	-	-	-	-	3	3
CO4	3	3	-	-	2	-	-	-	-	-	-	2	2
CO5	3	2	-	-	3	-	-	-	-	-	-	2	3
CO6	2	3	-	-	-	-	-	-	-	-	-	2	2

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEP503	AI INFRASTRUCTURE AND OPTIMIZATION TECHNIQUES LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 106106238	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AMPC302,24AIPC301,24AIPT401					

OBJECTIVES:

- To understand AI hardware, operating systems, cloud platforms, virtualization, and container technologies.
- To learn the design and implementation of computing infrastructures for AI applications.
- To develop skills in building and optimizing deep learning models using TensorFlow and PyTorch.
- To understand distributed AI computing, multi-GPU training, and scalable deep learning frameworks.
- To learn techniques for accelerating AI workloads, machine learning, and data processing pipelines.
- To develop AI-based solutions for real-world applications in domains such as healthcare and smart

MODULE - I AI SYSTEM HARDWARE AND SOFTWARE FOUNDATIONS 8

Introduction to AI System Hardware - CPU - RAM - GPU - Interconnect - Storage - Network Controller-Introduction to AI Accelerators - GPUs-Introduction to System Software - Operating System - Virtualization Cloud - Introduction to Containers and IDE (Jupyter Demo) - Scheduling and Resource Management - Introduction to schedulers and orchestration tools-DeepOps - Deep-dive into Kubernetes with deployment of various AI-based services

LIST OF EXPERIMENTS

1. Deploy a simple AI/ML service using Kubernetes and monitor resource utilization
2. Create, deploy, and manage Docker containers for AI applications.

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MODULE - II HIGH PERFORMANCE AI SYSTEMS AND PYTORCH 8

DeepOps- Design principles for building High Performance compute clusters for AI -Implementation details for building High Performance compute clusters for AI -Frameworks for Accelerated Deep Learning Workloads - PyTorch -Frameworks for Accelerated Deep Learning Workloads - PyTorch- Accelerated PyTorch .

LIST OF EXPERIMENTS

1. Implement a neural network for image classification using PyTorch.
2. Configure a small AI compute cluster using virtualization or cloud instances.

MODULE - III TENSORFLOW AND TRAINING OPTIMIZATION 7

Frameworks for Accelerated Deep Learning Workloads – TensorFlow- Frameworks for Accelerated Deep Learning Workloads – TensorFlow, Accelerated TensorFlow -Optimizing Deep Learning Training: Automated Mixed Precision - Optimizing Deep Learning Training: Transfer Learning

LIST OF EXPERIMENTS

1. Build and train a deep learning model using TensorFlow.
2. Fine-tune a pre-trained CNN model for a custom dataset

MODULE - IV DISTRIBUTED AI COMPUTING 7

Fundamentals of Distributed AI Computing: Multi-GPU and multi-node implementation (MPI, NCCL, RDMA) -Distributed AI Computing: Horovod - Challenges with Distributed Deep Learning Training Convergence - Fundamentals of Accelerating Deployment.

LIST OF EXPERIMENTS

1. Train a deep learning model using Horovod and compare performance.
2. Deploy a trained AI model using containerized inference services.

MODULE - V AI ACCELERATION AND DATA PIPELINES 7

Accelerating neural network inference in PyTorch and TensorFlow- Accelerated Data Analytics (Demo)- Accelerated Machine Learning - Scale Out with DASK- Web visualizations to GPU accelerated crossfiltering - Accelerated ETL Pipeline with SPARK.

LIST OF EXPERIMENTS

1. Optimize inference using TensorFlow or PyTorch acceleration techniques.
2. Design and execute an ETL pipeline using Spark for a large dataset.

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MODULE - VI APPLIED AI USE CASES 8

Applied AI: Smart City (Intelligent Video Analytics)- Applied AI: Smart City (Intelligent Video Analytics) -Applied AI: Healthcare (Federated Learning, AI Assisted Annotation).

LIST OF EXPERIMENTS

1. Implement object detection and tracking on surveillance video streams.
2. Develop a basic annotation system using AI-assisted labeling techniques.

TOTAL : 45 PERIODS

LABORATORY REQUIREMENTS:

Standalone desktop with Ubuntu Linux, Python, Anaconda, Jupyter Notebook, Docker, Kubernetes, PyTorch, TensorFlow, Horovod, Apache Spark, Dask, OpenCV, Label Studio, NumPy, Pandas, Matplotlib, and Scikit-learn-30 Nos.

TEXT BOOKS

1. Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications, Author: Chip Huyen, Edition: 1st Edition, Publisher: O'Reilly Media , Year: 2022
2. Deep Learning , Authors: Ian Goodfellow, Yoshua Bengio, Aaron Courville ,Edition: 1st Edition , Publisher: MIT Press ,Year: 2016.
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Author: Aurélien Géron , Edition: 3rd Edition ,Publisher: O'Reilly Media , Year: 2022

REFERENCES:

1. High Performance Python: Practical Performance Programming for Human, Authors: Micha Gorelick, Ian Ozsvald , Edition: 2nd Edition , Publisher: O'Reilly Media, Year: 2020
2. Distributed Machine Learning Patterns: Practical Machine Learning Solutions for Distributed and Collaborative Systems, Author: Yuan Tang , Edition: 1st Edition, Publisher: Manning Publications , Year: 2024

WEB REFERENCES:

1. PyTorch documentation — PyTorch 2.12 documentation
2. Deep Learning Institute (DLI) Training and Certification | NVIDIA
3. Kubernetes Documentation | Kubernetes
4. Overview - Spark 4.1.2 Documentation

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ONLINE RESOURCES:

1. https://www.nvidia.com/en-in/training
2. https://www.tensorflow.org/learn

OUTCOMES:

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

1. Apply AI hardware, system software, virtualization, cloud computing, and container technologies to support AI applications. (K3)
2. Utilize design principles to build and configure high-performance computing (HPC) clusters for AI workloads using modern infrastructure practices.(K3)
3. Examine deep learning models using frameworks such as PyTorch and TensorFlow with acceleration techniques. (K4)
4. Apply distributed AI computing techniques using multi-GPU and multi-node systems with communication frameworks and tools(K3).
5. Infer the methods for accelerating AI workloads including inference optimization, scalable data analytics using Dask and ETL pipelines with Apache Spark.(K4).
6. Analyse real-world AI applications such as smart city systems and healthcare solutions using advanced techniques like federated learning and intelligent video analytics.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-		-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	-	-	-	3	-	-	-	-	-	-	3	-
CO4	2	3	-	-		-	-	-	-	-	-	2	3
CO5	2	3	-	-	3	-	-	-	-	-	-	2	3
CO6	2	3	-	-	-	-	-	-	-	-	-	2	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEP506	BUSINESS VISUALIZATION LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 106106361	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA201, 24AIPC402					

OBJECTIVES:

- To understand the fundamentals of business visualization and visual analytics.
- To apply visualization techniques for business intelligence and decision-making.
- To design interactive dashboards using modern visualization tools.
- To interpret business data using charts, graphs, and storytelling techniques.
- To analyze trends, patterns, and KPIs through visual analytics.
- To develop data-driven reports and presentations for enterprises.

MODULE - I INTRODUCTION TO BUSINESS VISUALIZATION 7

Introduction to Business Analytics and Visualization - Importance of Data Visualization in Business - Types of Business Data: Descriptive, Predictive, and Prescriptive Analytics - Data Visualization Principles: Human Perception and Visual Cognition - Overview of Visualization Tools.

LIST OF EXPERIMENTS

1. Explore and visualize a business dataset using spreadsheet tools to identify key business metrics and trends.
2. Compare different chart types and evaluate their effectiveness for presenting descriptive, predictive, and prescriptive analytics.

MODULE - II DATA PREPARATION AND EXPLORATORY VISUALIZATION 8

Data collection and preprocessing - handling missing and inconsistent data - data transformation and aggregation - exploratory data analysis (EDA) - histograms - box plots - scatter plots - correlation analysis - visualization using spreadsheets and Python.

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LIST OF EXPERIMENTS

1. Perform data cleaning, preprocessing, and transformation on a business dataset using Python.
2. Conduct Exploratory Data Analysis (EDA) using histograms, box plots, scatter plots, and correlation matrices.

MODULE - III BUSINESS CHARTS AND DASHBOARD DESIGN 7

Bar charts - pie charts - line charts - area charts - heat maps and tree maps - KPI visualization - dashboard design principles - interactive dashboards - visual hierarchy and layout design - case studies using Tableau/Power BI.

MODULE - IV STORY TELLING WITH DATA 8

Data storytelling concepts - visual narratives and communication - choosing effective visuals - color theory and typography - business reporting techniques - infographics for business communication - ethical issues in data presentation.

LIST OF EXPERIMENTS

1. Create business charts (bar, line, pie, heat map, and treemap) to visualize organizational performance metrics.
2. Design an interactive business dashboard using Tableau or Power BI incorporating KPIs and visual filters.

MODULE - V ADVANCED BUSINESS VISUALIZATION TECHNIQUES 8

Time-series visualization - geographic and spatial visualization - network visualization - predictive visualization techniques - real-time business monitoring dashboards - visualization for marketing - finance - HR - and operations.

LIST OF EXPERIMENTS

1. Develop a visual story from a business dataset using appropriate charts, annotations, and narrative elements.
2. Create an infographic for business reporting using visualization and design principles.

MODULE - VI VISUALIZATION TOOLS AND BUSINESS APPLICATIONS 7

Tableau fundamentals - Microsoft Power BI - Google Data Studio (Looker Studio) - Python visualization libraries (Matplotlib, Seaborn, Plotly) - Visualization case studies.

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LIST OF EXPERIMENTS

1. Build interactive business reports and dashboards using Tableau, Power BI, or Looker Studio.
2. Develop advanced visualizations using Python libraries such as Matplotlib, Seaborn, and Plotly for business decision-making.

