



SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY

[Educational Service : SNR Sons Charitable Trust]

[Autonomous Institution, Reaccredited by NAAC with 'A' Grade]

[Approved by AICTE New Delhi, Permanently Affiliated to Anna University, Chennai]

Coimbatore - 641 010.



ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

R2025 CURRICULUM

SEMESTER 1

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	1	25HS204	Design Thinking	AEC	1	0	0	1
2	1	25MA201	Matrices and Calculus	BSC	3	1	0	4
3	1	25CH201	Green Computing	BSC	2	0	0	2
4	1	25IT201	Bio-inspired Computing	BSC	1	0	0	1
5	1	25CS251	C Programming	ESC	2	0	4	4
6	1	25CS270	Computer Practices Workshop	ESC	0	0	2	1
7	1	25IT202	Modern Digital Technologies	ETC	2	0	0	2
8	1	25HS251	Technical English	HSMC	2	0	2	3
9	1	25HS201	Heritage of Tamils	LAC	1	0	0	1
10	1	25HS203	Yoga	LAC	1	0	0	1

SEMESTER 2

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	2	25PH253	Engineering Physics	BSC	2	0	2	3
2	2	25MA202	Linear Algebra and Number Theory	BSC	3	1	0	4
3	2	25IT251	Object Oriented Programming	ESC	2	0	4	4
4	2	25IT203	Prompt Engineering	ETC	2	0	0	2
5	2	25HS270	Professional English / Foreign Language	HSMC	0	0	2	1
6	2	25HS202	Tamils and Technology	LAC	1	0	0	1
7	2	25HS252	Universal Human Values – I	MC	1	0	0	0
8	2	25EC271	Think Build Innovative Lab	SDC	0	0	2	1
9	2	25CS252	Data Structures	ESC	2	0	2	3
10	2	25EC202	Digital Principles and System Design	ESC	3	0	0	3

SEMESTER 3

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	3	25AI251	Excel Macros	ESC	1	0	2	2
2	3	25IT210	Cybercrimes-Laws, practice and Procedures	HSMC	2	0	0	2
3	3	25MA207	Probability and Statistics	BSC	3	1	0	4
4	3	25AI220	Social Impact of Artificial Intelligence	HSMC	2	0	0	2
5	3	25IT252	Python for Scientific Computing	ESC	2	0	2	3
6	3	25CS2E01	Clean Coding and Devops (IBM)	PEC	3	0	0	3
7	3	25HS253	Universal Human Values – II	MC	1	0	0	0
8	3	25AI252	Neural Networks	PCC	2	0	2	3
9	3	25CS254	Operating Systems	PCC	2	0	2	3
10	3	25CS255	Database Management Systems	PCC	2	0	2	3
11	3	25AI202	Data Science and Analysis	PCC	3	0	0	3

SEMESTER 4

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	4	25HS208	Quantitative Aptitude And Logical Reasoning	AEC	0	0	2	1
2	4	25HS210	Lingua skill	AEC	1	0	0	1
3	4	25XXXXXX	Open Elective 1	OPC	3	0	0	3
3	4	25EE256	Sensors and Instrumentation	ESC	1	0	2	2
4	4	25IT211	Universal Human Values - III (Cyber Ethics)	HSMC	1	0	0	1
5	4	25AI271	Professional Practice	IPW	0	0	4	2
6	4	25HS211	Indian Knowledge System	LAC	1	0	0	1
8	4	25AI274	Value Added Program	SDC	0	0	2	2
10	4	25CS211	Discrete Mathematics	PCC	2	1	0	3
11	4	25AI254	Data Analytics	PCC	2	0	2	3
12	4	25IT256	Web Technologies And Full Stack Development	PCC	2	0	2	3
13	4	25AI253	Computer Vision	PCC	2	0	2	3
14	4	25AI255	Machine Learning Techniques	PCC	2	0	2	3
15	4	25HS212	Constitution of India	MC	1	0	0	0

SEMESTER 5

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	5	25XXXX	Open Elective 2	OPC	3	0	0	3
2	5	25AI203	Automated Intelligence	ETC	2	0	0	2
3	5	25AI256	Deep Learning	PCC	2	0	2	3
4	5	25IT257	Cloud Computing and Virtualization	PCC	2	0	2	3
5	5	25CS265	Devops Skills	PCC	2	0	2	3
6	5	25CS259	Internet of Things and Smart Systems	PCC	2	0	2	3
7	5	25AI204	Reinforcement Learning	PCC	2	0	0	2
8	5	25AI257	Natural Language Processing	PCC	2	0	2	3

SEMESTER 6

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	6	25HS209	Problem Solving and Data Structures	AEC	0	0	2	1
2	6	25CS215	Software Development Standards(ISO)	HSMC	1	0	0	1
3	6	25AI272	MINI PROJECT	IPW	0	0	4	2
5	6	25AI275	Comprehensive VIVA	SDC	0	0	0	1
6	6	25XXXXXX	Professional Elective 2	PEC	3	0	0	3
7	6	25XXXXXX	Professional Elective 3	PEC	3	0	0	3
8	6	25AI215	Algorithm Design And Performance	PCC	2	0	0	2
9	6	25AI207	Computer Networks	PCC	2	0	0	2
10	6	25AI258	Large Language Model	PCC	2	0	2	3
11	6	25AI205	Predictive Analytics	PCC	2	0	0	2
12	6	25AI206	Generative AI	PCC	2	0	0	2
13	6	25IT259	Cryptography And Cyber Security	PCC	2	0	2	3

SEMESTER 7

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	7	25XXXXX	Professional Elective 4	PE	3	0	0	3
2	7	25XXXXX	Professional Elective 5	PE	3	0	0	3
3	7	25XXXXX	Professional Elective 6	PE	3	0	0	3

SEMESTER 8

Sl. No.	Sem	Course Code	Course	Course Type	L	T	P	Credits
1	8	25XXXXX	Project Work	EEC	0	0	16	8

SEMESTER I

25HS204	DESIGN THINKING	L	T	P	C
		1	0	0	1

COURSE OUTCOMES:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply empathy research methods to identify and understand user needs in engineering contexts.	2,4	1,3
CO2	Synthesize user data and formulate clear problem statements using structured analysis techniques.	2,4	1,2
CO3	Generate innovative solutions through systematic ideation methods and concept evaluation frameworks.	2,3	1,2,3
CO4	Create and validate prototypes using rapid testing methods to iterate engineering solutions.	3,4	2,3

EMPATHIZE PHASE

[3]

Human-centred design principles, user interviews, empathy mapping, persona development, stakeholder identification, journey mapping. Case Study.

ANALYSE PHASE

[4]

Data synthesis, insight generation, pattern recognition, problem statement formulation, root cause analysis, affinity mapping, How Might We questions, problem definition canvas, 5 Whys technique. Case Study.

SOLVE PHASE

[4]

Creative ideation, divergent vs convergent thinking, brainstorming, SCAMPER technique, idea sketching, concept selection matrix, solution feasibility assessment. Case Study.

TEST PHASE

[4]

Rapid prototyping, prototype fidelity levels, testing methodologies, iteration principles, paper prototyping, digital wire framing, user testing scripts, feedback collection methods. Case Study.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

1. Brown, Tim. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, 2019

REFERENCES:

1. Norman, Donald A. The Design of Everyday Things: Revised and Expanded Edition. Basic Books, 2013.
2. Kumar, Vijay. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization. Wiley, 2012.

ONLINE RESOURCES:

IDEO Design Kit: www.designkit.org

25MA201	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamental concepts expressed as matrix algebra, multivariable calculus and the solution techniques for ordinary differential equations.	1,2	1
CO2	Recall the definitions of eigenvalues and eigenvectors, notations of partial and total derivatives of vector field and standard form of second and higher order ODE.	1,2	1,2
CO3	Apply mathematical techniques from matrix theory, calculus and differential equations to solve interdisciplinary problems.	1,11	1,2
CO4	Examine multivariable functions, vector fields, differential equations and real-world dynamic systems, like elastic membranes and vibrating systems.	1,2,8,9,11	1,2,3
CO5	Integrate mathematical tools from matrices, multivariable calculus, vector calculus and differential equations to solve real- world physical systems.	1,2,5,8,9,11	1,2,3

MATRICES

[9+3]

Introduction – Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem (without proof)– Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Stretching of an Elastic Membrane – Vibrating System of two masses on two springs.

MULTIVARIABLE CALCULUS

[9+3]

Partial derivatives – Total derivative – Differentiation of implicit functions – Change of variables – Jacobian – Partial differentiation of implicit functions – Taylor's series for functions of two variables maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

MULTIPLE INTEGRALS

[9+3]

Double integrals – Change the order of integration - Double integrals in polar coordinates – Triple integrals – Rectangular Coordinate System – Cylindrical and Spherical Polar coordinates.

VECTOR CALCULUS

[9+3]

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Gauss divergence theorem and Stoke's theorems (without proofs)– Verification and application in evaluating line, surface and volume integrals.

ORDINARY DIFFERENTIAL EQUATIONS

[9+3]

Solution of second and higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear differential equations - Simultaneous first order linear differential equations with constant coefficients.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

CASE STUDIES

List of MATLAB Programs

Introduction to MATLAB.
Matrix Operations - Addition, Subtraction, Multiplication, Transpose and Inverse.
Finding Eigenvalues and Eigenvectors of Higher Order Matrices.
Finding Maxima and Minima of functions of two variables.
Applications of Taylor's series expansion to find continuity equation in bipolar transistors.
Solution of second and higher order ordinary differential equations with constant coefficients
Analysis of Dynamic characteristics of Biosensors using ordinary differential equations
Evaluating double and triple integral with constant and variable limits.
Finding area as double integral.
Finding volume as triple integral.

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2022.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 11th Edition, Wiley India, 2025.
3. T. Veerarajan, "Engineering Mathematics I & II", 3rd Edition, McGraw Hill Education India, 2018 (Reprint).

REFERENCE BOOKS:

1. James Stewart, "Calculus, Early Transcendental", 9th Edition, Cengage learning, New Delhi, 2020.
2. Joel Hass, Christopher Heil and Maurice D.Weir, Thomas "Calculus", Pearson, 14th Edition, New Delhi, 2018.
3. B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, New Delhi, 2017.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc25_ma79/preview \t "_blank.
2. <https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear-algebra-introduction-to-eigenvalues-and-eigenvectors>.

25CH201	GREEN COMPUTING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamentals and importance of green computing in reducing environmental impact.	1, 6	1
CO2	Compare traditional and green alternatives in computing practices.	1, 6	1
CO3	Use different methods for reducing energy consumption and carbon emissions in computing environment.	1, 6	1
CO4	Apply green computing practices in hardware selection, software development, and system design to minimize ecological footprints.	1, 6	1
CO5	Practice the e-waste management measures proposed under national and global legislations.	1, 6,11	1

GREEN COMPUTING FUNDAMENTALS

[6]

Definition: Personal Computers, Data Centre, Client/Server Architecture - Power consumption of Personal Computers – Power consumption in data centres – Cloud Services - computing and climate change – correlation between energy and data transfer - Case Study.

ENERGY CONSERVATION IN COMPUTING

[8]

Basic cooling mechanism of a personal computer – CPU vs GPU – Performance of Data Centres – Carbon Footprint – Conventional Cooling – Data Centre Cooling – Air Cooling – Rear door heat exchangers – Liquid-to-chip – Single-phase immersion cooling – Advantages of immersion cooling – Case Studies: Zelendata Centar, U.S. Air Force.

E-WASTE MANAGEMENT

[8]

Types of Contamination – Treatment Strategies: Recycling, Landfill disposal, Biological Treatment – Urban mining e-waste for metals – extraction of nanometals – Lifecycle of various elements – Toxicity (Cu, Cr, Pb and Hg) – Plastics in electronics and Electrical Items.

E-WASTE MANAGEMENT PRACTICES

[8]

Practices in India – Policy comparison between developed and developing countries – Impact of e-waste on ecosystem – Phytoremediation – Electro-kinetic remediation – Classification of E-waste – Legislations for e-waste management in India.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. Sapna Jain & Hena Parveen M. Afshar Alam,”Green Computing Approach Towards Sustainable Development”, I.K. International Publishing House, 2019.
2. Majeti Narasimha Vara Prasad, Meththika Vithanage, Anwesha Borthakur,”Handbook of Electronic Waste Management: International Best Practices and Case Studies”, Butterworth-Heinemann, 2020.

REFERENCE BOOKS:

1. Bud. E. Smith, “Green Computing: Tools and Techniques for Saving Energy, Money, and Resources”, CRC Press, 1st Edition, 2014 (2024 reprint).

WEB REFERENCES:

1. What is Green Computing? via <https://www.ibm.com/think/topics/green-computing>
2. The definitive guide to Immersion Cooling, Green Revolution Cooling (Open ebook)
3. The State of Sustainability Readiness 2024, IBM think report (Open E-resource)
4. PC Energy Report 2009, 1E, Alliance to Save Energy (Open E-resource)
5. E-waste Management Rules “<https://cpcb.nic.in/rules-6/>”, Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, Government of India.

25IT201	BIO-INSPIRED COMPUTING	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Review the basic concepts of bio-inspired optimization techniques.	1,2	1
CO2	Identify the main components of human biological systems and explain their respective functions.	1,2	3
CO3	Describe Mendel's laws of inheritance, gene mapping, and the impact of mutations on genetic abnormalities.	1,2	1,3
CO4	Compare biological neural networks with artificial neural networks.	1,2	1,2
CO5	Use bio-inspired optimization algorithms for addressing engineering optimization problems.	2,3	1,2
CO6	Develop artificial immune system models for network security, using biological principles.	2,3	1,3

BIO-INSPIRATION

[3]

Optimization and Bio-inspiration – Ant Colony – Bee colony – Particle Swarm Optimization principles – Modern Optimization techniques: Ant Lion – Dragonfly – Grey Wolf – Grasshopper – Advances in Swarm Intelligence.

GENETICS

[4]

Modern and Future Genetics – Heredity and Principles of Heredity – Mendel's law of inheritance – Dominance – Independent Assortment – Segregation – Allele – Gene mapping – Gene interaction – Mitosis and Meiosis – Phenotype Mapping – Mutation and abnormalities.

NERVOUS SYSTEM

[4]

Components of Human Nervous System – human neural network and its function – inspiration towards artificial neural networks – comparison – Perceptron model.

IMMUNE SYSTEM

[4]

Human immune system – organs, cells, immunity - functionalities – artificial immune system – network security applications.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	30

TEXT BOOKS:

1. Annamma Odaneth, "Biology for Engineers", All India Council for Technical Education, 2023.
2. Bibekanand Mallick, "Biology for Engineers", McGraw-Hill, 1st Edition, 2021.

REFERENCES:

1. Seyedali Mirjalili, Jin Song Dong, Andrew Lewis, “Nature-inspired Optimizers: Theories, Literature Reviews and Applications”, Springer: Studies in Computational Intelligence, 2020.
2. Seyedali Mirjalili, “Evolutionary Algorithms and Neural Networks: Theory and Applications”, Springer: Studies in Computational Intelligence, 2019.
3. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Wiley, 2018 (2019 Reprint).

25CS251	C PROGRAMMING	L	T	P	C
		2	0	4	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of computer organization, generations of computers, and number system representations.	1,2,5,9	1
CO2	Outline the fundamental syntax rules of C programming, such as keywords, data types, operators, and control structures.	1,5	1
CO3	Describe the operational principles of arrays, strings, functions, and pointers in C programming.	1,2,5,9	1,2
CO4	Summarize the structure and usage of sequential and random file access in C.	1,2,5,9	1,2
CO5	Develop C programs using arrays, strings, and functions to solve mathematical, scientific, and statistical problems.	1,2,5,9	1,2
CO6	Implement file handling and structures in C to create applications such as student record management and transaction processing systems.	2,3,5,9	1,2,3

FUNDAMENTALS OF COMPUTING

[6]

Basic concepts of computer organizations, Generation and classification of computers, Number System Representation, Fundamentals of algorithms, Pseudo code, Flow charts.

C LANGUAGE FUNDAMENTALS

[6]

Introduction to C programming, Structure of a C program, Compilation and Linking Processes, Character Set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-Output Operations, Control Structures, Decision Making, Branching & Looping. Application: Solving Simple Scientific and Mathematical Problems.