TOTAL : 45 PERIODS

LABORATORY REQUIREMENTS:

Standalone desktop with Python, Anaconda, Jupyter Notebook, LibreOffice Calc, Pandas, NumPy, Matplotlib, Seaborn, and Plotly-30 Nos.

TEXT BOOKS

1. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, 1st Edition, John Wiley & Sons, 2015, ISBN: 978-1119002253.
2. Stephen Few, Information Dashboard Design: The Effective Visual Communication of Data, 2nd Edition, Analytics Press, 2013, ISBN: 978-1938377006. (The 2nd Edition is the latest available edition.)
3. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, Princeton University Press, 2018, ISBN: 978-0691181622.

REFERENCES:

1. Claus O. Wilke, Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, 1st Edition, O'Reilly Media, 2019, ISBN: 978-1492031086.
2. Scott Murray, Interactive Data Visualization for the Web: An Introduction to Designing with D3, 2nd Edition, O'Reilly Media, 2017, ISBN: 978-1491921289

WEB REFERENCES:

1. https://matplotlib.org/stable/index.html
2. https://learn.microsoft.com/en-us/power-bi

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg14.
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg09.
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg07

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OUTCOMES:

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

1. Apply business visualization principles and analytical techniques to represent business data effectively. (K3)
2. Analyze business data using exploratory visualization and statistical techniques. (K4)
3. Develop interactive charts, dashboards, and KPI visualizations using modern BI tools. (K3)
4. Infer data storytelling methods to communicate business insights through effective visual narratives. (K4)
5. Utilize advanced visualization techniques for time-series, geographic, and predictive business analytics. (K3)
6. Examine visualization tools and business applications for effective business decision-making and reporting. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	3
CO2	2	3	-	-	2	-	-	-	-	-	-	3	3
CO3	3	2	-	-	3	-	-	-	-	-	-	2	3
CO4	2	3	-	-	2	-	-	-	-	-	-	2	2
CO5	3	2	-	-	2	-	-	-	-	-	-	2	2
CO6	2	3	-	-	2	-	-	-	-	-	-	3	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL509	AI FOR RELIABILITY ANALYSIS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105239	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 9				
PRE-REQUISITE COURSES	24BSMA201, 24AMPC302, 24BSMA303, 24AIPT201					

OBJECTIVES:

- To understand reliability engineering concepts and statistical foundations.
- To apply probability distributions and statistical inference in reliability analysis.
- To explore parametric and non-parametric techniques for reliability prediction.
- To learn machine learning and AI techniques for predictive maintenance.
- To analyze advanced AI architectures for reliability applications.
- To study reliability, safety, and deployment of AI systems in real-world scenarios.

MODULE - I FOUNDATIONS OF RELIABILITY ENGINEERING 8

Introduction to reliability and reliability estimation – Concept of statistical learning - Basic statistics and probability – Probability density function (PDF), cumulative distribution function (CDF) – Reliability metrics: Mean Time to Failure (MTTF), Mean Time Between Failures (MTBF), hazard rate – Bathtub curve – Lifetime distributions: Weibull, Exponential, Gaussian and Lognormal distributions.

MODULE - II PROBABILITY AND STATISTICAL INFERENCE TECHNIQUES 8

Discrete and continuous probability distributions – Applications in reliability modeling – Sampling distributions and reliability prediction – Statistical inference (Parametric approaches): Hypothesis testing- Confidence Interval Estimation – Maximum Likelihood Estimation (MLE) – Case studies in parametric reliability analysis.

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MODULE - III NON-PARAMETRIC METHODS AND STATISTICAL LEARNING 7

Non-parametric statistical techniques – Correlation analysis – Regression analysis –

Relation analysis – Case studies using non-parametric approaches – Statistical learning with single population – Paired t-tests – Statistical learning with multiple populations – ANOVA techniques

MODULE - IV MACHINE LEARNING FOR RELIABILITY PREDICTION 7

Data acquisition and preprocessing – Sensor data handling – Feature extraction and selection (PCA, ranking methods) – Supervised learning: Classification and regression – Support Vector Machines, Random Forest, Neural Networks – Remaining Useful Life (RUL) prediction – Unsupervised learning: K-Means clustering and anomaly detection.

MODULE - V ADVANCED AI TECHNIQUES IN RELIABILITY ENGINEERING 7

Deep Learning: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), LSTMs for time-series analysis – Probabilistic graphical models: Bayesian networks and Markov chains – Reinforcement learning for maintenance optimization – Entropy and its applications in statistical learning – Case studies in AI-based reliability analysis.

MODULE - VI RELIABILITY AND APPLICATIONS OF AI SYSTEMS 8

AI model reliability and robustness – Uncertainty quantification and confidence estimation – Validation and verification of AI systems – Model drift and risk assessment – Applications: Predictive maintenance, fault diagnosis using NLP, Failure Modes and Effects Analysis (FMEA) – MLOps: model deployment, monitoring, version control and automated pipelines.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Elmer E. Lewis, James E. Breneman, and Chittaranjan Sahay, Introduction to Reliability Engineering, 3rd Edition, John Wiley & Sons, 2022, ISBN: 978-1119640561.
2. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 7th Edition, John Wiley & Sons, 2018/2019, ISBN: 978-1119585596.

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3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, 1st Edition, MIT Press, 2012, ISBN: 978-0262018029.

REFERENCES:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, 1st Edition, Springer, 2006.
2. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Springer, 2009.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016.
4. ReliaSoft Corporation, Reliability Engineering Handbook, ReliaSoft Publishing, Latest Edition.

WEB REFERENCES:

1. https://www.nist.gov/artificial-intelligence
2. https://oecd.ai/en/dashboards/policy-initiatives/nist-ai-risk-management-framewk
3. https://www.oecd.org/en/topics/sub-issues/ai-principles.html
4. https://oecd.ai/en/nist
5. https://www.nist.gov/trustworthy-and-responsible-ai

ONLINE RESOURCES:

1. https://www.nist.gov/artificial-intelligence/ai-resources
2. https://oecd.ai
3. https://www.coursera.org/specializations/machine-learning-introduction
4. https://www.deeplearning.ai/courses/

OUTCOMES:

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

1. Apply reliability metrics, probability distributions, and statistical learning concepts for system performance assessment. (K3)
2. Apply probability, statistical inference, hypothesis testing, and MLE for reliability prediction analysis. (K3)
3. Analyze reliability data using non-parametric methods, regression, t-tests, and ANOVA techniques. (K4)

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4. Develop machine learning models for reliability prediction, clustering, classification, and anomaly detection. (K3)
5. Examine deep learning, Bayesian networks, Markov chains, and reinforcement learning techniques. (K4)
6. Analyze AI reliability, predictive maintenance, fault diagnosis, FMEA, and MLOps deployment practices. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	-	3	3
CO3	2	3	-	-	-	-	-	-	-	-	-	3	3
CO4	2	3	-	-	-	-	-	-	-	-	-	2	2
CO5	2	2	-	-	-	-	-	-	-	-	-	3	3
CO6	2	3	-	-	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL510	FOUNDATION OF STATISTICAL MACHINE LEARNING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 105105001	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 12				
PRE-REQUISITE COURSES	24BSMA201, 24AIPT401, 24BSMA303, 24AIPT201					

OBJECTIVES:

- To introduce the fundamental concepts of Statistics, Machine Learning, and Data Science for environmental and water resources applications.
- To develop an understanding of probability theory and probability distributions for data analysis.
- To apply joint probability, multivariate analysis, and copula concepts to hydroclimatic data.
- To analyze relationships among variables using correlation and regression techniques.

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- To employ multivariate statistical methods for dimensionality reduction and environmental data interpretation.
- To understand the principles of statistical learning and machine learning for solving classification, regression, and clustering problems.

MODULE - I INTRODUCTION TO DATA SCIENCE AND PROBABILITY FUNDAMENTALS 8

Role of Statistics, Machine Learning and Data Science - Introduction and Applications of Data Science in Hydroclimatology and Water Resources - Fundamentals of Probability - Sample Space and Events - Probability Axioms - Probability Mass Function (PMF) - Probability Density Function (PDF) - Cumulative Distribution Function (CDF) - Moments and Mathematical Expectation.

MODULE - II PROBABILITY DISTRIBUTIONS 7

Discrete Probability Distributions – Bernoulli, Binomial and Poisson Distributions; Continuous Probability Distributions – Uniform, Exponential and Normal Distributions; Applications of Probability Distributions in Hydroclimatology and Water Resources.

MODULE - III JOINT PROBABILITY DISTRIBUTIONS AND COPULAS 7

Joint Probability Distributions - Marginal Probability Distributions - Conditional Probability Distributions - Independence of Random Variables - Bivariate and Multivariate Probability Distributions - Introduction to Copulas - Applications of Copulas in Hydrological and Climate Data Analysis.

MODULE - IV REGRESSION ANALYSIS 7

Correlation Analysis - Simple Linear Regression - Multiple Linear Regression - Least Squares Method - Model Assessment and Performance Measures - Applications of Regression Models in Hydrology and Water Resources.

MODULE - V MULTIVARIATE ANALYSIS 8

Introduction to Multivariate Analysis - Principal Component Analysis (PCA) - Empirical Orthogonal Functions (EOF) - Analysis of Variance (ANOVA) - Interpretation and Applications in Hydroclimatology and Environmental Data Analysis.

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MODULE - VI STATISTICAL LEARNING AND MACHINE LEARNING FUNDAMENTALS 8

Introduction to Statistical Learning - Learning Frameworks - Supervised Learning - Unsupervised Learning - Classification and Regression Problems - Clustering Concepts - Loss Functions - Model Evaluation - Applications in Hydroclimatology and Water Resources.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Montgomery, D.C. and Runger, G.C., Applied Statistics and Probability for Engineers, Wiley.
2. James, G., Witten, D., Hastie, T., and Tibshirani, R., An Introduction to Statistical Learning, Springer.
3. Wilks, D.S., Statistical Methods in the Atmospheric Sciences, Academic Press.
4. Maity, R. (2022). Statistical methods in hydrology and Hydroclimatology. Second. ed. Springer Nature, Singapore.
5. David Forsyth (2019), Applied Machine Learning, Springer Nature Switzerland.
6. Pradhan, M., & Kumar, U. D. (2019). Machine learning using Python. Wiley Indi

REFERENCES:

1. Hastie, T., Tibshirani, R., & Friedman, J., The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Springer, 2009. ISBN: 9780387848570.
2. Rencher, A. C., & Christensen, W. F., Methods of Multivariate Analysis, 3rd Edition, John Wiley & Sons, 2012. ISBN: 9780470178966.
3. Nelsen, R. B., An Introduction to Copulas, 2nd Edition, Springer, 2006. ISBN: 9780387286594.
4. Shumway, R. H., & Stoffer, D. S., Time Series Analysis and Its Applications: With R Examples, 4th Edition, Springer, 2017. ISBN: 9783319524511.
5. Cressie, N., & Wikle, C. K., Statistics for Spatio-Temporal Data, 1st Edition, John Wiley & Sons, 2011. ISBN: 9780471692744.

WEB REFERENCES:

1. https://www.google.com/search?q=https://www.sciencedirect.com/book/9780123948113/introduction-to-probability-and-statistics-for-engineers-and-scientists
2. https://scikit-learn.org/stable/user_guide.html

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ONLINE RESOURCES:

1. https://www.khanacademy.org/math/statistics-probability
2. https://www.coursera.org/learn/machine-learning
3. https://developers.google.com/machine-learning
4. https://towardsdatascience.com
5. https://scikit-learn.org

OUTCOMES:

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

1. Apply probability concepts, PMF, PDF, CDF, moments, and expectation to analyze hydroclimatological and water resources data. (K3)
2. Utilize discrete and continuous probability distributions to model uncertainty in hydrological and climatic processes. (K3)
3. Analyze marginal, conditional, bivariate, and multivariate probability distributions for environmental and water resources applications. (K4)
4. Apply simple and multiple linear regression techniques for prediction and analysis of hydroclimatological variables. (K3)
5. Infer complex environmental datasets using multivariate techniques such as Principal Component Analysis (PCA), Empirical Orthogonal Functions (EOF), and Analysis of Variance (ANOVA). (K4)
6. Examine supervised and unsupervised statistical learning models for solving hydroclimatology and water resources problems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2	2
CO6	3	2	-	-	-	-	-	-	-	-	-	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL511	AI IN DRUG DESIGN	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 103106681	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 9				
PRE-REQUISITE COURSES	24AIPC301, 24AIPT401					

OBJECTIVES:

- To understand the fundamentals of drug discovery and the role of AI in modern pharmaceutical research.
- To apply machine learning and deep learning techniques for target identification, screening, and lead optimization.
- To use AI-based tools for molecular docking, ADMET prediction, and drug–target interaction analysis.
- To explore advanced AI applications such as generative models, precision medicine, and drug repurposing.
- To develop practical skills through hands-on implementation of AI-driven drug discovery workflows and case studies.

MODULE - I BASICS AND INTRODUCTION TO AI IN DRUG DISCOVERY AND DEVELOPMENT 8

Drug discovery and development-Overview of drug discovery workflows-Drug design strategies-Conventional methods for drug discovery-Riddles in drug discovery-History and evolution of AI in drug discovery -Overview of AI technologies-Key applications of AI across the pipeline-Available AI tools and platforms-Advantages of AI integration in drug discovery

MODULE - II FUNDAMENTALS AND APPLICATIONS OF AI & ML IN TARGET DISCOVERY AND VALIDATION 8

Introduction to Machine Learning Concepts - Overview of Neural Networks - Feature Engineering and Data Preprocessing - Evaluation Metrics for AI Models - Introduction to Python Libraries for AI in Drug Discovery-Introduction to Biological Targets - Basics of Target Identification and Validation -Binding Site and Protein Structure Prediction with AI .

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MODULE - III AI IN VIRTUAL SCREENING, LEAD IDENTIFICATION, LEAD OPTIMIZATION, AND DRUG–TARGET INTERACTION PREDICTION 7

Introduction and Approaches to Virtual Screening - AI Tools for Virtual Screening - AI-Assisted Molecular Docking - Workflow of High-Throughput Virtual Screening - Hands-on Tutorial: AI-Assisted Molecular Docking-Basics of Lead Optimization - AI for Drug-Target Interaction Studies - QSAR Modelling.

MODULE - IV AI-DRIVEN ADMET PREDICTIVE MODELING AND CLINICAL PHASE APPLICATIONS IN DRUG DISCOVERY 7

Introduction to ADMET Properties - Importance in Lead Optimization - Conventional Methods for ADMET Prediction - Patient Recruitment, Stratification, and Retention- Data Collection and Monitoring for Regulatory Submissions.

MODULE - V GENERATIVE AI IN DRUG DESIGN, PRECISION MEDICINE, NETWORK PHARMACOLOGY, AND DRUG REPURPOSING 7

Introduction to Generative AI in Drug Design - Deep Generative Models for Drug Design (GAN, GNN, RNN, VAE, etc.) - AI-Powered De Novo Drug Design-AI in Genomics for Personalized Treatments - AI in Real-Time Monitoring and Feedback -Integrating Multi-Target Drug Discovery

MODULE - VI CASE STUDIES, CHALLENGES, FUTURE TRENDS, RESOURCES, AND PRACTICAL HANDS-ON TRAINING 8

Public AI Resources for Drug Discovery - Examples of Notable Successful Case Studies - Challenges in the Modern Drug Discovery Realm- -Molecular Structure Representation - ML-Assisted Solubility Prediction - AI-Assisted Bioactivity Prediction -Large Virtual Screening - Similarity-Based Virtual Screening.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bender, A. & Elemento, O. (2018) – Machine Learning for Drug Discovery, Springer Nature, Cham.
2. Kamel, H. M. & Wright, D. W. (2021) – Artificial Intelligence in Drug Discovery, Wiley, Hoboken.
3. Kubinyi, H. (2008) – Drug Discovery: Methods and Applications, Wiley-VCH, Weinheim.

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4. Nowakowski, T. M. (Ed.) (2017) – Computational Drug Discovery and Design, Springer, New York.
5. Bajorath, J. (2012) – Chemoinformatics and Drug Discovery, Wiley, Hoboken.

REFERENCES:

1. Walters, P. (2019) – The Practice of Medicinal Chemistry, Elsevier, Amsterdam.
2. Silverman, R. B. & Holladay, M. W. (2014) – The Organic Chemistry of Drug Design and Drug Action, Academic Press, Elsevier.
3. Goodfellow, I., Bengio, Y. & Courville, A. (2016) – Deep Learning, MIT Press, Cambridge.
4. Azuaje, F. (Ed.) (2019) – Artificial Intelligence in Medicine and Biology, Springer, Cham.

WEB REFERENCES

1. PubChem – National Library of Medicine: https://pubchem.ncbi.nlm.nih.gov
2. ChEMBL Database – EMBL-EBI: https://www.ebi.ac.uk/chembl
3. Protein Data Bank (RCSB PDB): https://www.rcsb.org
4. DeepChem – Open Source AI for Drug Discovery: https://deepchem.io
5. RDKit – Open-source Cheminformatics Toolkit: https://www.rdkit.org

ONLINE RESOURCES

1. ZINC Database (Virtual Screening Library) – https://zinc.docking.org
2. DrugBank (Drug and Drug Target Database) – https://go.drugbank.com
3. KEGG (Pathway and Genomics Database) – https://www.kegg.jp
4. UniProt (Protein Sequence and Functional Information) – https://www.uniprot.org
5. Kaggle (AI/ML Datasets for Drug Discovery) – https://www.kaggle.com/datasets

OUTCOMES:

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

1. Apply the fundamentals of drug discovery pipelines and explain the evolution, concepts, and applications of AI in drug discovery and development. (K3)

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2. Apply machine learning and deep learning techniques for target identification, validation, and prediction using biological data. (K3)
3. Utilize AI tools for virtual screening and molecular docking in lead identification processes. (K3)
4. Analyze QSAR models and molecular dynamics simulations for drug–target interaction and lead optimization. (K4)
5. Examine ADMET properties and AI-based clinical trial approaches for decision-making in drug development. (K4)
6. Design and implement AI-driven workflows including generative models, precision medicine, and drug repurposing strategies. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-	3	3
CO6	3	2	-	-	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL515	DATA PRIVACY AND PROTECTION TECHNIQUES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105001	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24AIPC401					

OBJECTIVES:

- To understand privacy principles, regulations, and data protection frameworks.
- To apply cryptographic techniques to secure sensitive information effectively.
- To explore Privacy-Enhancing Technologies for secure data processing.

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- To design privacy-preserving systems for real-world applications securely.
- To evaluate privacy risks and implement compliance measures for secure data governance.

MODULE - I FOUNDATIONS OF DATA PRIVACY AND LEGAL FRAMEWORKS 8

Introduction to Data Privacy and Data Protection – Personally Identifiable Information (PII) and Sensitive Data – Privacy vs Data Protection – Privacy Challenges in Digital Systems – GDPR – CCPA – Digital Personal Data Protection Act (DPDP), India – Data Subject Rights – Consent Management – Data Minimization – Purpose Limitation – Privacy Governance and Compliance Frameworks.

MODULE - II DATA PROTECTION AND CRYPTOGRAPHY 7

Fundamentals of Cryptography – Symmetric Encryption (AES) – Asymmetric Encryption (RSA, ECC) – Data at Rest and Data in Transit – TLS/SSL Protocols – Hash Functions and Data Integrity – Password Security – Key Generation – Key Rotation – Secure Key Storage – Key Revocation – Cryptographic Best Practices.