ARRAYS AND STRINGS

[6]

Introduction to Arrays, One Dimensional Array, Multidimensional Array. Application: Matrix Operations, Sorting, Searching, Sum of Series and Statistical Problems. String Manipulation, String Arrays. Application: Solving problems using String Functions.

FUNCTIONS AND POINTERS

[6]

User Defined and Standard Functions, Formal and Actual arguments, Function Prototypes, Parameter Passing, Call-by-Value, Call-by-Reference, Recursion. Application: Math Functions, Computation of Sine Series, Random Number Generation, Tower of Hanoi and Factorial using Recursive Functions. Pointers, Pointer Variables, Pointer Arithmetic, Passing Parameters by Reference, Pointer to Pointer, Pointers to Functions, Dynamic Memory Allocation. Application: Card shuffling and Dealing Simulation using Pointers.

STRUCTURES, UNIONS AND FILE HANDLING

[6]

Declaration of Structures, Nested Structure, Pointer to Structure, Declaration of Unions, Pointer to Union, Application: Student Records. Storage Classes, Pre-Processor Directives. Files -Types of File Processing: Sequential Access, Random Access. Application: Transaction Processing Program.

LAB EXPERIMENTS:

[60]

1. Basic I/O and Operators
2. Control Statements
3. Loops and Iterations
4. Arrays
5. Strings
6. Functions
7. Pointers
8. Structures
9. Unions
10. File Handling

Total Notional Hours: 120

L	T	P	TW+SL	C
30	0	60	30	4

TEXT BOOK:

1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach in C, 4th ed. Boston, MA: Cengage Learning, 2023.

REFERENCES:

1. B. S. Gottfried, Programming with C (Schaum's Outlines Series), 3rd ed. New York, NY: McGraw-Hill Education, 2011.
2. E. Balagurusamy, Programming in ANSI C, 9th ed. New Delhi, India: McGraw Hill Education, 2024.
3. P. Deitel and H. Deitel, C How to Program, 9th ed. Hoboken, NJ: Pearson Education, 2023.
4. B. W. Kernighan and D. M. Ritchie, The C Programming Language, 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1988.
5. G. Perry and D. Miller, C Programming Absolute Beginner's Guide, 3rd ed. Indianapolis, IN: Que Publishing, 2020.

ONLINE RESOURCES:

- 1.https://onlinecourses.nptel.ac.in/noc22_cs40/
- 2.<https://www.geeksforgeeks.org/c-programming-language/>
- 3.<https://www.programiz.com/c-programming/>.

25CS270	COMPUTER PRACTICES WORKSHOP	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamental components of computer systems and operating systems, including their functions and interactions.	1,2, 5, 9	1
CO2	Create, format, and manage professional documents using word processing software and presentations using presentation software.	3,5, 9	1
CO3	Apply spreadsheet functions (Microsoft Excel) to organize, analyze, and visualize data for practical problem-solving scenarios.	3,5, 9	1
CO4	Implement file management strategies, command line operations, and basic troubleshooting techniques to maintain efficient computer operations.	2,4, 5, 9	1

LAB EXPERIMENTS:

[30]

1. Basic components of a computer and the operating system.
2. Word processing (Microsoft word)
3. Spreadsheet and advanced excel features.
4. File management and organization
5. Command line operations (Windows or Linux)
6. Creating and formatting presentations (Microsoft PowerPoint)
7. Introduction to cloud storage and collaboration tools
8. Data analysis in Microsoft Excel
9. Basic computer security
10. Basic troubleshooting and maintenance

Total Notional Hours: 30

L	T	P	TW+SL	C
0	0	30	0	1

REFERENCES:

1. ITL Education Solutions Limited, *Introduction to Information Technology*, 3rd ed. Noida, India: Pearson Education India, 2024.
2. J. Lambert, *Microsoft Office 365 & Office 2021 Step by Step*. Redmond, WA: Microsoft Press, 2022.
3. A. Goel, *Computer Fundamentals*, 11th ed. Noida, India: Pearson Education India, 2024.

ONLINE RESOURCES:

<https://support.microsoft.com/>

25IT202	MODERN DIGITAL TECHNOLOGIES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of digital transformation, including key technologies like cloud computing, big data, and IoT, and their evolutionary development.	1,2	1,2
CO2	Identify key components of digital accelerators: AI, machine learning, blockchain, and cybersecurity.	1,5	1,2,3
CO3	Explain the impact of digitalization and the internet on businesses and society, including economic and social implications.	2,6	2,3
CO4	Summarise elastic cloud computing architecture, its advantages, big data issues, and the shift from CapEx to OpEx models.	1,2	1,2
CO5	Interpret the role of AI and IoT in modern enterprises, including their strategic importance, ethical considerations, and real-world use cases.	2,4	1,2,3
CO6	Suggest solutions for digital transformation using technologies such as AI, IoT, cloud computing, or blockchain, with supporting case studies.	3,4	1,2,3

DIGITAL TRANSFORMATION

[6]

Digitalization – The Internet – Impact of Digitalization and the Internet – Evolutionary Adaptation – Modern Digital Transformation – Future of Digital Transformation.

INFORMATION AGE ACCELERATORS

[6]

Big Data - Cloud Computing – Virtualization and Containers – Multi-cloud and Hybrid Cloud – Artificial Intelligence – Machine Learning – Deep Learning – Internet of Things – AI and IoT – Model Driven Architecture.

ELASTIC CLOUD AND BIG DATA

[6]

Evolution of Elastic Cloud: From mainframes to Virtualization – rise of public cloud – Cloud features – Cloud Service Models – Global Public Cloud Infrastructure – CapEx to OpEx – History of Computer Storage – Data Center Storage – Evolution of Big Data – Size, Speed and Shape – Challenges of Big Data in a Modern Enterprise.

ARTIFICIAL INTELLIGENCE AND INTERNET-OF-THINGS

[6]

The AI Renaissance – Open-Source AI software – Machine Learning – Neural Networks – Business benefits – Economic and Social impact of AI – Origin of IoT – IoT Technology Solution – Potential and Impact – IoT Use Cases – Moore's Law – Metacalfe's Law – AI in government – Strategic Role of AI – Case Studies – Responsible AI – Safety in AI systems.

OTHER TECHNOLOGIES

[6]

Block chains – Consensus Mechanism – Use Case: Cryptocurrency – 3D printing – Augmented Reality – Virtual Reality – Digital Twin – Case Study: Remote Healthcare, Non-terrestrial networks – Fintech – Case Study: UPI, Digital Banking – Cyber security – Cybercrimes and Awareness.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXTBOOK:

1. Thomas M. Seibel, “Digital Transformation: Survive and Thrive in an Era of Mass Extinction”, Rosetta Books, 1st edition, 2019. ISBN: 9781948122481

ONLINE RESOURCE:

1. “2024 Technology Megatrends”, IEEE Future Directions accessible via <https://engage.ieee.org/FD-Megatrends-2024.html>

25HS251	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the foundational rules of English grammar, including parts of speech, tenses, and subject-verb agreement, to ensure accuracy in both written and spoken communication.	9	1,3
CO2	Describe the various strategies for effective reading and listening, such as skimming, scanning, and extracting specific information from a range of texts and audio sources.	9	1,3
CO3	Identify key strategies for improving presentation skills, group discussions, and technical sales talks, along with their grammatical and structural requirements.	9,11	1,3
CO4	Apply appropriate writing strategies to compose professional documents, including formal letters, emails, resumes, and technical reports.	9,11	1,3
CO5	Demonstrate effective oral communication skills by delivering a self-introduction, participating in group discussions, and giving a formal presentation on a technical topic.	5,9,11	1,3
CO6	Interpret visual graphics and respond appropriately in professional scenarios such as a sales talk, a product description, or an interview.	5,9,11	1,2,3

IMPORTANCE OF COMMUNICATION

[6]

Reading: Reading Comprehension, Skimming and Scanning

Speaking: Self-introduction

Writing: Grammar- Parts of Speech, Tense, Subject-Verb Agreement

Listening: Listening to documentaries and interviews with celebrities.

FORMAL COMMUNICATION

[6]

Reading: Reading Newspaper and Articles, Reading for specific information.

Speaking: Describing a product/place, Conversation practice

Writing: Grammar- Present Tense, Compound Nouns, Question types: Wh./Yes or No and Tags, Paragraph Writing, Email writing.

Listening: Listening to motivational talks / TED talks

WRITING STRATEGIES

[6]

Writing: Grammar- Past Tense, Gerunds and Infinitives, Articles, Modal Verbs, Recommendations, Checklist.

Listening: Listening to stories and event narration.

PRESENTATION SKILLS

[6]

Reading: Interpreting pictures of visual graphics.

Speaking: Group Discussion

Writing: Grammar- Future Tense, If Conditional Clause, Voices, Formal Letters (Quotations, Clarification, Placing orders & Complaint letter), SOP for conducting an event

Listening: Listening to Group Discussion and Interview Skills.

TECHNICAL COMMUNICATION

[6]

Reading: Reading advertisements and company profiles. Speaking:

Presentation on the technical topic, Sales talk.

Writing: Grammar-Purpose and Function, Prefix and Suffix, Reported Speech, Resume Writing, Report (Industrial visit reports, Accident report, Feasibility Reports).

Listening: Listening to Product description and Process

LIST OF LABORATORY EXERCISES

READING

1. Understanding short, real-world notices, messages. (Notices, messages, adverts)
2. detailed comprehension of factual material: Skimming and scanning skills (Longer text, business reports, Product description)
3. Interpreting visual information (Graphs, Charts, Tables, etc.)

SPEAKING

- 1.General Conversation on Business Context
- 2.Giving product information and expressing opinions
- 3.Technical Presentation (PPT)

WRITING

1. Arranging appointments, asking for permission, giving instructions
2. Apologizing and offering compensation, dealing with requests, giving information about a product. (e mail writing, letter writing, notices)

LISTENING

[4]

1. Listening for specific information (short conversations)
- 2.Listening for specific information (telephonic conversation, interview discussion)

Total Notional Hours : 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1. Technical English 2nd Edition Level2 Course Book and eBook, David Bonamy, 2022
2. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).

REFERENCE BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).
2. Cambridge BEC4 Preliminary (BEC Practice Tests), Cambridge university press, 2021.

WEB REFERENCES

1. NPTEL-https://www.youtube.com/playlist?list=PLzf4HHlsQFwIQUeZq_ykEVB6qZrTRnJZn.
2. https://www.youtube.com/playlist?list=PL3qvHcrYGy1sU_1nMMVrfFEhYROpQtVXXV

25HS201	தமிழர் மரபு Heritage of Tamils	L	T	P	C
		1	0	0	1

கற்றல் அடைவுகள்

பாட நெறியின் முடிவில் மாணவர்களின் கற்றலின் அடைவுகள்

COs	கற்றல் அடைவுகள்	POs	PSO
CO 1	மொழி மற்றும் இலக்கியம், சங்க இலக்கியத்தில் அறக்கோட்பாடுகள் மற்றும் தமிழ்க் காப்பியங்கள் பற்றி அறிதல்.	11	-
CO 2	பழந்தமிழரின் பாரம்பரியக் கலைகள் மற்றும் வாழ்வியல் முறைகள் குறித்து அறிந்துகொள்ளுதல்.	11	-
CO 3	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகளில் தமிழரின் பங்களிப்பு மற்றும் உறுதித்தன்மையை உணர்ந்துகொள்ளுதல்.	11	-
CO 4	தமிழர்களின் வாழ்க்கைமுறைகள், அறக்கோட்பாடு மற்றும் கல்விமுறைகள் குறித்து தெரிந்து கொள்ளுதல்.	11	-
CO 5	தமிழர்களின் கலாச்சாரத் தாக்கம்,சுயமரியாதை இயக்கம் மற்றும் தமிழ் நூல்களின் அச்ச வரலாறு குறித்து அறிந்துகொள்ளுதல்.	11	-

மொழி மற்றும் இலக்கியம்

[3]

இந்தியாவில் உள்ள மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி, தமிழின் செம்மொழித் தகுதிகள் - சங்க இலக்கியத்தின் மதச்சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மைக் கோட்பாடுகள் - தமிழ் காப்பியங்கள் மற்றும் தமிழில் பௌத்தம் & சமணத்தின் தாக்கம் - பக்தி இலக்கியம்,ஆழ்வார்கள் மற்றும் நாயன்மார்கள் தமிழில் நவீன இலக்கியம், வளர்ச்சி - பாரதியார் மற்றும் பாரதிதாசன் பங்களிப்பு.

பாரம்பரியம் - பாறை ஓவியங்கள் மற்றும் நவீன கலைகள் - சிற்பம்

[3]

நடுகல் முதல் நவீன சிற்பம் - வெண்கல சின்னங்கள் - பழங்குடியினர் மற்றும் அவர்களின் கைவினைப்பொருட்கள் , பொம்மைகள் -தேர்செய்யும் கலை, சுடுமண் சிற்பங்கள் - நாட்டுப்புற தெய்வங்கள், கன்னியாகுமரியில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பாறை, வீணை, யாழ் மற்றும் நாதஸ்வரம் - தமிழர்களின்

சமூக மற்றும் பொருளாதார வாழ்வில் கோயில்களின் பங்கு

நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள்

[3]

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியன் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம் - தமிழர்களின் விளையாட்டுகள்.

தமிழர்களின் திணைக்கோட்பாடுகள்

[3]

தமிழர்களின் தாவரங்கள் மற்றும் விலங்கினங்கள் -தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கருத்து - சங்க காலத்தில் கல்வி மற்றும் எழுத்தறிவு - சங்ககால நகரங்கள் மற்றும் துறைமுகங்கள் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

இந்திய தேசிய இயக்கம் மற்றும் இந்தியப்பண்பாட்டிற்கு தமிழர்களின் பங்களிப்பு [3]

இந்திய சுதந்திரப் போராட்டத்தில் தமிழர்களின் பங்களிப்பு - இந்தியாவின் சில பகுதிகளில் தமிழர்களின் கலாச்சார தாக்கம் - சுயமரியாதை இயக்கம் - சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள் & கையெழுத்துப் பிரதிகள் - தமிழ் நூல்களின் அச்ச வரலாறு.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

1. தமிழர் மரபு - ஆக்கம்:தமிழ்ப் பேராசிரியர்கள் ,அண்ணா பல்கலைக்கழகம் வெளியீடு : பொறியியல் தொழில்நுட்பத் தமிழ் வளர்ச்சி மையம் ,அண்ணா பல்கலைக்கழகம் ,சென்னை - 600 025. (முதல் பதிப்பு 2023)

REFERENCE BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
2. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

4. 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)
5. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
7. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.
8. தமிழக வரலாறும் மக்களும் பண்பாடும் – டாக்டர் கே.கே.பிள்ளை(தமிழ்நாடு பாடநூல் மற்றும் பணிகள் கழகம்)
9. கணினித் தமிழ் முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
10. கீழடி வைகை நதிக்கரையில் நகர நாகரிகம்(தொல்லியல் துறை வெளியீடு) .

WEB REFERENCES:

1. <https://www.tamilvu.org/> & <https://ta.wikipedia.org/>
2. <https://it.tn.gov.in/en/node/47> & <https://www.alagappauniversity.ac.in>
3. <https://clcl.uiowa.edu/language-resources/tamil-language-and-culture-resources>
4. <https://avvaitamil.org/online-resources/>
5. <https://www.alllanguageresources.com/tamil-resources/>

25HS203	YOGA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Review the basic concepts of Yoga, such as its origins, the eightfold path, and various classifications.	6	3
CO2	Summarise the benefits of Yoga for physical and mental health.	6	3
CO3	Explain the connection between the philosophical foundations of Yoga and their influence on individual development.	6	3
CO4	Demonstrate basic Yoga postures and breathing techniques to enhance strength, endurance, and mental quietude through personalized practice.	6	3

Introduction to Yoga – Origin - Need for Yoga – Yoga Mind Power – The Yoga Tradition – Classification - Yoga’s Eightfold path – Breathing Practices – Hatha Yoga – Yoga Practice – Procedure – Personalizing Yoga Practice – Postures to Build strength and endurance – Postures to Quiet the Body and Mind – Chakras – Mudras – Mandalas – Mantras – Practices

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

ASSESSMENT

Grading based on Attendance and Participation

Any two asanas

Any two pranayamas

One kriya

TEXT BOOK:

Joan Budilovsky and Eve Adamson, “The Complete Idiot’s Guide to Yoga”, Alpha Books, ISBN: 0-02-863970-7, 2024.

REFERENCE:

1. Deepak Chopra and David Simon, “The Seven Spiritual Laws of Yoga: a practical guide to healing body, mind, and spirit”, John Wiley and Sons, ISBN: 0-471-64764-0, 2023.

2. Sri Swami Sivananda, “Yoga in Daily Life”, Divine Life Trust Society, ISBN: 81-7052-055-X, 2024.

SEMESTER II

25PH253	ENGINEERING PHYSICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Classify various magnetic materials based on their fundamental properties and physical behavior.	1,2	1
CO2	Understand the core principles of quantum mechanics and the essential concepts of superconductivity.	1,2	1
CO3	Perform experiments to investigate semiconductor properties and relate the findings to theoretical models.	1,2	1,2
CO4	Simulate quantum phenomena and spintronic devices using computational tools to validate quantum principles.	1,2,5	1,2
CO5	Connect the theoretical foundations of quantum physics with the principles governing spintronics and the behavior of nanomaterials.	1,2,8,9	1,2,3

MAGNETIC MATERIALS

[7]

Classification of magnetic materials (diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic, and ferrimagnetic), magnetic susceptibility, permeability, hysteresis, and domain theory application of magnetic materials in transformers, magnetic storage devices, and spintronics.

SUPERCONDUCTING MATERIALS

[7]

Principle & Properties of superconductor, Types: Type I, Type II, High-Temperature, Organic and Heavy Fermion Superconductors – Applications: SQUID & superconducting qubits in quantum computer.

QUANTUM PHYSICS

[9]

Classical vs quantum information - Wave particle duality, de Broglie waves- Heisenberg's uncertainty principle. Wave function- normalization. Schrodinger's equation of motion: Time dependent and independent form. Particle in a box. Importance of Quantum Computing in Modern Technology - Quantum States and Superposition -The Principle of Entanglement - qubit - Bra-ket notation: $|\psi\rangle$, $\langle\psi|$. Single-qubit gates - multi-qubit gates: CNOT.

NANO MATERIALS

[7]

Classification based on dimensionality - Quantum Dots, Wires and Wells- Carbon based nano materials - graphene- Synthesis of nano materials: Top-Down Process- Mechanical Milling, Bottom -up approach – chemical (CVD) and biological method – engineering applications.

LIST OF EXPERIMENTS

[15]

1. Simulation and Analysis of PN Junction Diode V-I Characteristics.
2. Determination of band gap using semiconductor diode.
3. Thermistor: Measurement of temperature and band gap.
4. Experimental Analysis of Photodiode Characteristics
5. Determination of resistivity of metal and alloy using Carey Foster Bridge.
6. Determine the Planck's constant using Photo Electric method.
7. Generation and Initialization of a Qubit for Quantum Computation.
8. Simulation of the Quantum Double-Slit Experiment: Demonstrating Particle-Wave Duality.
9. Spintronic Device Simulation: Spin Valve / Magnetic Tunnel Junction.
10. Study of Graphene's properties.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1. Dr. M.N. Avadhanulu, Dr. P.G. Kshirsagar, "Engineering Physics" S. Chand Publishing, 1st Edition, 2023.
2. David A. B. Miller, "Quantum Mechanics for Scientists and Engineers" Cambridge University Press, 2008.

REFERENCE BOOKS:

1. Kuldeep Singh Kaswan, Jagjit Singh Dhatteval, Anupam Baliyan, Shalli Rani "Quantum Computing: A New Era of Computing" John Wiley & Sons, 2023.
2. J.J. Sakurai, "Modern Quantum Mechanics" Cambridge University Press, Third Edition, 2020.
3. Dietmar H. Vollath "Nanomaterials: An Introduction to Synthesis, Properties, and Applications" Wiley-VCH, (2nd Edition), 2013
4. Ashutosh Sharma and Goldie Oza "Nano chemistry: Synthesis, Characterization, and Applications", CRC Press 1st Edition, 2023.

WEB REFERENCES

1. <https://nptel.ac.in/courses/115105131>
2. <https://nptel.ac.in/courses/115101010>
3. <https://nptel.ac.in/courses/118104008>

25MA202	LINEAR ALGEBRA AND NUMBER THEORY	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the concepts of linear algebra and number theory, including the structure of vector spaces, orthogonality, and congruences.	1,2	1
CO2	Recall the definitions, notations, and fundamental theorems related to vector spaces, linear transformations, inner product spaces, and number theory.	1,2	1
CO3	Use linear algebra techniques and number theory tools to solve computational and theoretical problems.	1,11	1,2
CO4	Analyze the properties of linear mappings, orthogonality conditions, and congruences in number theory.	1,2,8,9,11	1,2
CO5	Construct solutions using concepts from linear algebra and number theory to solve complex and non-standard problems.	1,2,8,9,11	1,2,3

LINEAR SPACE

[9+3]

Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.

LINEAR TRANSFORMATIONS

[9+3]

Introduction, Linear Mappings, Geometric linear transformation of $\mathbb{R}^2$, Kernel and Image of a linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem (without proof), Singular and Nonsingular linear transformations, Invertible linear transformations.

INNER PRODUCT SPACES

[9+3]

Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error.

CONGRUENCES

[9+3]

Introduction, Congruences and Equivalence Relations, Linear Congruences, Linear Diophantine Equations and the Chinese Remainder Theorem, Modular Arithmetic: Fermat's Theorem, Wilson's Theorem and Fermat Numbers. Polynomial Congruences, Pythagorean equations, Legendre symbol, Quadratic reciprocity, the Jacobi symbol.

NONLINEAR DIOPHANTINE EQUATIONS

[9+3]

Pythagorean triangles, Fermat's last theorem, Sum of Squares, Pell's equation, Mordell's equation.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

CASE STUDIES

List of Experiments (MATLAB)

1. Finding bases and dimensions for the vector spaces and subspaces.
2. Finding the matrix representation of a linear transformation.
3. Data Transmission and processing of digital signals using vector spaces.
4. Prime number checker
5. Euclidean Algorithm
6. Extended Euclidean Algorithm
7. Modular inverse
8. Fermat's Little theorem

TEXT BOOKS:

1. Richard Bronson, Gabriel B.Costa, "Linear Algebra", 6th Edition, Academic Press Publications 2023.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 11th Edition, Wiley India, 2025.
3. Thomas Koshy, "Elementary number theory with Applications", Academic Press Inc, 2nd Edition-2009.

REFERENCE BOOKS:

1. Davis C Lay, Stephen R, Linear Algebra and its Applications, 6th Edition, Pearson, 2020
2. Neville Robbins, Beginning Number Theory, 2nd Edition-Jones and Barlett Publications, 2006.
3. David M Burton, Elementary Number Theory, Tata McGraw Hill Publ.-1st Edition 2010.
4. Gareth A. Jones and Josephine Mary Jones, Elementary Number Theory, Springer 1998.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc25_ma114/preview
2. https://onlinecourses.nptel.ac.in/noc25_ma102/preview
3. <https://www.mathworks.com>

25IT251	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		2	0	4	4

COURSE OUTCOMES:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Define the fundamental concepts of Object-Oriented Programming (OOP), including its benefits, basic structure of a C++ program, and core elements like tokens, keywords, data types, and operators.	1,2, 5, 9	1
CO2	Outline the primary characteristics of classes and objects, encompassing access specifiers, constructors, destructors, and memory management operators.	1,3, 5, 9	1,2
CO3	Explain the principles of function and operator overloading, inheritance hierarchies, and the role of virtual functions in polymorphism.	1,2,5, 9	1,2
CO4	Describe the concepts of generic programming, file handling, and exception handling mechanisms in C++.	1,5,9	1,2,3
CO5	Write C++ programs using classes, objects, inheritance, and operator overloading to solve real-world problems.	3,4,5,9	1,2
CO6	Develop applications leveraging advanced C++ features such as virtual functions, templates, file I/O operations, and structured exception handling for robust software solutions.	3,4,5,9	1,2,3

FUNDAMENTALS OF OOP AND C++

[6]

Structural versus object-oriented Programming - Elements of object-oriented programming benefits of OOP – Structure of C++ program - Variables - Tokens - Keywords – Identifiers - Type modifiers - Type casting - Input and Output - Data Types and Expressions - Operators - Flow of control - Arrays, Strings and Pointers.

CLASSES AND OBJECTS

[6]

Classes and Objects - Class specification: Class Members, Access Specifier, Scope resolution operator- Class Instantiation - Accessing class members- Passing and returning objects - Array of objects – Constructors: Parameterized constructors - Default arguments – Copy Constructor - Constructor overloading, Destructors - new, delete operators - “this” pointer - Friend classes and friend functions.

OVERLOADING AND INHERITANCE

[6]

Function overloading - Operator overloading: Overloadable operators - Unary operator overloading - Binary operator overloading, Overloading the Operator Using Friend Function - Inheritance: Base class and derived class relationship - Derived class declaration - Types of inheritance - Member accessibility - Constructors in derived class.

VIRTUAL FUNCTIONS AND GENERIC PROGRAMMING

[6]

Virtual Functions: Need for virtual function - Pointer to derived class objects - Pure virtual functions - Abstract classes – Virtual Destructors, Generic programming with templates: Function templates - class templates.

I/O STREAMS AND EXCEPTION HANDLING

[6]

Streams: Formatted and unformatted data – Manipulators - Files: Opening and Closing a file - File modes - File pointers and their manipulation, Sequential access to a file - Random access to a file - Reading and Writing files, Exception handling: Exception handling constructs - Handling exceptions.

LAB EXPERIMENTS:

[60]

1. Basics of C++
2. Flow Control Statements
3. Arrays, Strings & Pointers
4. Class and Object Basics
5. Constructors and Destructors
6. Array of Objects & Object Passing
7. Overloading
8. Inheritance
9. Virtual Functions and Friend Function
10. File and Exception Handling

Total Notional Hours: 120

L	T	P	TW+SL	C
30	0	60	30	4

TEXT BOOK :

1. H. Schildt, *C++ The Complete Reference*, 4th ed. New Delhi, India: Tata McGraw Hill, 2017.

REFERENCES:

1. B. Stroustrup, *The C++ Programming Language*, 4th ed. Upper Saddle River, NJ: Addison-Wesley Professional, 2013.
2. P. Deitel and H. Deitel, *C++ How to Program*, 10th ed. Hoboken, NJ: Pearson Education, 2017.
3. R. Lafore, *Object-Oriented Programming in C++*, 4th ed. Indianapolis, IN: Sams Publishing, 2001.
4. S. B. Lippman, J. Lajoie, and B. E. Moo, *C++ Primer*, 5th ed. Upper Saddle River, NJ: Addison-Wesley Professional, 2012.
5. E. Balagurusamy, *Object Oriented Programming with C++*, 8th ed. New Delhi, India: McGraw Hill Education, 2021.

ONLINE RESOURCES:

- https://onlinecourses.nptel.ac.in/noc24_cs44

25IT203	PROMPT ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain LLM architectures, capabilities and limitations and how prompts steer outputs	1,2,4,5,8,10	1
CO2	Design and structure prompts (instruction, context, constraints, templates) to achieve desired outputs	2,3,4,5,9,10	1
CO3	Evaluate and quantitatively compare prompt strategies and mitigation approaches for bias, toxicity and hallucination.	2,4,5,6,8,10	1
CO4	Implement prompt-driven applications (chatbots, summarizers, code assistants) and follow responsible-AI practices for deployment	1,2,3,4,5,6,8,9,10,11	1

COURSE CONTENT:

FOUNDATIONS OF GENERATIVE AI AND PROMPTS

[6]

What is Generative AI, LLMs (e.g., GPT, Claude, Gemini) & how they work, What is prompt engineering, Role of prompts in guiding AI output, Basic types of prompts: instruction-based, open-ended, zero-shot, few-shot, Tools & platforms overview (OpenAI APIs, Hugging Face, local models)

CRAFTING EFFECTIVE PROMPTS

[6]

Principles of prompt design: clarity, specificity, context, constraints, Iterative prompt refinement & prompt testing, Prompt types in depth: zero-shot vs few-shot vs chain-of-thought (CoT). Common pitfalls: ambiguous prompts, overly broad prompts, model hallucination

ADVANCED PROMPT ENGINEERING TECHNIQUES AND WORKFLOWS

[6]

Multi-turn dialogues / conversational prompting, Context engineering: specifying history, memory, agent-style prompting, Prompt chaining & workflow design (agentic prompts, tools + LLMs). Optimization: prompt templates, meta-prompts, prompt tuning

APPLICATIONS OF PROMPT ENGINEERING IN DOMAINS

[6]

Text summarization, paraphrasing, classification via prompts, Creative generation: story writing, scripts, images (via text → image prompts), Domain-specific use-cases: education, business, marketing, data analysis, Low-code / no-code tool integration (UI tools + LLMs)

ETHICS, LIMITATIONS AND FUTURE OF PROMPT ENGINEERING

[6]

Ethical issues: bias, fairness, safety, misuse of generative AI, Limitations of LLMs and prompts: hallucinations, domain-bias, context limitations, Evaluation & metrics: how to measure prompt performance, fairness, reliability, Emerging trends: multimodal prompting (text+image+voice), agentic AI, customizing models

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. James Phoenix, Mike Taylor,” Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs”, Oreilly & Associates Inc,2024

REFERENCE BOOKS:

1. Yashwant Sai Palghat,” Prompt Engineering: The Art of Asking: Master Generative AI Tools Like ChatGPT & MidJourney”, Notion Press
2. Jayant Deshmukh,” Prompt Engineering - The Ultimate Guide for Success in Artificial Intelligence”,2024

WEB REFERENCES:

- 1.<https://www.promptingguide.ai/>
- 2.<https://learnprompting.org/docs/introduction>
- 3.<https://www.ibm.com/think/prompt-engineering>
- 4.<https://www.geeksforgeeks.org/blogs/what-is-prompt-engineering-the-ai-revolution/>

25HS270	PROFESSIONAL ENGLISH (Common to all branches)	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify the process of improving specific skills to be more efficient and effective to perform a task.	9	-
CO2	Understand the concept of email writing, structures of grammar and to interpret advance listening skills	5,9,11	-
CO3	Infer the strategies of academic writing using advanced grammar mechanics.	5,9,11	-
CO4	Apply different styles and techniques of communication in professional context.	5,9,11	-
CO5	Develop the skills to perform tasks more efficiently, adapt to new challenges, and achieve goals faster.	5,9,11	-

RESUME / REPORT PREPARATION / LETTER WRITING [6]

Structuring the Resume / Report – Letter Writing / E-mail Communication – Samples.

PRESENTATION SKILLS [6]

Elements of an Effective Presentation – Structure of a Presentation –Presentation Tools – Voice Modulation – Audience Analysis – Body Language.

SOFT SKILLS [6]

Time Management – Articulateness – Assertiveness – Innovation and Creativity – Stress Management & Poise.

GROUP DISCUSSION [6]

Why is GD Part of the Selection Process? – Structure of a GD- Moderator-led and Other GDs – Strategies in GD – Team Work – Body Language –Mock GD.

INTERVIEW SKILLS [6]

Kinds of Interviews –Required Key Skills – Corporate Culture- Mock Interviews.

Total Notional Hours : 30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS:

1. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2020
2. Sheetal Desarda. Master the Group Discussion & Personal Interview. Notion Press: Delhi, 2020.

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills of Everyone. Cengage Learning: New Delhi, 2019
2. Effective Communication Skills, Khanna Publishing house, ISBN 10-82609-94-6, 2024
3. Cambridge BEC resource (Web): Cambridge English Exams IELTS Resources
4. Jack C. Richards. Cambridge Fifth Edition Interchange (with CD), 5 nd Edition, Cambridge University Press, 2021.