MODULE - III PRIVACY-ENHANCING TECHNOLOGIES (PETS) 8

Introduction to Privacy-Enhancing Technologies (PETS) – Fully Homomorphic Encryption (FHE) – Introduction to Torus-FHE – Recent Trends in FHE – Bootstrapping Efficiency – Hardware Implementation of FHE – Compiler Optimizations for FHE – Searchable Encryption – Searchable Symmetric Encryption (SSE) – Security Proofs in Searchable Symmetric Encryption – Functional Encryption – Attribute-Based Encryption.

MODULE - IV DIFFERENTIAL PRIVACY AND SECURE COMPUTATION 8

Introduction to Differential Privacy (DP) – Information-Theoretic Measures of Differential Privacy – Differential Privacy Techniques and Proofs – Practical Applications of Differential Privacy – Secure Multi-Party Computation (SMPC) – Applications of Secure Multi-Party Computation – Oblivious Transfer (OT) Protocols – Zero-Knowledge Proofs.

MODULE - V CONFIDENTIAL COMPUTING AND PRIVACY ENGINEERING 7

Trusted Architectures – Confidential Computing Fundamentals – Trusted Execution Environments (TEEs) – Intel SGX – Intel TDX – Limitations of TEEs

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for Confidential Computing – Role-Based Access Control (RBAC) – Attribute-Based Access Control (ABAC) – Privacy by Design – Secure Software Development Life Cycle (SSDLC) – Data Loss Prevention (DLP).

MODULE - VI PRIVACY ENGINEERING APPLICATIONS AND RISK MANAGEMENT 7

Anonymization and Pseudonymization – Data Masking – Tokenization – Privacy Impact Assessment (PIA) – Data Protection Impact Assessment (DPIA) – Data Auditing and Monitoring – Incident Response and Data Breach Management – Privacy Engineering Frameworks – Privacy-Preserving Search Engines – Privacy Computations in Smart Grids – Privacy-Preserving Machine Learning (PPML) – Emerging Trends in Privacy Engineering.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ninghui Li, Min Lyu, Dong Su and Weining Yang, "Differential Privacy: From Theory to Practice", Morgan & Claypool Publishers, 2016.
2. Wes McKinney, "Python for Data Analysis", O'Reilly Publications, 2022.
3. Khaled El Emam and Luk Arbuckle, "Anonymizing Health Data", O'Reilly Media, 2013.

REFERENCES:

1. Yehuda Lindell and Jonathan Katz, "Introduction to Modern Cryptography", CRC Press, 2020.
2. Oded Goldreich, "Foundations of Cryptography", Cambridge University Press.
3. Cynthia Dwork and Aaron Roth, "The Algorithmic Foundations of Differential Privacy", Now Publishers.
4. Joseph Near and Chiké Abuah, "Programming Differential Privacy", OpenDP Publications.
5. Kai Rannenberg, Prokopios Drogkaris, and Cédric Lauradoux (Eds.), Privacy Technologies and Policy, Springer, 2024.

WEB REFERENCES:

1. https://gdpr-info.eu/
2. https://oag.ca.gov/privacy/ccpa
3. https://csrc.nist.gov/
4. https://homomorphicencryption.org/
5. https://www.google.com/search?q=https://edpb.europa.org/

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ONLINE RESOURCES:

1. https://opendp.org/
2. https://homomorphicencryption.org/
3. https://www.microsoft.com/en-us/research/project/differential-privacy/
4. https://www.nist.gov/privacy-framework
5. https://www.openmined.org/

OUTCOMES:

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

1. Apply the concepts of data privacy, data protection, and global privacy regulations. (K3)
2. Apply cryptographic techniques and key management mechanisms to protect sensitive data. (K3)
3. Analyze and implement Privacy-Enhancing Technologies such as FHE, SSE, Functional Encryption, and Attribute-Based Encryption. (K4)
4. Apply Differential Privacy, Secure Multi-Party Computation, Oblivious Transfer, and Zero-Knowledge Proofs for privacy-preserving data processing. (K3)
5. Design privacy-aware systems using confidential computing technologies, TEEs, and privacy-by-design principles. (K3)
6. Examine privacy risks and develop privacy engineering solutions for real-world applications including machine learning, search engines, and smart grids. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	–	–	2	–
CO2	3	2	–	–	–	–	–	–	–	–	–	3	2
CO3	2	3	–	–	–	–	–	–	–	–	–	3	2
CO4	2	3	–	–	–	–	–	–	–	–	–	3	3
CO5	2	2	–	–	–	–	–	–	–	–	–	3	3
CO6	2	3	–	–	–	–	–	–	–	–	–	3	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL516	SMART BUILDING AND AUTOMATION SECURITY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 124107003	SYLLABUS VERSION 1.0	SDG NO. 3, 4, 9				
PRE-REQUISITE COURSES	24BSMA201, 24AIPT401, 24BSMA303, 24AIPT201					

OBJECTIVES:

- To understand the concepts and evolution of Futurist Architecture and Intelligent Buildings.
- To learn the components, technologies, and automation systems used in intelligent buildings.
- To analyze the integration of HVAC, lighting, security, and energy management systems.
- To explore BIM, VR, AI, and advanced digital technologies in intelligent building design.
- To evaluate building performance in terms of sustainability, occupant comfort, health, and productivity.
- To develop future-oriented intelligent building solutions aligned with smart city and net-zero objectives.

MODULE - I FOUNDATIONS OF FUTURIST ARCHITECTURE 9

Origins of the Futurist Movement - The Futurist Manifesto. Principles of Futurist Architecture - Antonio Sant'Elia: Life and Vision - Città Nuova: The Future City Imagined - Futurist Aesthetic and Technology - Impact and Legacy of Futurist Architecture - Revival and Reinterpretation of Futurist Architecture. Transition to Smart and Intelligent Buildings - Definition and Core Concepts of Intelligent Buildings.

MODULE - II INTELLIGENT BUILDING SYSTEMS — HISTORY, COMPONENTS AND AUTOMATION 7

History and Evolution of Intelligent Buildings, Benefits and Challenges of Intelligent Buildings, Basic Components and Technologies of Smart Buildings, Building Automation Systems (BAS) — Structure and Functions, BAS — Design, Implementation, and Integration.

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MODULE - III CONTROL STRATEGIES, HVAC AND ADVANCED BUILDING TECHNOLOGIES 7

Case Studies of BAS in Intelligent Buildings, Control Strategies for Energy Efficiency and Comfort, Integration with HVAC, Lighting, and Security, Smart Lighting — Fundamentals and Protocols, Smart Lighting — Case Studies

MODULE - IV INTELLIGENT HVAC, SECURITY SYSTEMS & BIM 8

Intelligent HVAC - Core Components - Intelligent HVAC AI Optimization - Intelligent HVAC Integration, Tools, and Challenges. Building Security - Access Control and Surveillance - Building Security Networked Systems and Standards. BIM, Virtual Reality and Data-Driven Design - BIM for Intelligent Building Design and Management - Virtual Reality in Architecture - Trans-Architecture: Beyond Physical Boundaries.

MODULE - VI DESIGNING, EVALUATING & EXPERIENCING INTELLIGENT BUILDINGS 7

Designing Intelligent Buildings - Evaluating Intelligent Buildings - Green Buildings and Human Performance - Thermal Environment - Productivity and Environmental Factors - Sick Building Syndrome.

MODULE - VI FUTURE DIRECTIONS — SUSTAINABILITY, AI & THE INTELLIGENT CITY 7

Planning, Design, and Management Recommendations for Intelligent Buildings - Net-Zero and Carbon-Positive Intelligent Buildings - AI and Machine Learning in Building Management - Intelligent Buildings within Smart Cities - Future Frontiers and Course Synthesis.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Intelligent Buildings: Design Management and Operation by Clements, Derek, Croome, Thomas Telford, Ltd.
2. Visionary Architecture: Unbuilt Works of the Imagination by Burden, Ernest, McGraw-Hill Professional.
3. Intelligent Building and Building Automation by Shengwei Wang, Spon press.
4. Berghaus, G. (Ed.). (2012). International futurism in arts and literature (Vol. 13). Walter de Gruyter.

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REFERENCES:

1. Asim, F., & Shree, V. (2018). A Century of Futurist Architecture: From Theory to Reality. p-ISSN: 2349-8404; e-ISSN: 2349-879X. Krishi Sanskriti Publications.
2. de Paor-Evans, A. (2016). Futurism: Futurist Architecture. Routledge Encyclopedia of Modernism.

WEB REFERENCES:

1. https://www.ibm.com/think/topics/building-automation
2. https://www.trane.com/commercial/north-america/us/en/products-systems/smart-building-technology.html
3. https://centaur.reading.ac.uk/76976/1/Manuscript%20-%20SBS%20-%20For%20CENTAUR.pdf

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/statistics-probability
2. https://www.coursera.org/learn/machine-learning
3. https://developers.google.com/machine-learning
4. https://towardsdatascience.com
5. https://scikit-learn.org

OUTCOMES:

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

1. Analyze the principles of Futurist Architecture and their influence on intelligent building development. (K4)
2. Apply Building Automation Systems and smart building technologies to improve building operations. (K3)
3. Analyze integrated HVAC, lighting, and security strategies for intelligent building management.(K4)
4. Utilize BIM, virtual reality, and advanced building technologies in intelligent building design and operation. (K3)
5. Examine sustainability, occupant well-being, and environmental factors in intelligent building design. (K4)
6. Infer AI and machine learning techniques in intelligent building management within smart city environments.(K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	1
CO2	3	2	-	-	-	-	-	-	-	-	2	3	2
CO3	3	3	-	-	-	-	-	-	-	-	2	3	2
CO4	2	2	-	-	-	-	-	-	-	-	2	3	3
CO5	2	3	-	-	-	-	-	-	-	-	2	2	2
CO6	2	3	-	-	-	-	-	-	-	-	3	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL517	INTRODUCTION TO SMART AND SECURE SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105195	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24AIPT401,24AIPC401					

OBJECTIVES:

- To understand the fundamentals of Industry 4.0, industrial communication, sensing, actuation, and networking technologies.
- To analyze enabling technologies such as Cyber Physical Systems (CPS), Artificial Intelligence (AI), Big Data Analytics, AR/VR, and Industrial Cybersecurity.
- To understand IIoT architectures, business models, communication layers, and industrial data processing frameworks.
- To apply industrial networking, machine learning, cloud/fog computing, and security concepts for IIoT-based applications.
- To evaluate and design Industry 4.0 solutions for manufacturing and industrial application domains through real-world case studies.