WEB REFERENCES

1. <https://www.youtube.com/playlist?list=PLUP07JBWJm8preRogkAN3TT0YGJVdPJuu>
2. https://www.youtube.com/playlist?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KIJ

25HS202	தமிழரும் தொழில்நுட்பமும் Tamils and Technology	L	T	P	C
		1	0	0	1

கற்றல் அடைவுகள்

பாட நெறியின் முடிவில் மாணவர்களின் கற்றலின் அடைவுகள்

COs	கற்றல் அடைவுகள்	POs	PSO
CO 1	நெசவு மற்றும் பானைத் தொழில்நுட்பம் பற்றி அறிதல்	11	-
CO 2	சங்க காலத்திய வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம் பற்றி அறிதல்	11	-
CO 3	இரும்பு, எஃகு மற்றும் உலோகவியல் ஆய்வுகள் குறித்து புரிந்து கொள்ளுதல்.	11	-
CO 4	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி அறிதல்	11	-
CO 5	அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் வளர்ச்சி சார்ந்த தொழில்நுட்ப முறைகளை அறிதல்	11	-

நெசவு மற்றும் பானைத் தொழில்நுட்பம்

[3]

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு மற்றும் சிவப்பு பாத்திரங்கள் - மட்பாண்டங்கள் மீது கீரல் குறியீடு

வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம்

[3]

சங்க காலத்தில் வீட்டு உபயோகப் பொருட்களில் வடிவமைத்தல் மற்றும் கட்டமைப்பு,கட்டுமானங்கள் - கட்டிட பொருட்கள் மற்றும் சங்க காலத்து நடுகற்கள் - சிலப்பதிகாரத்தில் கட்டப்பட்ட கட்டங்களின் விவரங்கள் மாமல்லபுரத்தில் உள்ள சிற்பங்கள் மற்றும் கோவில்கள் - சோழர்களின் பெரிய கோவில்கள் மற்றும் பிற வழிபாட்டு தலங்கள் - நாயக்கர் கால கோவில்கள் - வகை ஆய்வு (மதுரை மீனாட்சி கோயில்)- திருமலை நாயக்கர் மஹால் - செட்டி நாடு வீடுகள், ஆங்கிலேயர் காலத்தில் சென்னையில் உள்ள இந்தோ - சரசெனிக் கட்டிடக்கலை.

உற்பத்தித் தொழில்நுட்பம்

[3]

கப்பல் கட்டும் கலை - உலோகவியல் ஆய்வுகள் - இரும்புத் தொழில் - இரும்பு உருக்குதல், எஃகு - வரலாற்றின் ஆதாரமாக தாமிரம் மற்றும் தங்க நாணயங்கள் அச்சிடுதல் - மணிகள் செய்யும் தொழில்கள், கல் மணிகள் - கண்ணாடி மணிகள் - டெரகோட்டா மணிகள் - சங்கு மணிகள் / எலும்புத்துண்டுகள் தொல்பொருள் சான்றுகள் - சிலப்பதிகாரத்தில் விவரிக்கப்பட்டுள்ள மணிகள் .

வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பம்

[3]

அணை, தொட்டி, குளங்கள், மதகு, சோழர் கால குமிழி தூம்பு முக்கியத்துவம், கால்நடை பராமரிப்பு - கால்நடைகள் பயன்படுத்த வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த தொழில்நுட்பம் - கடல் சார் அறிவு - மீன்வளம் - முத்து - சங்கு அறுத்தல் - கடல் பற்றிய பண்டைய அறிவு கடல் குறிப்பிட்ட அறிவு சார் உலகம்.

அறிவியல் தமிழ் & கணினி தமிழ்

[3]

அறிவியல் தமிழ் மற்றும் கணினி தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருள் உருவாக்கம் – தமிழ் மெய்நிகர் அகாடமி – தமிழ் மின்நூலகம் – இணைய தமிழ் அகராதிகள் – சொற்குவை திட்டம்.

Total Notional Hours : 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

1. தமிழர் மரபு - ஆக்கம்:தமிழ்ப் பேராசிரியர்கள் ,அண்ணா பல்கலைக்கழகம் வெளியீடு : பொறியியல் தொழில்நுட்பத் தமிழ் வளர்ச்சி மையம் ,அண்ணா பல்கலைக்கழகம் ,சென்னை - 600 025. (முதல் பதிப்பு 2023)

REFERENCE BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print) Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
2. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
3. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
4. 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)
5. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
7. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

8. தமிழக வரலாறும் மக்களும் பண்பாடும் – டாக்டர் கே.கே.பிள்ளை(தமிழ்நாடு பாடநூல் மற்றும் பணிகள் கழகம்)
9. கணினித் தமிழ் முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
10. கீழடி வைகை நதிக்கரையில் நகர நாகரிகம்(தொல்லியல் துறை வெளியீடு) .

WEB REFERENCES:

1. <https://www.tamilvu.org/> & <https://ta.wikipedia.org/>
2. <https://it.tn.gov.in/en/node/47> & <https://www.alagappauniversity.ac.in>
3. <https://clcl.uiowa.edu/language-resources/tamil-language-and-culture-resources>
4. <https://avvaitamil.org/online-resources/>
5. <https://www.alllanguageresources.com/tamil-resources/>

25HS252	UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY I	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the significance of values like justice, trust, and respect in human relationships and their role in fostering harmony	7,11	3
CO2	Differentiate between respect and differentiation, highlighting their impact on interpersonal relationships	7, 11	3
CO3	Apply the Universal Order and its progression from family to the world family, emphasizing the interconnectedness of relationships.	7, 11	3
CO4	Assess the presence or absence of core human values in societal structures through real-life case studies	7, 11	3
CO5	Demonstrate how the nine universal values in relationships can be applied to resolve conflicts and strengthen bonds in diverse social settings.	7, 11	3
CO6	Integrate and utilize the understanding of universal values to critically evaluate their relationships and propose ways to cultivate a more just and respectful environment within their social circles.	7, 11	3

HUMAN UNDERSTANDING: FAMILY VALUES

[15]

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) - Trust and Respect Difference between respect and differentiation; the other salient values in relationship, Universal Order- from family to world family.

Practical – Case Study on Old- Age Home and Orphanages.

Practical – Case Study on Old- Age Home and Orphanages.

Total Notional Hours: 30

TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 53-2.

REFERENCE BOOKS:

1. Universal Human values, Dr.Kuldeep S Sharma, Dr. Sarveen Kaur Sachdeva, Booksclinic Publisher, 2023.
2. Universal Human Values and Professional Ethics, Dr. Anand Vyas, Anandvyas publisher, 2023.

WEB REFERENCES

1. <https://www.uhv.org.in/>
2. https://www.uhv.org.in/UHV-II_Cours_Material
3. <https://uhv.org.in/highereducation>
4. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

25EC271	THINK BUILD INNOVATE LAB	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the basic concepts and working principles of simple electronic systems used in idea lab projects.	1	1
CO2	Identify problems and analyse simple electronic circuits to understand their input–output behaviour.	2	1
CO3	Design and develop basic electronic circuits to meet given functional requirements.	3	2
CO4	Build and test simple hardware prototypes by integrating components and verifying their operation.	4	2
CO5	Demonstrate teamwork, communication, and basic project planning skills during the execution of idea lab projects.	8, 9	2

LIST OF PROJECT TITLES

1. Automatic plant watering system
2. Smart dustbin system.
3. Smart blind stick.
4. Smart patient room monitoring system.
5. Smart doorbell systems
6. Smart bank locker security system
7. **Smart library book locator system.**
8. Smart door lock system.
9. Smart fire exit guidance system.
10. Voice-controlled fan/light.
11. Low-cost solar phone charger.
12. Contactless hand sanitizer dispenser.
13. Smart bicycle tail light.
14. Medication reminder box.
15. Portable air quality monitor.
16. Water overflow alarm for tanks.
17. Automatic washroom light switch.
18. Home security intrusion alert.

19. Anti-sleep driver alarm.
20. The "smart trash sorter" (plastic vs. Metal).
21. Electronic "coin bank" counter.
22. IoT-enabled "smart-capacity" waste bin.
23. Temperature monitoring system.
24. Motion-based light control.
25. Automatic street light system.
26. Gas leakage detection system.
27. Digital voltmeter using Arduino.
28. Rain detection system.
29. Automatic fan speed control.
30. Obstacle detection robot.
31. Energy consumption monitoring system.
32. Home automation using Bluetooth.

REFERENCE BOOKS

1. Jacob Millman, Christos C. Halkias, *Electronic Devices and Circuits*, 4th Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2015.
2. R. Boylestad, L. Nashelsky, *Electronic Devices and Circuit Theory*, 14th Edition, Pearson Education, 2021.
3. Donald A. Neamen, *Microelectronics: Circuit Analysis and Design*, 4th Edition, McGraw Hill Education, New Delhi, 2019.
4. S. Salivahanan, N. Suresh Kumar, *Electronic Devices and Circuits*, 5th Edition, McGraw Hill Publishing Limited, New Delhi, 2022.
5. M. A. Mazidi, J. G. Mazidi, *The Arduino Microcontroller and Embedded Systems*, 2nd Edition, Pearson Education, 2017.

WEB LINKS / ONLINE RESOURCES

1. NPTEL – Basic Electronics & Analog Circuits <https://nptel.ac.in>
2. Arduino Official Documentation <https://www.arduino.cc>
3. All About Circuits (Beginner Friendly Tutorials) <https://www.allaboutcircuits.com>
4. Electronics Tutorials <https://www.electronics-tutorials.ws>
5. EasyEDA – PCB Design Learning Platform <https://easyeda.com>

25CS252	DATA STRUCTURES	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Review key concepts, types, and operations of linear and non-linear data structures.	1,2, 5, 9	1
CO2	Compare the implementation and uses of different list and tree structures.	1,2, 5, 9	1,2
CO3	Describe the working principles of graph algorithms and sorting/searching techniques.	1,2, 5, 9	1,2
CO4	Implement stack and queue ADTs to solve practical problems such as expression evaluation and priority-based processing.	3,5, 9	1,2
CO5	Develop applications using tree and graph data structures for problems like expression trees and network routing.	3,5, 9	1,2,3
CO6	Analyze and compare the efficiency of different sorting algorithms and hashing techniques for various data scenarios.	1,2, 5, 9	1,2

LINEAR DATA STRUCTURES: (LIST) [6]

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

LINEAR DATA STRUCTURES: (STACKS-QUEUES) [6]

Stack ADT – Evaluating arithmetic expressions- other applications- Queue ADT – circular queue implementation – Double ended Queues – Priority queue - applications of queues.

NON-LINEAR DATA STRUCTURES: (TREES) [6]

Tree ADT – Tree traversals - Binary Tree ADT – expression trees – applications of trees – Binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of heap.

NON-LINEAR DATA STRUCTURES: (GRAPH) [6]

Representation of Graphs – Breadth-first search – Depth-first search – Topological sort – Minimum Spanning Trees – Kruskal and Prim algorithm – Shortest path algorithm – Dijkstra's algorithm – Bellman-Ford algorithm – Floyd - Warshall algorithm.

SORTING, SEARCHING AND HASHING TECHNIQUES. [6]

Sorting algorithms: Insertion sort - Selection sort - Shell sort - Bubble sort - Quick sort - Merge sort - Radix sort – Searching: Linear search –Binary Search - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendable Hashing.

LAB EXPERIMENTS:**[30]**

1. Implementation of Linked List Operations.
2. Implementation of Stack using arrays and Linked list.
3. Implementation of Queue using arrays and Linked list.
4. Implementation of Sorting algorithms.
5. Implementation of Linear search and Binary Search.
6. Implementation of Tree traversal Techniques.
7. Implementation of Depth for Search.
8. Implementation of Breadth first Search.
9. Implementation of Minimum Spanning Trees.
10. Implementation of Shortest Path Algorithms.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1. Mark Allen Weiss, *Data structures and Algorithm Analysis in C*, 2nd Edition, Pearson Education, 2020.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 4th ed. Cambridge, MA, USA: MIT Press, 2022.

REFERENCES:

1. M. de Berg, O. Cheong, M. van Kreveld, and M. Overmars, *Computational Geometry: Algorithms and Applications*, 3rd ed. Berlin, Germany: Springer, 2008.
2. D. E. Knuth, *The Art of Computer Programming, Volume 1: Fundamental Algorithms*, 3rd ed. Boston, MA, USA: Addison-Wesley, 1997.
3. B. Stroustrup, *The C++ Programming Language*, 4th ed. Upper Saddle River, NJ, USA: Addison-Wesley Professional, 2013.

ONLINE RESOURCES:

https://onlinecourses.nptel.ac.in/noc25_cs81/

https://onlinecourses.nptel.ac.in/noc23_cs88/

25EC202	DIGITAL PRINCIPLES AND SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Apply number systems and Boolean algebra to design and implement combinational and sequential digital circuits using appropriate logic families.	1	1,2
CO2	Design digital systems by integrating simplified Boolean logic, combinational and sequential circuits, and implement them using hardware description languages and suitable digital IC and memory technologies.	1,2,8	1,2
CO3	Simulate and test digital circuits using Verilog HDL, integrating optimized Boolean expressions, hardware building blocks, logic family constraints, and programmable logic devices.	2,5	1,2
CO4	Analyze and compare the performance of digital systems based on simplification strategies, logic family characteristics, memory design, and implementation complexity in both combinational and sequential circuits.	1	1,2,3
CO5	Design and integrate complete digital systems using simplified logic, combinational and sequential modules, logic, family constraints, and programmable memory for real-time applications.	2,5	1,2,3

SIMPLIFICATION OF BOOLEAN EXPRESSIONS

[9]

Number systems, Boolean expressions and Notations, Karnaugh Maps - Up to Four-variable maps, Sum of products and product of sums, Minterms and Maxterms, Minimization of Boolean Functions using Karnaugh Maps.

COMBINATIONAL CIRCUIT DESIGN

[12]

Design with basic logic gates, adders and subtractors - Verilog models. Priority encoders, decoders, Multiplexers and Demultiplexers, comparators.

Lab modules:

1. Design of 4-bit Binary Adder using IC 7483
2. Implementation of 4:1 Multiplexer and 1:4 Demultiplexer
3. Simulation of Encoder and Decoder

SEQUENTIAL CIRCUIT DESIGN

[12]

Memory elements and their excitation functions, SR, JK, T, and D latches and flip-flops - Verilog models, master slave JK flip-flop, edge-triggered flip-flop, synchronous and asynchronous counters.

Lab modules:

1. Implementation of Shift Registers using Flip-Flops
2. Simulation of Synchronous and Asynchronous Counter

LOGIC FAMILIES AND MEMORY DEVICES

[12]

Characteristics of Digital ICs, DTL, TTL, ECL, Calculation of noise margins and fan-out - Memory: Basic Organization, ROM, RAM, PROM, EPROM, EEPROM, PLDs - FPGA - Design of combinational circuits using PLDs

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. M. Morris Mano & Michael D. Ciletti, Digital Design, 6th Edition, Pearson Education, 2021
2. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, McGraw- Hill Education, 2025, 4th Edition.

REFERENCE BOOKS:

1. John F. Wakerly, Digital Design: Principles and Practices, Prentice Hall India, 2005, 4th Edition.
2. R.P. Jain & Kishor Sarawadekar, Modern Digital Electronics, McGraw-Hill Education, 5th Edition, 2022.
3. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2nd Edition 2003,
4. Thomas L. Floyd, "Digital Fundamentals", 11th edition, Pearson Education, 2014
5. Salivahanan S, S.Arivaxzhagan, "Digital Circuits and Design", 5th Edition, Oxford university Press, 2019.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc25_ee125
2. Digital Systems: From Logic Gates to Processors | Coursera

SEMESTER III

25AI251	EXCEL MACROS	L	T	P	C
		1	0	2	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain fundamentals of Excel macros and automation	1,2,3	1
CO2	Apply VBA programming concepts to automate tasks	1,2,3,4	1,2
CO3	Use Excel object model for data manipulation	1,2,3,5	1,2
CO4	Design user forms and develop applications	1,2,3,4,5	1,2,3
CO5	Develop real-time automation solutions using VBA	1,2,3,4,5	1,2,3

INTRODUCTION TO EXCEL MACROS

[3]

Overview of Microsoft Excel environment, Introduction to macros, Applications of automation, Enabling developer tab and macro security, Macro recorder, Recording and running macros, Absolute and relative references, Editing recorded macros

VBA PROGRAMMING FUNDAMENTALS

[3]

Introduction to VBA, Visual Basic Editor (VBE), Modules, Sub procedures and Functions, Variables and data types, Constants, Operators and expressions, InputBox and MsgBox

EXCEL OBJECT MODEL

[3]

Object-oriented programming concepts, Workbook, Worksheet, Range and Cells, Properties, Methods and Events, Referencing cells and ranges, Working with multiple worksheets and workbooks

CONTROL STRUCTURES AND ADVANCED CONCEPTS

[3]

Conditional statements (If, Select Case), Looping constructs (For, Do While, For Each), Arrays and collections, User Defined Functions (UDF), Error handling, Debugging techniques

FORMS AND REAL-TIME AUTOMATION

[3]

Creating UserForms, Controls (TextBox, CommandButton, ComboBox, ListBox), Event-driven programming, Automating reports, Dashboard creation basics, File handling (CSV/Text), Sending emails using Outlook

LABORATORY EXPERIMENTS

[30]

1. Record a macro to format a dataset (fonts, colors, borders)
2. Develop a macro to sort and filter data automatically
3. Write a VBA program to perform arithmetic operations on cells
4. Implement loops to calculate sum and average of data
5. Create a User Defined Function (UDF)
6. Write a program to copy data between worksheets
7. Design a simple data entry form using UserForms
8. Develop a macro for automated report generation
9. Implement error handling in VBA program
10. Import data from CSV file and perform data cleaning

Total Notional Hours:60

L	T	P	TW+SL	C
15	0	30	15	2

TEXT BOOKS

1. John Walkenbach, *Excel VBA Programming for Dummies*, Wiley India, 2015
2. Michael Alexander & Dick Kusleika, *Excel 2019 Power Programming with VBA*, Wiley, 2019

REFERENCE BOOKS

1. Paul McFedries, *Absolute Beginners Guide to VBA*, 1st Edition, Kindle Edition
2. Bill Jelen, *VBA and Macros for Microsoft Excel*, Kindle Edition

WEB REFERENCES

1. Microsoft Learn – Excel VBA Documentation
2. NPTEL Excel/Data Analytics Courses

25IT210	CYBERCRIMES - LAW, PRACTICE AND PROCEDURES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the jurisprudential basis, scope, and classification of cybercrimes under Indian law.	2, 6, 8	1,2
CO2	Explain the key provisions of the Information Technology Act, 2000, and the Digital Personal Data Protection Act, 2023.	6, 8	1,2
CO3	Recall the procedural framework for cybercrime investigation.	6	1,2
CO4	Identify the legal principles governing the admissibility and evidentiary value of electronic records in court.	6	1,2
CO5	Apply legal principles to real-world cybercrime scenarios.	2, 6, 8	1,2

FOUNDATIONS OF CYBER LAW AND JURISDICTION

[6]

Introduction to Cyberspace and Cyber Law - Definition, evolution, and need for cyber laws - Jurisprudence of Cyber Law: Challenges of regulating the borderless digital world - Overview of the Indian legal framework: Constitution of India, IPC/BNS, Evidence Act/BSA, and the IT Act - The Information Technology Act, 2000 - Objectives, scope, and salient features - Key amendments via the IT (Amendment) Act, 2008 - Legal recognition of electronic records and digital/electronic signatures - Jurisdictional Issues in Cyberspace - Theories of cyber jurisdiction - Issues in cross-border data flow and investigation - Provisions for extra-territorial application under the IT Act.

CYBER OFFENSES AND LEGAL PROVISIONS

[6]

Offenses under the Information Technology Act, 2000 - Section 43: Penalty and compensation for damage to computer systems - Section 66: Computer-related offenses (Hacking, data alteration, virus dissemination) - Section 66B: Punishment for dishonestly receiving stolen computer resource - Section 66C: Punishment for identity theft - Section 66D: Punishment for cheating by personation by using computer resource - Section 66E: Punishment for violation of privacy - Section 66F: Punishment for cyber terrorism - Analysis of Specific Cybercrimes: Against Persons: Cyber stalking, cyber bullying, cyber defamation, online harassment, morphing, and publishing obscene content (Section 67, 67A, 67B) - Against Property: Phishing, vishing, online fraud, credit/debit card frauds, Intellectual Property (IP) crimes, and cybersquatting - Against Government: Cyber terrorism and espionage - Overlap with Traditional Laws: - Applicability of the Bharatiya Nyaya Sanhita (BNS), 2023 (and IPC) to cybercrimes - Mapping between IT Act offenses and BNS offenses (cheating, forgery, defamation, stalking) - Case studies.

CYBERCRIME INVESTIGATION AND PROCEDURE

[6]

The Investigation Framework: Role and powers of the Investigating Officer (IO) - Procedure for registration of cybercrime complaints (FIR vs. NCR) - Issues of territorial and subject-matter jurisdiction for investigation - Search, Seizure, and Arrest: Procedural requirements for search and seizure of computer resources - Handling of digital evidence at the crime scene:

Do's and Don'ts - Arrest of an accused in a cybercrime case - Intermediary Liability and Data Disclosure - Definition and role of intermediaries (ISPs, social media platforms) - Safe harbor provisions and due diligence requirements (Rules under IT Act) - Procedures for lawful interception, monitoring, and decryption (Section 69) - Obligations to preserve and retain user information (Section 67C).

ELECTRONIC EVIDENCE AND COURTROOM PROCEDURE [6]

Electronic Evidence under the Indian Evidence Act, 1872 / Bharatiya Sakshya Adhiniyam (BSA), 2023 - Concept of primary and secondary evidence for electronic records - Admissibility of electronic evidence (Section 65B of Evidence Act / corresponding provisions in BSA) - The "Certificate under Section 65B" – requirements and judicial interpretation - Forensic Analysis and Reporting - Trial of Cybercrime Cases - Pre-trial procedures (cognizance of offenses, taking of evidence) - Role of key players: Judge, Prosecutor, Defense Counsel, Expert Witness - Preparation of case materials for court: Chronology, evidence log, and presentation.

EMERGING ISSUES, ETHICS, AND CASE LAWS [6]

Data Protection and Privacy: Overview of the Digital Personal Data Protection (DPDP) Act, 2023 - Rights and duties of data principals (citizens) and obligations of data fiduciaries - Interface between the DPDP Act and the IT Act - Specialized Cybercrimes: Legal issues in E-Banking and Mobile Payments - Social media-related crimes and platform accountability - Cryptocurrency and blockchain-related frauds.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

1.R.P. Kataria & S.K.P. Srinivas. *Cyber Crimes: Law, Practice and Procedure*, 2/E. Orient Publishing Company, 2025.

REFERENCES:

1. Dr Gupta & Agrawal. *Cyberlaws*. Premier Publication Company, 2024.
2. D.P. Mittal. *Law Relating to Information Technology, E-Commerce, E-Governance & Cyber Crimes*. Orient Publishing Company, 2025.

ONLINE RESOURCES:

- 1.The Information Technology Act, 2000.
https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf
- 2.The Digital Personal Data Protection Act, 2023.
<https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>

25MA207	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Apply the basic concepts of probability and probability distributions (discrete and continuous) in analyzing engineering-related uncertainties	1,2,5	1
CO2	Apply the concepts of probability distributions to solve problems in the engineering field	1,2,5	1.2
CO3	Apply statistical sampling methods and hypothesis testing procedures to draw inferences from data using standard distributions.	1,2,5	1,2
CO4	Apply the principles of experimental design and perform analysis of variance (ANOVA) to interpret experimental data.	1,2,5	1,2
CO5	Apply the methods of statistical process control in the engineering field	1,2,5	1,2,3

PROBABILITY AND STATISTICAL DISTRIBUTIONS

[9+3]

Probability – The axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

TWO DIMENSIONAL RANDOM VARIABLES

[9+3]

Joint probability distribution – Marginal probability distribution – Conditional probability distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables)

SAMPLING THEORY

[9+3]

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

DESIGN OF EXPERIMENTS**[9+3]**

Analysis of Variance – One way classification – Two way classifications – Completely randomized design – Randomized block design – Latin square design – 22 factorial designs.

STATISTICAL QUALITY CONTROL**[9+3]**

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

CASE STUDIES**List of Experiments using MATLAB**

1. Verification of axioms of probability and Bayes' theorem
2. Computation of moments for discrete random variables
3. Moment generating function for continuous random variables
4. Simulation of Binomial, Poisson and Geometric distributions
5. Simulation of Uniform, Exponential and Normal distributions
6. Joint, marginal and conditional probability distributions
7. Covariance, correlation and linear regression analysis
8. Verification of Central Limit Theorem using simulation
9. Hypothesis testing using t, Chi-square and F tests
10. Statistical Quality Control charts and acceptance sampling

TEXT BOOKS:

1. E. Kreyszig, Advanced Engineering Mathematics, 11th ed., Indian Adaptation. New Delhi, India: Wiley India Pvt. Ltd., 2025.
2. R. A. Johnson, I. Miller, and J. E. Freund, *Miller & Freund's Probability and Statistics for Engineers*, 9th ed. New Delhi, India: Pearson Education, 2020/2023.

REFERENCES:

1. A. Papoulis and S. Unnikrishnapillai, Probability, Random Variables and Stochastic Processes, 4th ed. New Delhi, India: McGraw-Hill Education India Pvt. Ltd., 2017.

25AI220	SOCIAL IMPACT OF ARTIFICIAL INTELLIGENCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of Artificial Intelligence, its societal impacts, and the importance of ethics in AI systems	1,6,8,11	3
CO2	Analyse key ethical issues and legal considerations related to AI technologies..	2,6,8	3
CO3	Examine concepts such as fairness, transparency, accountability, and responsibility in AI systems.	2,8,11	2,3
CO4	Evaluate interdisciplinary perspectives on AI ethics and the concept of trustworthy AI.	6,8,9,11	3
CO5	Assess ethical challenges in real-world AI applications through case studies in domains such as healthcare, law, and smart cities.	2,6,8,11	1,2

COURSE CONTENT:

INTRODUCTION [6]

Introduction – Introduction to Artificial Intelligence – Overview for Law and Regulations – Impacts of AI – Ethics of AI – Approaches in AI Ethics.

RISE OF AI ETHICS [6]

AI Ethics – Common Themes and Varieties of Questions – Ethical Questions in AI – AI Ethics Now – AI Ethics Law – Case study: An Indigenous AI Report.

CONCEPTS AND ISSUES [6]

Moral frameworks of Justice in AI – Accountability in Computer Systems – Transparency – Responsibility – Concept of Handoff as a Model – Race and Gender – Autonomy – Troubleshooting AI .

PERSPECTIVES AND APPROACHES [6]

Perspectives on Ethics of AI – Computer Science - Engineering – Cognitive Science – Economics – Humanities – Philosophy – Anthropology – Trustworthy AI – Case study of AI for Social Good

CASE STUDIES AND APPLICATIONS

[6]

Ethics of AI – Transport – Military – Biomedical research – Patient care and Public health – Law – Robot teaching – Algorithms and the Social Organization of work – Smart city Ethics..

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. Markus D. Dubber, Frank Pasquale, Sunit Das, The Oxford Handbook Of Ethics Of AI, Oxford University Press, 2021, ISBN: 019006739X;
2. Paula Boddington, AI Ethics: A Textbook, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer, 2023, ISBN: 9811993815;

REFERENCE BOOKS:

1. Mark Coeckelbergh, AI Ethics, The MIT Press Essential Knowledge, The MIT Press, 2020, ISBN: 0262538199;

WEB REFERENCES:

<https://www.youtube.com/watch?v=xy2B52ZO3X0>

25IT252	PYTHON FOR SCIENTIFIC COMPUTING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply Python programming constructs to solve engineering and scientific problems using appropriate data structures and program flow techniques.	1,2,5	1
CO2	Perform numerical computations using NumPy for vector/matrix operations, linear algebra, and statistical analysis	1,2,4,5	1
CO3	Visualize and animate mathematical models using Matplotlib for 2D/3D plotting, subplots, and dynamic simulations.	2,3,5	1
CO4	Utilize symbolic computation with SymPy for algebraic manipulation, equation solving, differentiation, integration, and differential equations	2,4,6	1
CO5	Implement advanced numerical methods using SciPy for optimization, interpolation, numerical integration, and solving differential equations	2,4,5	1
CO6	Develop interactive simulations and 3D visualizations using VPython and integrate GUI elements with Tkinter for engineering applications	3,5	1

COURSE CONTENT:

FOUNDATIONS OF PYTHON PROGRAMMING

[6]

Development Environments – Modules of Python: NumPy – Matplotlib – SymPy – SciPy – Vpython – Keywords – Linear Program Structures – Functions – Branching Structures – Repetitive Structures – Data Structures – Functional Program Style – Object-oriented program style.

NUMERICAL COMPUTING

[5]

NumPy Functions – One-dimensional array – two-dimensional array – slicing – mathematical and statistical functions – Vectors: addition – product – Matrix Multiplication – Linear Systems of Equations.

DATA VISUALIZATION AND ANIMATION

[5]

2D function plots – 3D function plots – Vector Field – Displaying Figures, Lines and Arrows - Animations.

SYMBOLIC MATHEMATICS

[5]

Basic Mathematical Operations – Multiplying Matrices – Equations – Simplification of terms – series expansion – partial fractions – Limits – Differentiation – Integrations – Differential Equations – Laplace Transform.

ADVANCED NUMERICAL METHODS**[9]**

Numerical computation of zeros – optimizations – interpolations – numerical differentiation – numerical integration – solving differential equations numerically – Discrete Fourier Transform – basic shapes, points, and lines – bodies in motion – generating, saving, and reading measurements – frequency distribution – location parameters – dispersion parameters – normal distribution – skew – regression analysis – layout manager of Tkinter – Radio button - slider.

LAB EXPERIMENTS:**[60]**

1. Solve a system of linear equations using NumPy's solve() function.
2. Compute scalar, cross, and triple products for given vectors and visualize them using Matplotlib.
3. Plot multiple functions (e.g., harmonics of a square wave) with custom line styles, legends, and axis labels.
4. Use SymPy to find derivatives and integrals of given functions and plot the results alongside numerical approximations.
5. Compare rectangle, trapezoidal, and Simpson's rule using SciPy for a definite integral and analyze error trends.
6. Solve a second-order ordinary differential equation using SymPy and SciPy and animate the solution with Matplotlib.
7. Simulate a bouncing ball or planetary orbit using VPython and analyze motion parameters.
8. Generate normally distributed random data, compute mean/median/variance, and plot histograms with regression lines.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

1. Veit Steinkamp. *Python for Engineering and Scientific Computing*. Rheinwerk Computing, 2024.

REFERENCES:

1. Claus Führer, Jan Erik Solem, Olivier Verdier. *Scientific Computing with Python: High-performance scientific computing with NumPy, SciPy, and pandas*, 2/E. Packt Publishing Limited, 2021.
2. Stephen Lynch. *Python for Scientific Computing and Artificial Intelligence*. CRC Press, 2025.

ONLINE RESOURCES:

1. Scientific Computing using Python, 2023. <https://nptel.ac.in/courses/115104135>
2. The Joy of Computing using Python, 2025. <https://nptel.ac.in/courses/106106182>
3. Introduction to Computer Science and Programming in Python, <https://ocw.mit.edu/courses/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/>

25HS253	UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY II	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

COs	Course Outcomes	PO	PSO
CO1	Understand the interconnectedness and mutual fulfilment of four orders in nature (material, plant, animal, and human) and their role in maintaining ecological balance.	7,11	-
CO2	Describe the principles of recyclability and self-regulation in nature, highlighting their significance in sustainability.	7,11	-
CO3	Discuss the concept of existence as co-existence, emphasizing the interdependent relationship between all units in nature within all-pervasive space.	7,11	-
CO4	Document the interconnectedness observed during a field visit to farms, as demonstrated through a comprehensive report.	7,11	-
CO5	Prepare a structured report based on field observations, integrating theoretical concepts of holistic harmony with practical findings.	7,11	-

HARMONY IN SOCIETY: NURTURING DISPOSITION

[15]

Understanding the harmony in the Nature-Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space- Holistic perception of harmony at all levels of existence. Practical - Field trip to various farms and Report writing on field work.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	0

TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034 53-2.