MODULE - I FUNDAMENTALS OF INDUSTRIAL IOT SYSTEMS 7

Introduction - Sensing & Actuation - Communication Part I - Communication Part II - Networking Part I - Networking Part II. Industry 4.0 - Globalization and Emerging Issues - The Fourth Revolution - LEAN Production Systems - Smart and Connected Business Perspective - Smart Factories.

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MODULE - II ENABLING TECHNOLOGIES FOR INDUSTRY 4.0 7

Industry 4.0 - Cyber Physical Systems and Next Generation Sensors - Collaborative Platform and Product Lifecycle Management - Augmented Reality and Virtual Reality - Artificial Intelligence - Big Data and Advanced Analysis. Cybersecurity in Industry 4.0 - Basics of Industrial IoT - Industrial Processes Part I - Industrial Processes Part II - Industrial Sensing & Actuation - Industrial Internet Systems.

MODULE - III INDUSTRIAL IOT ARCHITECTURE AND BUSINESS MODELS 7

IIoT Introduction - Industrial IoT - Business Model and Reference Architecture - IIoT Business Models Part I - IIoT Business Models Part II - IIoT Reference Architecture Part I - IIoT Reference Architecture Part II. Industrial IoT Layers - IIoT Sensing Part I - IIoT Sensing Part II - IIoT Processing Part I - IIoT Processing Part II - IIoT Communication Part I.

MODULE - IV INDUSTRIAL NETWORKING AND DATA ANALYTICS 8

Industrial IoT Layers - IIoT Communication Part II - IIoT Communication Part III - IIoT Networking Part I - IIoT Networking Part II - IIoT Networking Part III. Industrial IoT - Big Data Analytics and Software Defined Networks - IIoT Analytics Introduction - Machine Learning and Data Science Part I - Machine Learning and Data Science Part II - R and Julia Programming - Data Management with Hadoop.

MODULE - V SECURITY, CLOUD, FOG COMPUTING AND INDUSTRIAL APPLICATIONS 8

Industrial IoT - Big Data Analytics and Software Defined Networks - SDN in IIoT Part I - SDN in IIoT Part II - Data Center Networks. Industrial IoT - Security and Fog Computing - Cloud Computing in IIoT Part I - Cloud Computing in IIoT Part II - Fog Computing in IIoT - Security in IIoT Part I - Security in IIoT Part II. Industrial IoT Application Domains - Factories and Assembly Line - Food Industry.

MODULE - VI ADVANCED IIOT APPLICATIONS AND INDUSTRIAL CASE STUDIES 8

Industrial IoT Application Domains - Healthcare - Power Plants - Inventory Management and Quality Control - Plant Safety and Security (Including AR and VR Safety Applications) - Facility Management. Industrial IoT Application Domains - Oil, Chemical and Pharmaceutical Industry - Applications of UAVs in Industries. Real Case Studies - Case Study I: Milk Processing and Packaging

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Industries - Case Study II: Manufacturing Industries Part I - Case Study III: Manufacturing Industries Part II - Case Study IV: Student Projects Part I - Case Study V: Student Projects Part II - Case Study VI: Virtual Reality Lab - Case Study VII: Steel Technology Lab.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Industry 4.0: The Industrial Internet of Things,Author: Alasdair Gilchrist Publisher: Apress, 2016.
2. Internet of Things: A Hands-On Approach, Authors: Arshdeep Bahga, Vijay Madisetti Publisher: Universities Press, 2015
3. Raj Kamal, Internet of Things: Architecture and Design Principles, 3rd Edition, McGraw Hill, 2024.

REFERENCES:

1. Fog and Edge Computing: Principles and Paradigms, Publisher: Wiley, 2019
2. Security and Privacy in Internet of Things (IoTs): Models, Algorithms and Implementations, Publisher: CRC Press, 2016
3. Machine Learning, Publisher: McGraw-Hill, 1997.
4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 2nd Edition, Cisco Press, 2024.

WEB REFERENCES:

1. https://www.researchgate.net/publication/305848081_Industry_40
2. https://www.researchgate.net/publication/304568537_Introducing_Industry_40
3. https://www.kngac.ac.in/elearning-portal/ec/admin/contents/4_18KP2CS07_20210129022344 24.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105195
2. https://www.ibm.com/think/topics/industry-4-0
3. https://www.geeksforgeeks.org/computer-networks/introduction-to-internet-of-things-iot-set-1/

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OUTCOMES:

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

1. Apply the concepts of Industry 4.0, industrial sensing, actuation, communication, networking, and smart manufacturing systems.(K3)
2. Make use of Cyber Physical Systems, AI, AR/VR, Big Data technologies, and cybersecurity mechanisms used in Industry 4.0 environments.(K3)
3. Analyze Industrial IoT architectures, business models, sensing, processing, and communication layers for industrial applications.(K4)
4. Apply industrial networking, machine learning, big data analytics, software-defined networking, and Hadoop-based frameworks for IIoT systems.(K3)
5. Infer cloud computing, fog computing, SDN, and security solutions for industrial IoT deployments.(K4)
6. Examine IIoT solutions for industrial sectors such as healthcare, manufacturing, power plants, food processing, pharmaceuticals, and smart facilities using real-world case studies.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	-	-	-	3	3
CO2	-	-	-	-	-	-	-	-	2	-	-	2	3
CO3	3	-	-	-	-	-	-	-	2	-	-	2	2
CO4	3	-	-	-	-	-	-	2	-	-	-	2	2
CO5	3	-	-	-	3	-	-	-	-	-	-	2	3
CO6	3	-	-	-	3	-	-	-	-	-	-	2	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL503	CLOUD COMPUTING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105167	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24AIPT301 ,24AIPC401					

OBJECTIVES:

- To interpret the basics of cloud computing.
- To learn about concepts of virtualization and virtualization infrastructure.
- To understand the principles of Cloud Architecture, Design challenges and Infrastructure.
- To explore and experiment various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

MODULE - I CLOUD ARCHITECTURE AND MODELS 7

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Characteristics – Cloud deployment models – Cloud service models – Pros and Cons of Cloud.

MODULE - II INTRODUCTION TO VIRTUALIZATION 8

Basics of Virtualization – Virtualization Types – Implementation Levels of Virtualization – Virtualization Structures / Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual Clusters and Resource management – Virtualization for Data-Center Automation – Virtualization Support and Disaster Recovery – Taxonomy of Virtual Machines – Create VM Cluster using VMWare or Virtual Box and deploy an application.

MODULE - III CLOUD INFRASTRUCTURE 8

Cloud Infrastructure: Architectural design of compute and storage clouds – Layered cloud architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

MODULE - IV CLOUD DEPLOYMENT ENVIRONMENT 7

Parallel Programming Framework: Hadoop Map Reduce – Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack – OpenNebula – Aneka.

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MODULE - V CLOUD SECURITY 7

Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice; Security Management in the Cloud – Security Management Standards – SaaS, Paas and IaaS Availability Management – Access Control; Security-As-A-Service.

MODULE - VI CLOUD SIMULATOR & CLOUD APPLICATIONS 8

CloudSim – Architecture - Cloudlets – VM creation – Broker – VM allocation – Hosts – Data Center. Web Service Architecture – Web service APIs – Web service authentication - Web service authentication methods - Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffery C Fox, Jack J Dongarra, "Distributed and Cloud Computing: Clus- ters, Grids, Clouds and the Future of Internet", 1st Edition, Morgan Kaufman Publisher, Oxford, an Imprint of Elsevier, 2012.
2. Srinivasan A, Suresh J, "Cloud Computing: A practical Approach for Learning and Implementation", Pearson Education India, 2014.

REFERENCES:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif , "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, 2009.
2. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009.
3. James E Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4. William von Hagen, "Professional Xen Virtualization", Wrox Publications, January, 2008.
5. David Marshall, Wade A Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.
6. Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley, 2010. 3. Rajkumar Buyya, Christian Vecchiola, S.TamaraiSelvi, "Mastering Cloud Computing", Tata McGraw Hill,2013.

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7. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", first edition, McGrawHill Osborne Media, 2009.

ONLINE RESOURCES:

1. National Institute of Standards and Technology - https://www.nist.gov/itl/cloud
2. Amazon Web Services Documentation - https://docs.aws.amazon.com
3. Microsoft Azure Learn - https://learn.microsoft.com/azure
4. Google Cloud Docs - https://cloud.google.com/docs
5. OpenStack Foundation - https://www.openstack.org
6. https://onlinecourses.nptel.ac.in/noc24_cs118/announcements
7. https://www.coursera.org/browse/information-technology/cloud-computing
8. https://www.edx.org/learn/cloud-computing
9. https://aws.amazon.com/training/learn-about/cloud-practitioner/
10. https://learn.microsoft.com/en-us/training/paths/azure-fundamentals/
11. https://www.cloudskillsboost.google/paths/11

OUTCOMES:

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

1. Apply cloud computing architecture concepts, including distributed system models and NIST reference architecture, to solve real-world cloud scenarios. (K3)
2. Implement virtualization techniques to create virtual machines, manage virtual clusters, and utilize tools like VMware or VirtualBox. (K3)
3. Use cloud infrastructure design principles to develop scalable compute and storage solutions with efficient resource provisioning. (K3)
4. Build applications using parallel programming frameworks and cloud platforms such as Hadoop, AWS, Azure, and Google App Engine. (K3)
5. Apply cloud security mechanisms, including identity and access management (IAM), access control, and data protection strategies. (K3)
6. Model cloud simulation tools like CloudSim and web service technologies to model, deploy, and evaluate cloud-based applications. (K3)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	2	2
CO2	2	2	3	-	3	-	-	-	-	-	-	2	2
CO3	2	2	3	-	3	-	-	-	-	-	2	2	2
CO4	2	2	3	-	3	-	-	-	-	-	2	2	2
CO5	2	2	3	-	2	-	-	-	-	-	-	2	2
CO6	2	2	3	-	3	-	-	-	-	-	2	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL510	ADVANCED ANALYSIS OF ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105704	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24AMPC302					

OBJECTIVES:

- To understand advanced algorithmic analysis techniques including amortized analysis.
- To study advanced data structures and network flow algorithms.
- To analyze matching problems and stable matching algorithms.
- To explore randomized algorithms and order statistics techniques.
- To understand computational complexity, NP-completeness and reductions.
- To examine approximation algorithms for NP-hard optimization problems

MODULE - I AMORTIZED ANALYSIS & ADVANCED DATA STRUCTURES 8

Introduction to Amortized Complexity – Aggregate Method – Accounting Method – Potential Function Method – Applications of Amortized Analysis – Fibonacci Heaps: Structure, Operations, Amortized Cost Analysis and Applications.

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MODULE - II NETWORK FLOW ALGORITHMS 8

Maximum Flow Problem – Flow Networks – Ford-Fulkerson Method – Edmond-Karp Algorithm– Dinic's Algorithm – Push-Relabel Method – Correctness and Complexity Analysis.

MODULE - III MATCHING AND FLOW APPLICATIONS 8

Applications of Maximum Flow – Hall's Marriage Theorem – Maximum Bipartite Matching –König's Theorem – Edmonds' Blossom Algorithm for Maximum Matching in General Graphs – Stable Matching Problem – Gale-Shapley Algorithm.

MODULE - IV ORDER STATISTICS, STRING MATCHING AND RANDOMIZED ALGORITHMS 7

Order Statistics – Selection Algorithms – String Matching Techniques – Introduction to Randomized Algorithms – Karger's Minimum Cut Algorithm – Karger-Stein Algorithm – Analysis of Randomized Algorithms..

MODULE - V COMPUTATIONAL COMPLEXITY & NP - COMPLETENESS 7

Lower Bounds on Sorting – Decision and Optimization Problems – Complexity Classes P and NP – Introduction to NP-Completeness – Polynomial-Time Reductions – NP-Completeness Proof Techniques and Examples.

MODULE - VI APPROXIMATION ALGORITHMS 8

Approximation Algorithms – Approximation Ratio – Approximation Algorithm for 3SAT – Metric Traveling Salesman Problem (Metric TSP) – Performance Guarantees – Limitations of Approximation Algorithms.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, " Introduction to Algorithms", Fourth Edition, MIT Press, 2022.
2. Jon Kleinberg and Éva Tardos, "Algorithm Design", First Edition, Pearson Education, 2006.

REFERENCES:

1. Vijay V. Vazirani, "Approximation Algorithms", Springer, First Edition, 2003.
2. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", McGraw-Hill Education, First Edition, 2008.

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3. Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley, Second Edition, 2013.
4. Dexter C. Kozen, "The Design and Analysis of Algorithms", Springer, First Edition, 1992.
5. Christos H. Papadimitriou, "Computational Complexity", Addison-Wesley, First Edition, 1994.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105704
2. https://nptel.ac.in/courses/106106131
3. https://ocw.mit.edu
4. https://online.stanford.edu
5. https://visualgo.net

OUTCOMES:

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

1. Apply amortized analysis techniques and advanced data structures to evaluate algorithmic efficiency. (K3)
2. Analyze and implement maximum flow algorithms for network optimization problems. (K4)
3. Solve matching problems using graph-theoretic algorithms and stable matching techniques. (K4)
4. Apply order statistics, string matching and randomized algorithms to computational problems. (K3)
5. Examine computational complexity classes and prove NP-completeness using polynomial-time reductions. (K4)
6. Design and analyze approximation algorithms for NP-hard optimization problems. (K5)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	-	2	-	-	-	-	-	-	2	2
CO2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2
CO4	2	2	2	-	2	-	-	-	-	-	-	2	2
CO5	2	3	1	-	1	-	-	-	-	-	-	2	2
CO6	2	3	3	-	2	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL512	PARALLEL ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106103359	SYLLABUS VERSION 1.0	SDG NO. 9				
PRE-REQUISITE COURSES	24BSMA201,24AMPC302					

OBJECTIVES:

- To introduce the design principles of parallel algorithms
- To understand various models of parallel computation (PRAM, EREW, CREW, CRCW and DCM) and Performance analysis metrics such as cost, speedup and efficiency.
- To learn fundamental parallel algorithms for sorting and Searching
- To apply parallel algorithms to solve matrix operations, algebraic and Geometry problems.
- To apply parallel algorithm techniques in solving real-world computational problems

MODULE - I INTRODUCTION TO PARALLEL ALGORITHMS 7

Introduction to Parallel Algorithms-Parallel Programming Paradigms-Parallel Architecture-Need for Parallel Algorithms-Serial vs Parallel Computation-Concepts of Concurrency and Parallelism-Overview of Models of Computation-Applications of Parallel Algorithms

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MODULE - II MODELS & COMPLEXITY ANALYSIS 8

Introduction to PRAM Model-PRAM Model (EREW, CREW, CRCW)-Distributed Computing Model (DCM – basics)-Work, Time Complexity, Cost Optimality-Brent's Theorem (basic idea)-Analysis of Parallel Algorithms

MODULE - III PERFORMANCE AND BASIC PARALLEL TECHNIQUES 7

Performance Measures: cost, speedup, efficiency-Work-time analysis-Basic Parallel Techniques-Parallel Prefix (Scan) Computation-Pointer Jumping Technique-Divide and Conquer Approach-Parallel Reduction Operations-Synchronization and Communication overheads

MODULE - IV PARALLEL SORTING & SEARCHING 8

Sorting Networks and Bitonic Sort & odd-Even Transposition Sort-Cole's Merge sort-Sorting on Linear Array-Sorting in EREW, CREW, CRCW-Parallel Searching: Linear and Binary Search-Performance Comparison

MODULE - V ALGEBRAIC, GRAPH & GEOMETRY ALGORITHMS 7

Matrix Transposition-Matrix Multiplication (Matrix–Matrix, Matrix–Vector)-Connected Components-Minimum Spanning Tree-All-Pairs Shortest Paths-Computational Geometry Problems

MODULE - VI ADVANCED PREFIX ALGORITHMS AND APPLICATIONS 8

Prefix Sums (Advanced)-Job Sequencing Problem-Knapsack Problem-Integer Addition and Multiplication-Speedup, Efficiency, Scalability-Amdahl's Law and Gustafson's Law-Applications in AI, Big Data, Scientific Computing

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing" , Edition: 2nd Edition, 2003.
2. Joseph JáJá , "Introduction to Parallel Algorithms", Addison-Wesley ,1992

REFERENCES:

1. Xavier & Iyengar, "Introduction to Parallel Algorithms", Wiley, 1998.
2. Sanders et al., "Sequential and Parallel Algorithms and Data Structures", Springer, 2019.
3. Barry Wilkinson & Michael Allen, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Pearson, 2005.

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4. Selim G. Akl , "Design and Analysis of Parallel Algorithms", Prentice Hall, 1989.

ONLINE RESOURCES:

1. https://www.mindluster.com/lesson/221422-video?
2. https://slidetodoc.com/pram-model-lecture-3-efficient-parallel-algorithms-comp/
3. https://www.geeksforgeeks.org/dsa/bitonic-sort/
4. https://onlinecourses-archive.nptel.ac.in/noc19_cs17/preview1
5. https://www.nptelprep.in/courses/106104120/materials
6. https://ocw.mit.edu/search/?q=parallel%20algorithms&t=Algorithms%20and%20Data%20Structures

OUTCOMES:

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

1. Apply parallel algorithm design principles to solve computational problems using appropriate models.(K3)
2. Apply PRAM models (EREW, CREW, CRCW) and distributed computing concepts to implement parallel solutions.(K3)
3. Apply performance analysis metrics such as cost, speedup, efficiency and work-time analysis to evaluate parallel algorithms(K3)
4. Implement parallel sorting and searching algorithms.(K3)
5. Apply parallel algorithms to solve matrix operations, graph problems and computational geometry problems.(K3)
6. Apply parallel algorithms to solve real-world problems(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	-	2	2	2
CO3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	-	-	-	-	-	-	2	2	2
CO6	2	2	2	2	-	-	-	-	-	-	2	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEP501	SOFTWARE DESIGN PATTERNS FOR INTELLIGENT AUTOMATION LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 106105182	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AMPC302, 24AMPT301, 24AIPC401					

OBJECTIVES:

- To understand the software development lifecycles and agile paradigms tailored for intelligent automation.
- To learn advanced object-oriented modeling techniques for non-deterministic automated environments.
- To master creational design patterns for dynamic object instantiation in robotics and process automation.
- To study structural integration patterns to streamline data normalization and wrap complex libraries.
- To implement behavioral design patterns to orchestrate real-time decision-making systems.
- To examine system reliability, software quality metrics, and continuous refactoring strategies.

MODULE - I AUTOMATION LIFECYCLES AND AGILE PROJECT MANAGEMENT 8

Evolution of Software Engineering Paradigms to Autonomous, Data-Driven Systems - Traditional Lifecycles (Waterfall, V-Model) - Iterative and Continuous Paradigms for AI and Intelligent Automation - Agile Engineering Practices - Scrum Framework - DevSecOps Pipelines for Automated Software Generation - DevSecOps Pipelines for Machine Learning Models.

LIST OF EXPERIMENTS:

1. Build an automated DevOps pipeline featuring blue-green deployment strategies for an Intelligent Document Processing (IDP) scoring model.
2. Develop an agile tracking dashboard to monitor runtime model drift and automated system performance metrics.