REFERENCE BOOKS:

1. Universal Human values, Dr.Kuldeep S Sharma, Dr. Sarveen Kaur Sachdeva, Booksclinic Publisher, 2023.

2. Universal Human Values and Professional Ethics, Dr. Anand Vyas, Anandvyas publisher, 2023.

WEB REFERENCES

1. <https://www.uhv.org.in/>
2. https://www.uhv.org.in/UHV-II_Cours_Material
3. <https://uhv.org.in/highereducation>
4. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

25AI252	NEURAL NETWORKS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	To understand the fundamentals of artificial neural networks	1,2	1
CO2	To analyse learning mechanisms and optimization techniques	1,2,4	1,2
CO3	To study different neural network architectures	1,2,3	1,2
CO4	To apply neural networks to real-world problems	2,3,5	1,2,3
CO5	To explore recent trends in deep learning	5,11	1,2,3

COURSE CONTENT:

INTRODUCTION TO NEURAL NETWORKS

[6]

Introduction to Artificial Intelligence and Neural Networks, Biological neuron vs Artificial neuron, McCulloch-Pitts neuron model, Perceptron model and learning rule, Linear separability, Limitations of perceptron

MULTI-LAYER NEURAL NETWORKS

[6]

Multi-Layer Perceptron (MLP), Activation functions: Sigmoid, Tanh, ReLU, Softmax, Forward propagation, Loss functions: Mean Squared Error, Cross-Entropy, Backpropagation algorithm

OPTIMIZATION AND REGULARIZATION

[6]

Gradient Descent (Batch, Stochastic, Mini-batch), Optimization techniques: Momentum, RMSProp, Adam optimizer, Overfitting and underfitting, Regularization techniques: L1, L2, Dropout, Hyperparameter tuning

ADVANCED NEURAL NETWORK ARCHITECTURES

[6]

Convolutional Neural Networks (CNN) basics, Recurrent Neural Networks (RNN) basics, Introduction to LSTM and GRU, Feedforward vs recurrent networks, Applications of CNN and RNN

APPLICATIONS AND EMERGING TRENDS

[6]

Neural networks in: Computer Vision ,Natural Language Processing ,Speech Processing ,Introduction to Deep Learning frameworks (TensorFlow, PyTorch) ,Basics of Transfer Learning ,Overview of Transformers and Generative AI

EXPERIMENTS:

[30]

1. Implementation of AND Gate using McCulloch–Pitts Neuron
2. Implementation of OR Gate using Perceptron
3. Demonstration of XOR Problem in Perceptron
4. Implementation of Sigmoid Activation Function
5. Implementation of ReLU Activation Function
6. Simple Forward Propagation in Neural Network
7. Simple Backpropagation Algorithm
8. Gradient Descent for Weight Update
9. Simple Image Classification using CNN
10. Simple Sequence Prediction using RNN

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS

- 1.Ian Goodfellow, Yoshua Bengio & Aaron Courville, “*Deep Learning*”, MIT Press, 2016.
- 2.Simon Haykin, “*Neural Networks and Learning Machines (3rd Edition)*”, Pearson, 2009.

REFERENCE BOOKS

- 1.S. Rajasekaran & G. A. Vijayalakshmi Pai, “*Neural Networks, Fuzzy Logic, and Genetic Algorithms*”, PHI Learning, 2003.
- 2.Satish Kumar, “*Neural Networks: A Classroom Approach*”, Tata McGraw-Hill, 2004.
- 3.Charu C. Aggarwal, “*Neural Networks and Deep Learning*”, Springer, 2018.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/117105084>
- 2.<https://nptel.ac.in/courses/127105006>

25CS254	OPERATING SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental organization and architecture of computer systems, the evolution of operating systems, OS structure, and the process of building and booting an OS.	1,2	1
CO2	Implement process management techniques to solve scheduling problems.	1,2	1
CO3	Apply synchronization mechanisms to coordinate concurrent processes and resolve resource conflicts.	1,2,3,5	1
CO4	Recommend memory management strategies to improve system performance.	1,2,3,4,5	1
CO5	Compare their trade-offs across different operating systems in terms of system structure.	1,2,4	1

INTRODUCTION TO OPERATING SYSTEMS

[4]

Computer System Organization – Computer System Architecture- Evolution of Operating System- OS Structure Services - System Calls –OS Structures- Building and Booting an OS.

PROCESS MANAGEMENT

[8]

Processes: Process Concept-Process Scheduling-Operations on Process-Interprocesses Communication – Threads-Multithreads Models. CPU Scheduling: Basic Concept-Scheduling Criteria-Scheduling Algorithms- Multi Processor Scheduling. Process Synchronization: Critical Section Problem – Peterson’s Solution-Semaphores - Monitors – Hardware Synchronization: Deadlocks: System Model-Characterization-Methods-Prevention - Avoidance and Detection-Recovery from Deadlocks.

MEMORY MANAGEMENT

[6]

Memory Management Strategies: Swapping – Contiguous Memory Allocation-Segmentation -Paging. Virtual memory Management: Demand Paging - Page Replacement Algorithms- Thrashing

FILE MANAGEMENT AND DISK MANAGEMENT

[8]

File System: File concepts – Access Methods -Directory and Disk Structure-File System Mounting -File System Structure-Implementation-Directory Implementation-Allocation Methods-Free Space Management. Mass Storage Structure: Disk Structure - Disk Scheduling

- Disk Management -Swap Space Management- I/O Systems - System Protection and Security.

ADVANCED TOPICS

[4]

Virtual Machines- Network and Distributed Systems – Case Studies: Linux-Windows 11

LABORATORY EXPERIMENTS

1. Linux Commands
2. System Calls
3. CPU Scheduling
4. Semaphore
5. Deadlock Avoidance
6. Paging
7. Page Replacement Algorithms
8. File Allocation Methods
9. Directory Implementation
10. Disk Scheduling

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, John Wiley and Sons Inc., 10th Edition, ISBN: 978-1-119-45408-3, 2021.

REFERENCE BOOKS:

1. William Stallings, “Operating Systems - Internals and Design Principles”, Pearson Education India 9th Edition, 2018.
2. Andrew S Tanenbaum, “Modern Operating Systems”, Pearson Education, 5th Edition, 2024.

WEB RESOURCE:

1. https://onlinecourses.nptel.ac.in/noc21_cs72/preview
2. https://onlinecourses.nptel.ac.in/noc21_cs88/preview

25AI202	DATA SCIENCE AND ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain Python environment setup and Excel data handling using pandas.	1,5	1
CO2	Apply data cleaning and pre-processing techniques using Excel and pandas.	1,2,5	1.2
CO3	Perform exploratory data analysis and visualization using pandas and Excel tools.	2,4,5	1,2
CO4	Implement basic machine learning models using datasets prepared in Excel and pandas.	2,3,5	1,2,3
CO5	Develop automated data analysis and reporting pipelines using pandas and Excel integration.	3,5,11	1,2,3

COURSE CONTENT:

INTRODUCTION AND DATA HANDLING

[9]

Python environment setup (Jupyter/VS Code), introduction to **pandas**, reading and writing Excel files, working with multiple sheets, data inspection (head, info, describe), comparison of Excel functions and pandas operations.

DATA CLEANING AND EXCEL–PANDAS INTEGRATION

[9]

Handling missing values, duplicates, and inconsistent formats, data type conversions (dates, categorical, numeric), working with date/time data, merging and concatenating datasets, automation of repetitive Excel tasks using pandas.

EXPLORATORY DATA ANALYSIS AND VISUALIZATION

[9]

Descriptive statistics, value counts, groupby operations, pivot tables, basic Excel charts and pivot charts, visualization using pandas/matplotlib, exporting visualizations and results to Excel, basic feature engineering.

MACHINE LEARNING WITH EXCEL DATA

[9]

Using pandas DataFrames for ML workflows, integrating Excel datasets with ML pipelines, simple regression and classification models, training–testing split, evaluation metrics (MAE, MSE, accuracy), exporting results to Excel.

AUTOMATION, DEPLOYMENT AND REPORTING

[9]

Automating Excel reports using pandas scripts, exporting outputs to multiple Excel sheets and charts, maintaining reproducible data pipelines, versioning workflows, capstone mini-project integrating Excel data, pandas analysis, ML model, and report generation.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. **Wes McKinney**, “*Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter*”, 3rd Edition, O’Reilly Media, 2022.

2. **Eric Mithcell and Clive Pearson**, “*Excel Data Analysis: Your visual blueprint for analysing data, charts & PivotTables*”, 3rd Edition, Wiley, 2022.

REFERENCE BOOKS:

1. **Aurélien Géron**, “*Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*”, 2nd Edition, O’Reilly, 2022.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106107220>
2. <https://www.geeksforgeeks.org/data-science/data-science-with-python-tutorial/>

25CS255	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Ability to Describe fundamental DBMS concepts, data models, database architecture, and schema design principles.	1,2	1,2
CO2	Ability to Apply relational algebra and SQL queries to create, manipulate, and retrieve database data.	1,2	1,2
CO3	Ability to Recommend normalization techniques and ER modeling to eliminate redundancy and improve database integrity.	1,2,5	1,2
CO4	Ability to Evaluate query execution and optimization strategies for improving database performance.	1,2,3,5	2
CO5	Ability to Design ETL pipelines, data warehousing solutions, and data engineering workflows for scalable data processing.	1,2,3,5	2

DATABASE CONCEPTS AND ARCHITECTURE

[6]

Database system overview, DBMS architecture, data models (hierarchical, network, relational), schema vs instance, data independence, ER modeling, enhanced ER concepts (specialization, generalization, aggregation), relational schema mapping.

RELATIONAL MODEL AND QUERY LANGUAGES

[6]

Relational algebra (operators and expressions), relational calculus (tuple and domain), SQL: DDL, DML, DQL, constraints, joins, nested/correlated subqueries, views, triggers, assertions, transactions, concurrency basics.

NORMALIZATION AND INTEGRITY

[6]

Functional, multivalued, and join dependencies, attribute closure, keys and candidate keys, normal forms (1NF, 2NF, 3NF, BCNF), lossless decomposition, dependency preservation, indexing concepts (B-tree, B+-tree).

QUERY PROCESSING, STORAGE AND OPTIMIZATION

[6]

Query execution stages, cost estimation, sorting, hashing, join techniques, query rewrite rules, plan selection, buffer management, caching, RAID storage, file organizations (heap, sorted, hashed, clustered).

DATA ENGINEERING AND WAREHOUSING

[6]

Introduction to data engineering, ETL lifecycle, data integration techniques, data warehousing architecture, OLTP vs OLAP, star/snowflake schema, dimensional modeling, ETL/ELT tools, Big Data platforms and distributed processing.

LIST OF EXPERIMENTS

1. Create and query relational databases using SQL DDL/DML/DQL.
2. Implement joins, nested and correlated queries.
3. Apply constraints, triggers, and views in database design.
4. Perform ER modeling and map to relational schemas.
5. Normalize database tables to 3NF/BCNF and test for integrity.
6. Develop a mini ETL pipeline or data warehousing workflow using a sample dataset.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan. *Database System Concepts*, 7/E. McGraw-Hill, 2021.

REFERENCES:

1. Ramez Elmasri and Shamkant B. Navathe. *Fundamentals of Database Systems*, 7/E. Pearson, 2017.
2. Garcia-Molina H., Ullman J.D., Widom J. *Database Systems: The Complete Book*, 3/E, Pearson, 2020.
3. Mark L. Gillenson, Pradeep Singh. *Fundamentals of Database Management Systems*, 3/E, Wiley, 2025.

ONLINE RESOURCES:

1. Database Systems, 2025. https://onlinecourses.nptel.ac.in/noc24_cs55
2. Data Engineering Foundations, 2025.

<https://www.coursera.org/specializations/data-engineering-foundations>

SEMESTER IV

25HS208	QUANTITATIVE APTITUDE AND LOGICAL REASONING (CDPC-1)	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of quantitative aptitude including numbers, percentages, ratios, and averages for placement preparation.	1,2,4,5	-
CO2	Apply arithmetic and algebraic techniques to solve aptitude problems related to profit and loss, time and work, and equations.	1,2,3,4,5	-
CO3	Analyze logical reasoning problems involving series, coding-decoding, seating arrangement, and blood relations.	1,2,3,4,5	-
CO4	Evaluate data interpretation, analytical reasoning, and decision-making problems using appropriate problem-solving strategies.	1,2,4,5,11	-
CO5	Develop effective aptitude and reasoning skills for competitive examinations, placement tests, and interview assessments.	3,4,5,9,10,11	-

COURSE CONTENT

FUNDAMENTALS OF QUANTITATIVE APTITUDE [6]

Number systems; divisibility rules; LCM and HCF; simplification; percentages; ratios and proportions; averages; ages; partnership problems; basic arithmetic shortcuts and problem-solving techniques.

ARITHMETIC AND ALGEBRAIC APTITUDE [6]

Profit and loss; simple and compound interest; time and work; pipes and cisterns; time, speed and distance; boats and streams; permutations and combinations; probability; linear and quadratic equations, Alligations and Mixture

LOGICAL REASONING AND ANALYTICAL THINKING [6]

Series completion; coding and decoding; blood relations; direction sense test; seating arrangements; syllogisms; statement and conclusions; logical puzzles; analytical reasoning techniques.

DATA INTERPRETATION AND DECISION MAKING [6]

Tabular data interpretation; bar graphs; pie charts; line graphs; caselets; data sufficiency; critical reasoning; decision making; problem-solving approaches for placement aptitude tests.

VERBAL REASONING AND PLACEMENT PREPARATION

[6]

Non-verbal reasoning; pattern recognition; mirror and water images; cube and dice problems; logical sequence; mock aptitude tests; interview-oriented reasoning practice; strategies for campus recruitment examinations.

Total Notional Hours: 30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS

1. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishing.
2. Arun Sharma, How to Prepare for Quantitative Aptitude for CAT, McGraw Hill.
3. A Modern Approach to Logical Reasoning, R.S. Aggarwal, S. Chand Publishing.

REFERENCE BOOKS

1. M. Tyra, Magical Book on Quicker Maths, BSC Publishing.
2. Edgar Thorpe, Test of Reasoning, Pearson Education.
3. Nishit K. Sinha, Quantitative Aptitude for Competitive Examinations, Pearson.

WEB REFERENCES

1. IndiaBix Aptitude and Reasoning Resources
2. Freshersworld Placement Preparation Portal
3. GeeksforGeeks Aptitude Preparation
4. PrepInsta Placement Training Materials

25HS210	LINGUA SKILL	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	To strengthen grammar and vocabulary skills for accurate and effective communication in various contexts.	9	1
CO2	Describe the various strategies for effective reading and listening, such as skimming, scanning, and extracting specific information from a range of texts and audio sources.	9	1
CO3	To improve reading comprehension by utilizing different reading techniques and critically analyzing texts	9,11	2
CO4	Apply appropriate writing strategies to compose professional documents, including formal letters, emails, resumes, and technical reports.	9,11	3
CO5	To refine writing skills for academic and professional contexts.	5,9,11	3
CO6	Interpret visual graphics and respond appropriately in professional scenarios such as a sales talk, a product description, or an interview.	5,9,11	1,2

FOUNDATION OF COMMUNICATIVE SKILLS

[3]

Reading: Skimming & Scanning, identifying main ideas and supporting details in short texts

Writing: Informal & Formal Letters

Listening: Listening to short presentations and workplace conversations

Speaking: Just a Minute (JAM), Picture Description

BUILDING FLUENCY AND ACCURACY

[3]

Reading: Reading Newspaper and Articles

Speaking: Describing a product/place, Conversation practice

Writing: Email writing.

Listening: Listening to motivational talks / TED talks

COMMUNICATION IN ACADEMICS AND WORKPLACE CONTEXTS

[3]

Reading: Cloze reading

Speaking: Role-Play, Picture description.

Writing: Article writing

Listening: Listening to stories and event narration.

PRESENTATION SKILLS

[3]

Reading: Interpreting pictures of visual graphics. Speaking: Group Discussion

Writing: Formal Letters (Quotations, Clarification, Placing orders & Complaint letter), SOP for conducting an event

Listening: Listening to Group Discussion and Interview Skills.

CREATIVE COMMUNICATION

[3]

Reading: Reading advertisements and company profiles.

Speaking: Master of Ceremonies (MC) Practice

Writing: Blog Writing

Listening: Listening to Product description and Process

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

1. Technical English 2nd Edition Level2 Course Book and eBook, David Bonamy, 2022
2. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).

REFERENCE BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).
2. Cambridge BEC4 Preliminary (BEC Practice Tests), Cambridge university press, 2021.