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MODULE - II REQUIREMENTS ANALYSIS AND ADVANCED OBJECT-ORIENTED MODELING 8

Requirement Elicitation Techniques for Non-Deterministic Automation Workflows - Functional Requirements - Non-Functional Requirements - Latency Requirements - Safety Boundaries - Drift Observability - Core Object-Oriented Analysis and Design (OOAD) Principles - Encapsulation - Polymorphism - Inheritance - Dynamic Binding - Application of OOAD Principles to Multi-Agent Automation Architectures.

LIST OF EXPERIMENTS:

1. Draft an automated Software Requirement Specification (SRS) mapping multi-threaded failure modes for a smart warehouse sorting robot.
2. Develop an object-oriented abstract hardware wrapper layer using polymorphism to process inputs from diverse sensor types dynamically.

MODULE - III SYSTEM MODELING AND CREATIONAL ORCHESTRATION PATTERNS 7

Unified Modeling Language (UML) Structural and Behavioral Modeling for Complex Automation Platforms - Class Diagrams - Use Case Diagrams - Sequence Diagrams - Statechart Diagrams - Coupling Metrics in Automation Components - Cohesion Metrics in Automation Components - Introduction to Creational Design Patterns - Singleton Pattern for Hardware Configurations - Factory Method Pattern for Instantiating Polymorphic RPA Bots and Web Scrapers - Abstract Factory Pattern for Instantiating Polymorphic RPA Bots and Web Scrapers.

LIST OF EXPERIMENTS:

1. Generate interactive UML sequence and statechart diagrams capturing communication flows within an autonomous drone delivery system.
2. Implement a thread-safe Singleton telemetry manager and an Abstract Factory pattern to instantiate Web, Desktop, and Mobile UI automation drivers at runtime.

MODULE - IV STRUCTURAL INTEGRATION AND DATA NORMALISATION PATTERNS 8

Deep Dive into Structural Software Relationships - Adapter Pattern for Standardizing Heterogeneous Legacy Enterprise APIs - Facade Pattern for Abstracting Massive and Complex Machine Learning and AI Inference Libraries - Proxy Pattern for Controlling Resource-Heavy Edge Computing Nodes - User Interface (UI) Design Principles - Human-in-the-Loop Automation Dashboards.

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LIST OF EXPERIMENTS:

1. Build a structural Adapter to ingest unstructured data streams (JSON, XML, CSV) into a unified enterprise automation pipeline.
2. Create a Facade interface to simplify a multi-layered Natural Language Processing (NLP) framework for an automated customer support routing tool.

MODULE - V BEHAVIORAL SYNCHRONIZATION AND STATE-DRIVEN AUTOMATION 7

Coding Standards for Automation Scripts - Test-Driven Development (TDD) - Clean Code Implementations for Automation Scripts - Introduction to Behavioral Design Patterns - Strategy Pattern for Dynamic Algorithmic Trading - Strategy Pattern for Operational Routing - Observer Pattern for Real-Time Event-Driven Sensor Alerts - State Pattern for Orchestrating Robot Execution Phases.

LIST OF EXPERIMENTS:

1. Code an Observer-driven notification engine that triggers real-time responses based on network anomaly detection thresholds.
2. Design a robotic picking-arm state controller using the State pattern to seamlessly transition between scanning, grasping, and docking phases.

MODULE - VI QUALITY ASSURANCE, RELIABILITY AND ARCHITECTURAL PATTERNS 7

Software Quality Assurance (SQA) Metrics - Reliability Estimation Models - Fallback Exception-Handling Paradigms for Autonomous Software - Architectural Patterns - Model-View-Controller (MVC) - Microservices Architecture - Event-Driven Architecture (EDA) - Utilization of CASE Tools - Generative Programming Assistants for Automated Refactoring - Generative Programming Assistants for Performance Optimization.

LIST OF EXPERIMENTS:

1. Write structured unit test suites using Mocking frameworks to isolate and validate an autonomous decision matrix without calling live external APIs.
2. Execute an automated structural code refactoring script to eliminate structural smells and improve operational throughput in a legacy RPA macro workflow.

TOTAL : 45 PERIODS

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LABORATORY REQUIREMENTS:

Standalone desktop with Python, Anaconda, Visual Studio Code, Git, Jenkins, Docker, PlantUML, Selenium, PyTest, Mock, SonarQube Community Edition, Pandas, NumPy, and Matplotlib-30 Nos.

TEXT BOOKS

1. Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software", Pearson Education, 1st Edition, 2015.
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021.
3. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill Higher Education, 8th Edition, 2019.

REFERENCES:

1. Robert C. Martin, "Clean Code: A Handbook of Agile Software Craftsmanship", Prentice Hall, 1st Edition, 2008.
2. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc., First Edition, 2008.
3. Alan Shalloway and James R. Trott, "Design Patterns Explained: A New Perspective on Object-Oriented Design", Addison-Wesley, 2nd Edition, 2004.

WEB REFERENCES:

1. NPTEL Software Engineering Course Portal
2. O'Reilly Design Patterns Digital Resource Library

ONLINE RESOURCES:

1. https://docs.cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning
2. https://learn.microsoft.com/en-us/dotnet/architecture/modern-web-apps-azure/architectural-principles
3. https://www.geeksforgeeks.org/java-singleton-design-pattern-practices-examples/
4. https://www.google.com/search?q=https://refactoring.guru/design-patterns/behavioral

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OUTCOMES:

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

1. Utilize modern agile life cycles and DevSecOps pipelines to autonomous automation workflows. (K3)
2. Analyze requirement specifications and model object-oriented structural designs for complex multi-agent systems. (K4)
3. Implement creational design patterns for dynamic runtime component orchestration. (K3)
4. Analyze structural integration patterns to unify disparate data streams and complex libraries. (K4)
5. Apply behavioral design patterns to construct state-driven and event-driven automation architectures. (K3)
6. Examine system quality metrics, execute automated refactoring, and establish comprehensive test coverage. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	2	3	3
CO2	2	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	-	2	-	-	-	-	-	-	3	3
CO4	3	3	-	-	2	-	-	-	-	-	-	2	2
CO5	3	2	-	-	3	-	-	-	-	-	-	2	3
CO6	2	3	-	-	-	-	-	-	-	-	2	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEP504	AI FOR ENTERPRISES DATA ANALYTICS LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 110104513	SYLLABUS VERSION 1.0	SDG NO. 8, 9				
PRE-REQUISITE COURSES	24BSMA407, 24AIPC402					

OBJECTIVES:

- To provide knowledge of advanced R programming concepts, data structures, and functional programming techniques for data science applications.
- To enable students to perform data visualization and exploratory data analysis using R and ggplot2 packages.
- To develop skills in data preprocessing, cleaning, transformation, and handling of complex datasets including date and time objects.
- To impart statistical analysis knowledge including descriptive statistics, probability distributions, and inferential statistical techniques using R.
- To train students in regression analysis, time-series modelling, and panel data methods for predictive analytics.
- To introduce advanced machine learning and classification techniques such as quantile regression, logit, and probit models for data-driven decision making.

MODULE - I FUNDAMENTALS OF R PROGRAMMING AND DATA VISUALIZATION 7

Introduction and Background of R Programming – Installation and Setup – Working Directory – Packages and Libraries – Arithmetic, Assignment, Comparison and Logical Operators – Data Types – Vector Creation and Manipulation – Sequence, Repetition, Sorting and Random Number Generation – User Defined Functions – lapply(), sapply(), tapply() – Factor Variables – Indexing – Data Coercion – Conditional Statements – Basic Data Visualization using R – Bar Chart, Pie Chart, Histogram, Density Plot and Boxplot – Plot Customization – Legends, Colors, Axis Labels, Chart Titles – Overlay Plots.

LIST OF EXPERIMENTS:

1. Installation and setup of R environment, packages, libraries, and implementation of basic R programming constructs.

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2. Creation and manipulation of vectors, matrices, lists, factors, and implementation of user-defined functions in R.
3. Implementation of data visualization techniques using basic R plots such as bar chart, pie chart, histogram, density plot, and boxplot.

MODULE - II ADVANCED VISUALIZATION AND DATA WRANGLING 7

Introduction to ggplot2 – Key Components – Aesthetic Attributes: Color, Size and Shape – Faceting Techniques – Plot Geometries – Smoother, Boxplot, Jitter Plot, Histogram and Frequency Polygon – Time Series Visualization – Axes Modification – Correlation Matrix Visualization – Exploratory Data Analysis – Reading and Writing Data – Exporting and Saving Dataframes – Data Cleaning and Handling – Missing Value Treatment – Adding Rows and Columns – Wide and Long Data Formats – Merging Dataframes.

LIST OF EXPERIMENTS:

1. Design and customization of advanced data visualizations using ggplot2 including faceting, smoothing, and correlation plots.
2. Reading, writing, cleaning, transforming, and merging datasets using data wrangling techniques in R.

MODULE - III DATE-TIME HANDLING AND BASIC STATISTICS 7

Date and Time Handling in R – Current Date and Time – POSIXct and POSIXlt Classes – Parsing Dates – Date and Time Components – Date Arithmetic – Time Zones – Time Intervals, Periods and Durations – Rounding and Truncating Dates – Measures of Central Tendency – Measures of Variability – Measures of Shape – Summary Statistics by Group – Outlier Detection and Treatment – Truncation and Winsorization.

LIST OF EXPERIMENTS:

1. Handling date and time objects using POSIX classes, date arithmetic, time intervals, and time-zone operations.
2. Computation of descriptive statistics, outlier detection, and implementation of probability distributions and sampling methods using R.

MODULE - IV PROBABILITY, INFERENTIAL STATISTICS AND HYPOTHESIS TESTING 8

Probability Distributions – Binomial and Normal Distribution – Sampling Distribution – Types of Sampling – Probability and Non-Probability Sampling – One Sample and Two Sample Tests – Z-Test and T-Test – Proportion Test – Variance Test – Analysis of Variance (ANOVA) – One-Way and Two-Way ANOVA.