WEB REFERENCES

1. NPTEL-https://www.youtube.com/playlist?list=PLzf4HHlsQFwIQUeZq_ykEVB6qZrTRnJZn.
2. https://www.youtube.com/playlist?list=PL3qvHcrYGy1sU_1nMMVrfFEhYROpQtVXV

25EE256	SENSORS AND INSTRUMENTATION	L	T	P	C
		1	0	2	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Interpret sensor types for given measurement tasks	1,2,3,4	1
CO2	Differentiate various types of sensors and transducers and select appropriate transducers based on measurement requirements.	1,2,3,4	1,2
CO3	Identify and implement basic signal conditioning circuits for sensor interfacing.	1,2,3,4 ,5	1,2
CO4	Develop simple software-based data acquisition and visualization for sensor signals.	1,2,3,4 ,5	1,2
CO5	Identify smart sensor systems for IoT and automation applications.	1,2,3,4	1,2,3

SENSORS AND TRANSDUCERS:

[10]

Principles and classification of transducers, Electrical Mechanical and Thermal Characterization. Definition, Classification & Characteristics of sensors, Displacement sensors: Potentiometer, LVDT, Measurement of force using strain gauge. Temperature sensors: Thermistor, Thermocouple & RTD. Position and proximity sensors: Hall effect, Inductive & Capacitive. Flow & Level Sensors: Ultrasonic, Laser & Capacitive.

DATA ACQUISITION METHODS

[10]

Instrumentation amplifiers, Analog-to-Digital Conversion (ADC): successive approximation, sigma-delta types, Digital-to-Analog Conversion (DAC): weighted resistor and R-2R ladder, Data Acquisition System (DAS): block diagram, analog & digital I/O, counters, timers.

INTELLIGENT SENSORS:

[10]

General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

PRACTICAL / EXPERIMENTS

1. Signal Conditioning Using ADC
2. Signal Conditioning Using DAC

3. Temperature Measurement Using a Thermistor.
4. Temperature Measurement Using RTD
5. Temperature Measurement Using a Thermocouple.
6. Design and implement a simple three-op-amp instrumentation amplifier for a low-level sensor.
7. Level Or Flow Sensing Using Ultrasonic Sensor.
8. Strain Gauge–Based Force/Load Measurement.
9. Pressure Measurement.
10. Mini Project.

Total Notional Hours:60

L	T	P	TW+SL	C
15	0	30	15	2

TEXT BOOKS:

- 1.DVS Murthy, “Transducers and Instrumentation”, PHI 2nd Edition 2013
- 2.D. Patranabis, “Sensors and Transducers”, 2nd Edition, PHI Learning, 2013.
- 3.S. Gupta, J.P.Gupta, “PC interfacing for Data Acquisition & Process Control”, 2nd Edition, Instrument Society of America, 1994.

REFERENCE BOOKS:

- 1.Arun K. Ghosh, “Introduction to Measurements and Instrumentation”, PHI, 4th Edition, 2012.
- 2.A.D. Helfrick and W.D. Cooper, “Modern Electronic Instrumentation & Measurement Techniques”, PHI, 2001
- 3.Hermann K.P. Neubert, “Instrument Transducers” 2nd Edition 2012, Oxford University Press.

25IT211	UNIVERSAL HUMAN VALUES – III (CYBER ETHICS)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational ethical theories, normative principles, and the complex architecture of the internet that shape moral dilemmas in cyberspace.	1, 2, 7	2,3
CO2	Identify contemporary issues involving free speech, intellectual property, and privacy in digital contexts by applying ethical frameworks and relevant legal concepts.	2, 7	1,2
CO3	Interpret the societal, security, and environmental impacts of networked technologies and cybersecurity measures from the perspective of sustainable and ethical engineering practice.	3, 6	1,2
CO4	Propose ethical and legal strategies for protecting personal data, securing digital infrastructure, and managing online content, considering principles from statutes.	3, 7	1,2,3
CO5	Describe the professional and ethical responsibilities of engineers in promoting inclusive, secure, and rights-respecting digital ecosystems, and commit to the need for continuous learning in this evolving field.	7, 11	1,2,3

THE INTERNET AND ETHICAL VALUES

[3]

Cyberethics and Code – Ethical Values and the digital frontier – Postscript on Moral Theory – Floridi's Macroethics – Normative Principles – Early history of the internet – The Internet's architecture – Net neutrality – The World Wide Web – Gatekeepers and Search Engines – Social Networking – Internet Governance – Contested Sovereignty in Cyberspace – Internet Monopolies – Case Studies.

FREE SPEECH AND CENSORSHIP

[3]

Speech and Internet Architecture – Pornography – Hate Speech – Online Threats – Anonymous speech – Government censorship and the fate of political speech – Case Studies.

INTELLECTUAL PROPERTY

[3]

Background on Intellectual Property – Issues for the internet and networking technologies – Digital Books and E-books – Case studies.

PRIVACY RIGHTS IN THE AGE OF SURVEILLANCE

[3]

Definition and Theory of Privacy – Personal Information on the Internet – Consumer Privacy on the Internet – Privacy Protection – Privacy in the Workplace - Digital Personal Data Protection Act, 2023 – Case Studies.

SECURING THE DIGITAL INFRASTRUCTURE

[3]

Vulnerabilities of Networked Technologies – Cybercrime – Anti-Piracy Architectures – Trespass, Hackers and Hacktivism - Security Measures in Cyberspace – Cybersecurity as a Moral Obligation – The Encryption Controversy – New Encryption Disputes and Challenges – Encryption code, Privacy and Free Speech – Case Studies.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOK:

1.Richard A. Spinello. *Cyberethics: Morality and Law in Cyberspace*, 7/E. Jones & Bartlett Learning, 2021.

REFERENCES:

- 1.Sanjana Singh. *Digital Ethics and Cyber Security*. Yking Books, 2024.
- 2.Mary Manjikian. *Cybersecurity Ethics: An Introduction*. Routledge, 2022.
- 3.Mark Grabowski and Eric P. Robinson. *Cyber Law and Ethics: Regulation of the Connected World*. Routledge, 2021.
- 4.Joseph Migga Kizza. *Computer Network Security and Cyber Ethics*, 4/E. McFarland & Company, Inc., 2014.
- 5.Terry Halbert, Elaine Ingulli. *Cyberethics*. CBS Publishers & Distributors Pvt. Ltd, 2004.

ONLINE RESOURCES:

The Digital Personal Data Protection Act, 2023.

<https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>

Ethics of Technology. <https://ocw.mit.edu/courses/24-131-ethics-of-technology-spring-2023/>

25HS211	INDIAN KNOWLEDGE SYSTEM	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational concepts of the Vedic corpus, including the structure of the four Vedas, Vedāṅgas, and Vedic life, and interpret their relevance to ancient knowledge systems.	1,2,4,5,8,10	2,3
CO2	Analyze India's mathematical heritage, including number systems, combinatorial methods, binary mathematics, contributions of key mathematicians, and applications of algebra, geometry, and trigonometry.	2,3,4,5,9,10	1,2
CO3	Illustrate the principles of Indian astronomy, including calendar systems, celestial coordinates, astronomical instruments, and historical contributions to observational astronomy.	2,4,5,6,8,10	1,2
CO4	Evaluate traditional Indian engineering, technology, and architectural practices, including metallurgy, irrigation systems, temple architecture, Vāstu-śāstra, town planning, and the role of indigenous S&T in societal development.	1,2,3,4,5,6,8,9,10,11	1,2,3

VEDIC CORPUS

[6]

Introduction to Vedas - A synopsis of the four Vedas - Sub-classification of Vedas - Messages in Vedas - Introduction to Vedāṅgas - Prologue on Śikṣā and Vyākaraṇa - Basics of Nirukta and Chandas - Introduction to Kalpa and Jyotiṣa - Vedic Life: A Distinctive Features.

MATHEMATICS

[6]

Number systems in India - Historical evidence - Salient aspects of Indian Mathematics - Bhūta-Saṃkhyā system - Kaṭapayādi system - Measurements for time, distance, and weight - Piṅgala and the Binary system - Introduction to Indian Mathematics - Unique aspects of Indian Mathematics - Indian Mathematicians and their Contributions – Algebra – Geometry – Trigonometry - Binary mathematics and combinatorial problems in Chandaḥ Śāstra - Magic squares in India.

ASTRONOMY

[6]

Introduction to Indian astronomy - Indian contributions in astronomy - The celestial coordinate system - Elements of the Indian calendar - Notion of years and months - Pañcāṅga – The Indian calendar system - Astronomical Instruments (Yantras) - Jantar Mantar of Rājā Jai Singh Sawai.

ENGINEERING AND TECHNOLOGY**[6]**

Wootz Steel: The rise and fall of a great Indian technology - The Indian S & T heritage - Mining and ore extraction - Metals and metalworking technology - Iron and steel in India - Lost wax casting of idols and artefacts - Apparatuses used for extraction of metallic components - Irrigation systems and practices in South India - Literary sources for science and technology - Physical structures in India - Irrigation and water management - Dyes and painting technology - The art of making perfumes - Surgical techniques – Shipbuilding - Sixty-four art forms (64 Kalās) - Status of Indigenous S & T.

TOWN PLANNING AND ARCHITECTURE**[6]**

Perspective of Arthaśāstra on town planning - Vāstu-śāstra – The science of architecture - Eight limbs of Vāstu - Town planning - Temples in India: marvelous stone architecture for eternity - Temple architecture in India - Iconography.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOK:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. *Introduction to Indian Knowledge System: Concepts and Applications*. PHI Learning Pvt. Ltd., 2022.

REFERENCES:

1. Kapoor Kapil, Singh Avadhesh. *Indian Knowledge Systems Vol – I & II*. Indian Institute of Advanced Study, 2021.

ONLINE RESOURCES:

1. Indian Knowledge System (IKS): Concepts and Applications in Engineering.
https://onlinecourses.swayam2.ac.in/imb23_mg53/

25AI253	COMPUTER VISION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of computer vision, image formation, and camera models.	1,2,11	1
CO2	Apply image processing and filtering techniques for enhancement and edge detection.	1,2,3,5	1
CO3	Analyse feature detection, descriptors, and feature matching methods.	1, 2, 4, 5	1,2
CO4	Examine geometric vision concepts including transformations, stereo vision, and 3D understanding	1, 2, 3, 4	2
CO5	Implement motion analysis and image segmentation techniques for object detection and tracking.	1,2,3,4,5	1,2,3

COURSE CONTENT:

INTRODUCTION AND IMAGE FORMATION

[6]

Introduction and scope of computer vision, human vs machine vision, image formation using the pinhole camera model, camera geometry (intrinsic and extrinsic parameters), image sampling and quantization, color models (RGB, grayscale, HSV).

IMAGE PROCESSING AND FILTERING

[6]

Pixel intensity transformations, histogram processing, image smoothing (averaging, Gaussian), image sharpening, convolution and correlation, edge detection (Sobel, Prewitt, Canny), thresholding techniques, morphological operations (erosion and dilation), basic noise removal methods.

FEATURES, DESCRIPTORS AND MATCHING

[6]

Interest point detection (Harris, Shi–Tomasi), scale-space concept, blob detection (LoG, DoG), local feature descriptors (SIFT, SURF, ORB – overview), feature matching techniques (SSD, NCC), Hough transform for line and circle detection.

GEOMETRIC VISION AND 3D UNDERSTANDING [6]

2D geometric transformations (translation, rotation, scaling, affine), camera projection model, fundamentals of epipolar geometry, stereo vision basics and depth estimation, homography and planar scene understanding, introduction to structure from motion.

MOTION ANALYSIS AND SEGMENTATION [6]

Motion detection concepts and brightness constancy, optical flow (Lucas–Kanade – overview), basic tracking methods, background subtraction, image segmentation techniques (thresholding, region-based methods, clustering), watershed algorithm concept, connected component labeling.

LAB EXPERIMENTS: [30]

1. Basic Image I/O and Color Conversions
2. Image Resizing, Cropping & Rotation
3. Pixel Intensity Transformations
4. Histogram Generation & Equalization
5. Image Smoothing using basic filters
6. Edge Detection Basics
7. Thresholding Techniques
8. Morphological Operations
9. Contour Detection
10. Basic Feature Detection

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- 1.Szeliski, R. (2022). *Computer Vision: Algorithms and Applications* (2nd ed.). Springer.
- 2.Hartley, R., & Zisserman, A. (2003). *Multiple View Geometry in Computer Vision* (2nd ed.). Cambridge University Press.

REFERENCE BOOKS:

- 1.Forsyth, D. A., & Ponce, J. (2011). *Computer Vision: A Modern Approach* (2nd ed.). Pearson.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/108106189>
2. <https://nptel.ac.in/courses/106105216>
3. <https://www.geeksforgeeks.org/computer-vision/feature-extraction-in-image-processing-techniques-and-applications/>

25CS211	DISCRETE MATHEMATICS	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	Course Outcomes	POs	PSO
CO1	Understand propositional logic, predicates, quantifiers, inference rules, and proof strategies to evaluate logical statements and construct formal proofs.	1,2,5	1
CO2	Apply combinatoric methods to count, organize, and solve problems involving permutations, combinations, recurrence relations, and the pigeonhole principle.	1,2,5	1
CO3	Solve problems involving graphs and their properties, including graph representation, connectivity, and special types like Eulerian and Hamiltonian paths.	1,2,5	1
CO4	Analyze the concepts of algebraic systems such as groups, rings, and fields, including their properties and operations, and apply them to solve algebraic problems.	1,2,5	1
CO5	Analyze the properties and applications of lattices and Boolean algebra, including minimization of Boolean expressions and their role in digital logic design.	1,2,5	1

MATHEMATICAL LOGIC

[9]

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs.

COMBINATORICS

[9]

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions.

GRAPH THEORY

[9]

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

ALGEBRAIC STRUCTURES

[9]

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

LATTICES AND BOOLEAN ALGEBRA

[9]

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

Total Notional Hours: 90

L	T	P	TW+SL	C
30	15	0	45	3

CASE STUDIES

List of Experiments using MATLAB

1. Truth Table Generator for Propositional Logic
2. Predicate Logic Evaluator
3. Permutations and Combinations Calculator
4. Recurrence Relation Solver
5. Graph Representation using Adjacency Matrix
6. Euler & Hamiltonian Graph Simulation
7. Group Operation Table Generator
8. Cosets and Subgroups Visualizer
9. Hasse Diagram Generator for Lattices
10. Boolean Expression Minimization and Logic Gate Simulation

TEXT BOOKS:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
2. Tremblay, J.P. and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

REFERENCES:

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

OPEN SOURCES ONLINE:

NPTEL (National Programme on Technology Enhanced Learning)

1. Discrete Mathematics – IIT Ropar

Link: <https://nptel.ac.in/courses/111/106/111106086>

2. Discrete Mathematics – IIT Madras

Link: <https://nptel.ac.in/courses/111/106/111106130>

3. Graph Theory – IIT Kharagpur

4. Link: <https://nptel.ac.in/courses/111/105/111105035>

5. Group Theory – IIT Madras

Link: <https://nptel.ac.in/courses/111/106/111106112>

5. MIT OpenCourseWare (OCW)

1. Mathematics for Computer Science (6.042J)

2. Link: <https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-spring-2015/> **6. Coursera**

1. Discrete Mathematics Specialization – UC San Diego

Link: Introduction to Discrete Mathematics for Computer Science

2. Introduction to Logic – Stanford University

Link: <https://www.coursera.org/learn/logic-introduction>

3. Algorithms on Graphs – UC San Diego

Link: <https://www.coursera.org/learn/algorithms-on-graphs>

4. Introduction to Group Theory – University of Sydney

Link: <https://www.coursera.org/learn/introduction-to-group-theory>

7. Tutorial Platforms

1. Discrete Math and Logic Concepts

Link: <https://www.khanacademy.org/computing/computers-and>

[internet/xcae6f4a7ff015e7d:computers/xcae6f4a7ff015e7d:logic-gates-and-circuits/a/logic-gates](https://www.khanacademy.org/computing/computers-and-internet/xcae6f4a7ff015e7d:computers/xcae6f4a7ff015e7d:logic-gates-and-circuits/a/logic-gates) 2. Permutations, Combinations & Counting

Link: <https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations> 3. Intro to Graph Theory

Link: <https://www.khanacademy.org/computing/computer-science/algorithms/graph-representation>.