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LIST OF EXPERIMENTS:

1. Implementation of hypothesis testing techniques including t-test, z-test, proportion test, variance test, and ANOVA.

MODULE - V REGRESSION AND TIME SERIES MODELLING 8

Introduction to Model Building and Evaluation – Simple and Multiple Linear Regression – Assumptions of Regression – Linearity and Normality – Model Fitting and Interpretation – Regression Diagnostics – Autocorrelation and Heteroscedasticity Tests – Robust Standard Errors – Visualization of Regression Results – Introduction to Time Series Modelling – Time Series Properties – Panel Data Methods – Pooled OLS – Fixed Effect and Random Effect Models – Diagnostic Tests – Residual Analysis and Robust Estimation.

LIST OF EXPERIMENTS:

1. Development and evaluation of simple and multiple linear regression models including residual analysis and visualization.
2. Implementation of time-series modelling, panel data analysis, quantile regression, and classification models such as logit and probit regression.

MODULE - VI ADVANCED NONLINEAR AND CLASSIFICATION MODELS 8

Quantile Regression – Quantile Data Manipulation and Visualization – Outlier Treatment – Diagnostic Tests – Residual Analysis – Robust Estimation – Introduction to Classification Algorithms – Linear Probability Models – Logit and Probit Regression Models – Thresholding and Classification Matrix – ROC Curve – Maximum Likelihood Estimation – Parameter Interpretation – Goodness-of-Fit Measures.

LIST OF EXPERIMENTS:

1. Implementation of quantile regression, quantile data visualization, outlier treatment, and robust estimation techniques.
2. Implementation of classification models such as Linear Probability Model (LPM), Logit Regression, and Probit Regression, including ROC curve analysis, classification matrix, and goodness-of-fit evaluation.

TOTAL : 45 PERIODS

LABORATORY REQUIREMENTS:

Standalone desktop with R Programming Environment, RStudio Desktop (Open Source Edition), LibreOffice Calc, and relevant open-source R packages- 30 Nos

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TEXT BOOKS

1. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly Media, 2023.
2. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, 2011.

REFERENCES:

1. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2021.
2. Roger D. Peng, R Programming for Data Science, Leanpub Publications, 2020.
3. Hadley Wickham, ggplot2: Elegant Graphics for Data Analysis, Springer, 2016.

WEB REFERENCES:

1. https://cran.r-project.org/
2. https://r4ds.hadley.nz/
3. https://ggplot2.tidyverse.org/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110104513
2. https://www.coursehero.com/file/119859021/AI-in-the-enterprisedocx/

OUTCOMES:

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

1. Apply advanced R programming concepts, data structures, and functional programming techniques for data analysis applications. (K3)
2. Develop effective data visualizations and perform exploratory data analysis using R and ggplot2 packages. (K3)
3. Examine data pre-processing, cleaning, transformation, and handling of structured and unstructured datasets. (K4)
4. Analyze datasets using descriptive statistics, probability distributions, and inferential statistical methods. (K4)
5. Build regression, time-series, and panel data models for predictive analytics applications. (K3)

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6. Examine advanced classification and nonlinear modelling techniques such as quantile regression, logit, and probit models for data-driven decision making. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	-	-	-	2	2
CO2	2	3	-	-	3	-	-	-	-	-	-	2	2
CO3	2	3	-	-	3	-	-	-	-	-	-	2	2
CO4	3	3	-	-	2	-	-	-	-	-	-	2	2
CO5	3	3	-	-	2	-	-	-	-	-	-	2	2
CO6	3	3	-	-	2	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEP505	ARTIFICIAL INTELLIGENCE APPLICATIONS IN ROBOTICS LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: 106107001	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA407, 24AIPT401					

OBJECTIVES:

- To understand the fundamentals of Artificial Intelligence and Robotics and their applications in intelligent robotic systems.
- To explore Python programming, Robot Operating System (ROS), and simulation tools for robotic applications.
- To apply robot perception, motion planning, and navigation techniques in autonomous robotic systems.
- To develop computer vision and object recognition solutions using machine learning and deep learning techniques.
- To analyse and implement AI-based learning, decision-making, and navigation algorithms for robotics applications.
- To perform laboratory experiments related to intelligent robotics, human-robot interaction, and AI-enabled robotic systems.

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MODULE - I FUNDAMENTALS OF AI AND ROBOTICS 8

Introduction to Robotics: Components, Types, and Applications - Introduction to Artificial Intelligence and its Role in Robotics - Python Programming for Robotics Applications - Robot Operating System (ROS): Architecture, Nodes, Topics, and Services - Robot Perception: Sensors and Environment Representation - Fundamentals of Robot Navigation and Motion Planning - Robotic Simulation using ROS and Virtual Environments.

LIST OF EXPERIMENTS

1. Installation and configuration of Python, ROS, and Gazebo simulation environment.
2. Create and simulate a mobile robot in ROS/Gazebo.

MODULE - II ROBOT CONTROL AND MOTION PLANNING 7

Fundamentals of Robot Control Systems - Motion Control in Mobile and Autonomous Robots - Trajectory Generation and Path Planning - Motion Planning Algorithms for Intelligent Robots - Obstacle Avoidance Techniques - Autonomous Navigation Strategies - Simulation and Implementation of Robot Control and Navigation using ROS.

LIST OF EXPERIMENTS

1. Implement path planning algorithms in a simulated robot environment.
2. Simulate obstacle avoidance and autonomous navigation using ROS.

MODULE - III COMPUTER VISION AND OBJECT RECOGNITION 8

Fundamentals of Computer Vision and Image Processing - Artificial Neural Networks (ANN) - Supervised Learning for Object Recognition - Deep Learning-Based Object Detection - YOLOv8 for Real-Time Object Recognition - Applications of Computer Vision in Robotics.

LIST OF EXPERIMENTS

1. Perform image processing operations using OpenCV.
2. Implement object detection using YOLOv8 on images and videos.

MODULE - IV MACHINE LEARNING AND AI-BASED NAVIGATION 7

Fundamentals of Machine Learning - Python Libraries and Tools for Machine Learning Implementation - Reinforcement Learning - Deep Reinforcement Learning - Simultaneous Localization and Mapping (SLAM) - AI-Based Navigation in Autonomous Robots.

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LIST OF EXPERIMENTS

1. Develop a reinforcement learning model for autonomous navigation.
2. Implement SLAM for mapping and localization in a simulated environment.

MODULE - V INTELLIGENT NAVIGATION AND HUMAN-ROBOT INTERACTION 8

Intelligent Navigation and Human-Robot Interaction: Decision-Making Algorithms for Robotics - Path Planning and Obstacle Avoidance - A Algorithm for Navigation - Natural Language Processing and Speech Recognition - Chatbots and Generative AI - Human-Robot Interaction and Emotion-Aware Robotic Systems.

LIST OF EXPERIMENTS

1. Implement the A* path-planning algorithm for robot navigation.
2. Develop a speech recognition and chatbot-based interaction system using NLP.

MODULE - VI AI ROBOTICS APPLICATIONS AND FUTURE TRENDS 7

AI Robotics Applications and Future Trends: Robot Hardware and Sensors - Application Domains of AI Robotics - AI Applications in Humanoid, Mobile, and Industrial Robots - Current Trends in Artificial Intelligence - Ethics and Safety in AI Robotics - Robot Demonstration using ROS - Future Trends and Career Opportunities.

LIST OF EXPERIMENTS

1. Simulate sensor data acquisition and environment perception in ROS.
2. Develop a mini project integrating ROS, Computer Vision, Machine Learning, or NLP for an intelligent robotic application.

TOTAL : 45 PERIODS

LABORATORY REQUIREMENTS:

Standalone desktop with Python, Anaconda, Jupyter Notebook, ROS, Gazebo, OpenCV, TensorFlow/PyTorch, YOLOv8, OpenAI Gym, NumPy, Pandas, Matplotlib, Scikit-learn, and NLTK-30 Nos.

TEXT BOOKS

1. Robotics, Vision and Control, Peter Corke, Springer, 2nd Edition, 2017.
2. Programming Robots with ROS, Morgan Quigley, Brian Gerkey, William D. Smart, O'Reilly Media, 2015.

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3. Introduction to Autonomous Robots, Nikolaus Correll, Bradley Hayes, David Wingate, et al., MIT Press, 2022.

REFERENCES:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 4th Edition, 2021.
2. Probabilistic Robotics, Sebastian Thrun, Wolfram Burgard, Dieter Fox, MIT Press, 2005.
3. Learning OpenCV 4 Computer Vision with Python, Joseph Howse and Joe Minichino, Packt Publishing, 2020.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
5. Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, MIT Press, 2nd Edition, 2018.
6. Human-Robot Interaction, Christoph Bartneck, Dana Kulić, Elizabeth Croft, Susana Zoghbi, Cambridge University Press, 2020.

WEB REFERENCES:

1. https://gazebosim.org/docs
2. https://theconstructcore.bitbucket.io/openai_ros/index.html?
3. https://wiki.ros.org/ROS/Tutorials

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/robotics
2. https://nptel.ac.in
3. https://www.theconstruct.ai

OUTCOMES:

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

1. Apply ROS tools, robot perception techniques, and simulation environments to model and analyse robotic systems. (K3)
2. Implement robot control, motion planning, and autonomous navigation algorithms using ROS-based platforms. (K3)
3. Analyse computer vision, neural networks, and YOLO-based object detection techniques for robotic perception tasks. (K3)
4. Apply machine learning, reinforcement learning, and SLAM techniques for intelligent robot navigation and localization. (K4)

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5. Analyse intelligent navigation, path planning, NLP, and speech-based human-robot interaction systems. (K4)
6. Analyse AI-enabled robotic applications, ethical issues, and emerging trends in intelligent robotics. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	-	-	-	2	3
CO2	3	-	-	-	3	-	-	-	-	-	-	3	3
CO3	3	2	-	-	2	-	-	-	-	-	-	2	3
CO4	2	3	-	-	2	-	-	-	-	-	-	2	2
CO5	2	3	-	-	3	-	-	-	-	-	-	2	2
CO6	2	3	-	-	3	-	-	-	-	-	-	3	2

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