25AI254	DATA ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals, characteristics, and architecture of Big Data systems	1,2,11	1,2
CO2	Describe the Hadoop ecosystem and HDFS for distributed data storage	1,2,5	2
CO3	Apply the MapReduce programming model for processing large datasets.	1,2,3,5	1
CO4	Analyse big data processing using Apache Spark and its core components.	1,2,3,5	1,2
CO5	Evaluate Big Data analytics techniques and applications with security considerations.	1,2,6,8,11	2,3

COURSE CONTENT:

INTRODUCTION TO BIG DATA

[6]

Introduction to Big Data, characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), traditional data processing vs Big Data processing, Big Data use cases, challenges in Big Data, overview of Big Data architecture.

HADOOP ECOSYSTEM AND HDFS

[6]

Introduction to Hadoop, Hadoop architecture, Hadoop Distributed File System (HDFS), HDFS components, data storage in HDFS, HDFS read and write operations, fault tolerance and replication, overview of Hadoop ecosystem tools.

MAPREDUCE PROGRAMMING

[6]

Introduction to MapReduce programming model, Map and Reduce functions, data flow in MapReduce, word count example, combiners and partitioners, limitations of MapReduce, introduction to YARN.

APACHE SPARK AND BIG DATA PROCESSING

[6]

Introduction to Apache Spark, Spark architecture, Resilient Distributed Datasets (RDDs), Spark transformations and actions, Spark SQL and DataFrames, Spark vs MapReduce, basic Spark applications.

BIG DATA ANALYTICS AND APPLICATIONS

[6]

Introduction to Big Data analytics, data ingestion tools (Flume, Sqoop – overview), basic data analysis using Spark, visualization of Big Data results, real-world Big Data applications, security and privacy issues in Big Data.

LAB EXPERIMENTS:

[30]

1. Installation and configuration of Hadoop/Spark environment, understanding Hadoop file system commands.
2. Uploading, downloading, deleting files in HDFS, directory management and permissions.
3. Implementation of word count program using MapReduce.
4. Finding maximum, minimum, or average values from a large dataset using MapReduce.
5. Processing log files to count events or analyze access patterns.
6. Running basic Spark programs, understanding RDD operations.
7. Implementing map, filter, reduce, and collect operations.
8. Creating DataFrames, running SQL queries on structured data.
9. Importing data from relational databases into HDFS (conceptual or demo).
10. End-to-end analysis of a dataset using Hadoop or Spark and interpretation of results.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS

1. **Tom White**, *Hadoop: The Definitive Guide*, 4th Edition, O'Reilly, 2015
2. **Viktor Mayer-Schönberger and Kenneth Cukier**, *Big Data: A Revolution That Will Transform How We Live, Work, and Think*, Houghton Mifflin

REFERENCE BOOKS

3. **Anand Rajaraman and Jeffrey Ullman**, *Mining of Massive Datasets*, Cambridge University Press
4. **Bill Chambers and Matei Zaharia**, *Spark: The Definitive Guide*, O'Reilly

WEB REFERENCES:

1. nptel.ac.in/courses/106104189
2. <https://nptel.ac.in/courses/110106072>

25IT256	WEB TECHNOLOGIES AND FULL STACK DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the structure and components of modern web applications.	1	1
CO2	Apply HTML5 semantic elements, forms, and multimedia, along with CSS3 styling, responsive layouts, and visual effects, to create accessible, SEO-friendly, and visually engaging web interfaces.	1,2,3,5	1
CO3	Implement client-side interactivity, form validation, and dynamic content updates using JavaScript, DOM manipulation, event handling, and asynchronous programming techniques (AJAX/fetch API).	1,2,3,5	1
CO4	Develop server-side functionality using PHP to handle form data, manage sessions and cookies, perform CRUD operations with MySQL, and apply security best practices in web programming.	1,2,3,4,5	1
CO5	Integrate front-end and back-end technologies to design, build, test, and deploy a full-stack web application, incorporating version control (Git) and deployment on local or cloud platforms.	1,2,3,4,5	1

COURSE CONTENT:

HTML5: WEB PAGE STRUCTURE AND ELEMENTS

[6]

Introduction to web technologies – client–server architecture – structure of HTML document – headings, paragraphs, lists, tables, and hyperlinks – forms and input types – semantic tags: header, nav, section, article, footer – multimedia elements (audio, video, canvas) – metadata and accessibility – SEO-friendly markup.

CSS3: STYLING AND RESPONSIVE DESIGN

[6]

Introduction to CSS3 – syntax and selectors – box model – borders, margins, padding, positioning – display properties – Flexbox and CSS Grid – typography and color schemes – gradients, shadows, transitions, animations – responsive design using media queries – mobile-first design principles.

JAVASCRIPT: CLIENT-SIDE PROGRAMMING

[6]

Introduction to JavaScript – variables, data types, operators – control structures – functions, arrays, and objects – DOM manipulation – event handling (click, mouse, form) – form

validation – ES6 features (let, const, arrow functions, template literals) – asynchronous JavaScript (AJAX, fetch API) – debugging and developer tools.

PHP: SERVER-SIDE SCRIPTING AND DATABASE CONNECTIVITY [6]

Introduction to PHP – syntax and variables – control structures and arrays – functions and file handling – form handling using GET and POST – session and cookie management – error handling and input validation – connecting PHP with MySQL using MySQLi/PDO – CRUD operations – security practices in web programming.

FULL STACK INTEGRATION AND DEPLOYMENT [6]

Integration of front-end and back-end – combining HTML, CSS, JavaScript, PHP, and MySQL – designing a full stack architecture – client-server communication and data flow – user authentication and session tracking – testing and debugging – version control using Git – deployment on XAMPP/WAMP or cloud platforms – documentation and maintenance.

LAB MODULES: [30]

1. Design a personal portfolio webpage using HTML5 structure and semantic tags.
2. Create a responsive web layout using CSS3 Flexbox and Grid system.
3. Develop a form with various HTML5 input types and validate it using JavaScript.
4. Implement JavaScript DOM manipulation to dynamically change web page content.
5. Use JavaScript events to create an interactive image gallery or slideshow.
6. Write a PHP program to process a feedback form using POST method.
7. Develop a PHP script for performing CRUD operations in MySQL (student database).
8. Implement user login and session management using PHP and MySQL.
9. Build an integrated mini web application combining HTML, CSS, JS, PHP, and MySQL.
10. Deploy the mini full stack web application on a local or cloud-based web server (e.g., XAMPP/WAMP/000webhost).

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1. Philip Ackermann (2022), “Full Stack Web Development: The Comprehensive Guide,” Wiley Publications. (Covers all five modules: HTML5, CSS3, JavaScript, PHP, and MySQL)

2. Luke Welling & Laura Thomson, “PHP and MySQL Web Development,” 5th Edition, Pearson, 2020.
3. Robin Nixon, “Learning PHP, MySQL & JavaScript,” 5th Edition, O’Reilly, 2022.
4. Jon Duckett, “Web Design with HTML, CSS, JavaScript and jQuery,” Wiley, 2021.

REFERENCE BOOKS:

1. Marijn Haverbeke, “Eloquent JavaScript,” 4th Edition, No Starch Press, 2023.
2. Ben Frain, “Responsive Web Design with HTML5 and CSS,” 4th Edition, Packt Publishing, 2022.
3. David Sawyer McFarland, “CSS: The Missing Manual,” 5th Edition, O’Reilly, 2020.
4. W3C Consortium, “Web Standards and HTML5 Specifications,” Latest Online Version, W3C, 2024.

WEB REFERENCES:

1. W3Schools Online Web Tutorials – <https://www.w3schools.com>
1. Mozilla Developer Network (MDN Web Docs) – <https://developer.mozilla.org>
2. PHP Manual and MySQL Developer Guide – <https://www.php.net/manual/en/> and <https://dev.mysql.com/doc/>

25AI255	MACHINE LEARNING TECHNIQUES	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain basic concepts, types, and applications of Machine Learning	1,2,11	1
CO2	Apply regression techniques for predictive modeling.	1,2,3,5	1,2
CO3	Implement classification algorithms and evaluate their performance.	1,2,3,4,5	1,2
CO4	Analyse clustering and dimensionality reduction techniques.	1,2,4,5	1,2
CO5	Evaluate ML models using validation methods and simple applications.	1,2,4,5,11	1,3

COURSE CONTENT:

INTRODUCTION TO MACHINE LEARNING

[6]

Introduction to Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Reinforcement, Applications of Machine Learning, Machine Learning workflow, Challenges in Machine Learning

SUPERVISED LEARNING – REGRESSION

[6]

Linear Regression, Multiple Linear Regression, Polynomial Regression, Cost functions and gradient descent, Model evaluation for regression

SUPERVISED LEARNING – CLASSIFICATION

[6]

Logistic Regression-Nearest Neighbors (k-NN), Naïve Bayes Classifier, Decision Trees, Performance measures: Accuracy, Precision, Recall, F1-score

UNSUPERVISED LEARNING

[6]

Introduction to clustering-Means Clustering, Hierarchical Clustering, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA)

MODEL EVALUATION AND APPLICATIONS

[6]

Training, validation, and test sets, Overfitting and underfitting, Cross-validation, Introduction to ensemble learning, Case studies and simple applications

LAB EXPERIMENTS:

[30]

1. perform data cleaning and preprocessing.
2. implement simple linear regression for prediction
3. implement multiple linear regression.
4. classify data using logistic regression.
5. implement k-NN classification.
6. implement Naïve Bayes classification.
7. build a decision tree classifier
8. perform clustering using k-Means.
9. evaluate and compare machine learning models using cross-validation techniques.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

1. Mehryar Mohri, Afshin Rostamizadeh & Ameet Talwalkar — *Foundations of Machine Learning* (2nd ed.), MIT Press, 2018.

REFERENCE BOOKS:

1. Kevin P. Murphy — *Probabilistic Machine Learning* (volumes; MIT Press / recent editions, 2022 onward).
2. Christopher M. Bishop — *Pattern Recognition and Machine Learning*, Springer, 2006.
3. Trevor Hastie, Robert Tibshirani & Jerome Friedman — *The Elements of Statistical Learning*, 2nd ed., Springer, 2009.
4. Shai Shalev-Shwartz & Shai Ben-David — *Understanding Machine Learning: From Theory to Algorithms*, Cambridge Univ. Press, 2014

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106105152>
2. <https://nptel.ac.in/courses/108103192>
3. <https://www.geeksforgeeks.org/machine-learning/machine-learning/>

25HS212	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the provisions and guiding principles of the Constitution of India.	6,8	2,3
CO2	Explain the Constitutional Rights, Fundamental Rights, and Duties guaranteed under the Indian Constitution.	6,8	2,3
CO3	Describe the structure, powers, and functions of the Government of India	6,8	2,3
CO4	Analyze the Parliamentary System and the Constitutional Scheme of governance in India.	6,8	2,3

HISTORICAL PERSPECTIVE OF THE CONSTITUTION OF INDIA [3]

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution of India - Salient features and characteristics of the Constitution of India

FUNDAMENTAL RIGHTS AND LEGAL STATUS [3]

Scheme of the fundamental rights - The scheme of the Fundamental Duties and its legal status - The Directive Principles of State Policy – Its importance and implementation

THE CONSTITUTION POWERS [3]

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India – The constitution powers and status of the President of India - Amendment of the Constitutional Powers and Procedure

CONSTITUTIONAL AMENDMENTS [3]

The historical perspectives of the constitutional amendments in India - Emergency Provisions: National Emergency, President Rule, Financial Emergency - Local Self Government – Constitutional Scheme in India

RIGHT TO LIFE AND PERSONAL LIBERTY [3]

Scheme of the Fundamental Right to Equality - Scheme of the Fundamental Right to certain Freedom under Article 19- Scope of the Right to Life and Personal Liberty under Article 21

Total Notional Hours:15

L	T	P	TW+SL	C
15	0	0	0	0

REFERENCES:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, First Edition, 2015.
3. Granville Austin, Working Democratic Constitution: The Indian Experience, Oxford Publication. 2003.
4. Jain M P, Indian Constitution Law, Seventh Edition, Lexis Nexis, 2014.
5. The Constitution of India (Bare Act), Government Publication, 1950.

SEMESTER V

25AI203	AUTOMATED INTELLIGENCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Comprehend intelligent agent frameworks and its usage in solving real world problems	1,2,5,6,10	1,2
CO2	Apply Artificial Intelligence algorithms in constraint-based game design	2,3,5,9,11	1
CO3	Infer Deep impact of Logical Reasoning in real time problem solving	2,4,6,8,10	2,3
CO4	Apply Probabilistic mechanisms in solving problems of uncertainty	1,2,3,4,5	1,3
CO5	Apply Knowledge based agents to solve critical problems	1,2,3,4,5	1

COURSE CONTENT:

INTELLIGENT AGENTS

[6]

Introduction to Artificial Intelligence, Intelligent Agents and Environments, Rational Agents, Problem Solving Agents, Uninformed and Heuristic Search Techniques, Human–AI Interaction.

SEARCH AND OPTIMIZATION

[6]

Local Search and Optimization Problems, Search in Continuous and Partially Observable Environments, Online Search Agents, Non-deterministic Search.

GAME PLAYING AND CSP

[6]

Game Theory, Alpha-Beta Pruning, Monte Carlo Tree Search, Stochastic and Partially Observable Games, Constraint Satisfaction Problems, Backtracking and Local Search for CSP, Multi-Agent Systems

LOGICAL REASONING

[6]

Knowledge-based agents – propositional logic – propositional theorem proving – Knowledge-Based Agents, Propositional Logic, First-Order Logic, Knowledge Representation, Forward and Backward Chaining, Resolution Techniques.

PROBABILISTIC REASONING

[6]

Reasoning under Uncertainty, Bayesian Inference, Naïve Bayes Model, Bayesian Networks, Exact and Approximate Inference, Causal Networks

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.

REFERENCE BOOKS:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.

WEB REFERENCES:

3. nptel.ac.in/courses/106102220
4. nptel.ac.in/courses/106105079
5. <https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/download/>

25AI256	DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of deep learning, neural networks, activation functions, and optimization concepts.	1,2,11	1
CO2	Apply training techniques for deep neural networks including backpropagation, gradient descent, and regularization methods.	1,2,3,5	1,2
CO3	Analyze convolutional neural networks (CNNs) for image processing and classification tasks.	1,2,3,4,5	1,2
CO4	Examine recurrent neural networks (RNNs) and their variants for sequence and time-series data analysis	1,2,3,4,5	1,2
CO5	Evaluate modern deep learning models and applications such as autoencoders, transformers, and real-world case studies.	1,2,4,5,11	1,2,3

COURSE CONTENT:

INTRODUCTION TO DEEP LEARNING

[6]

Motivation for Deep Learning, Shallow vs Deep Networks, Biological neuron vs artificial neuron, Architecture of Artificial Neural Networks (ANN), Activation functions (Sigmoid, Tanh, ReLU, SoftMax), Loss functions and optimization overview

TRAINING DEEP NEURAL NETWORKS

[6]

Forward and backward propagation, Gradient descent and variants (SGD, Momentum, Adam), Weight initialization techniques, Overfitting and underfitting, Regularization methods (L1, L2, Dropout), Batch normalization

CONVOLUTIONAL NEURAL NETWORKS (CNNs)

[6]

Motivation for CNNs, Convolution, padding, stride, Pooling layers, CNN architectures (LeNet, AlexNet – overview), Image classification using CNNs, Transfer learning concept

RECURRENT NEURAL NETWORKS (RNNs)

[6]

Sequence modeling concepts, Recurrent Neural Networks, Backpropagation Through Time (BPTT), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Applications: text and time-series data

MODERN DEEP LEARNING & APPLICATIONS

[6]

Autoencoders, Introduction to Transformers, Model evaluation and tuning, Ethics and limitations of Deep Learning, Case studies: vision, NLP, speech, End-to-end deep learning workflow

LAB EXPERIMENTS:

[30]

1. Installation and usage of Python, NumPy, TensorFlow/Keras or PyTorch, loading datasets, basic tensor operations.
2. Design a simple ANN with input, hidden and output layers, choose activation functions, train the model on a small dataset.
3. Manual or programmatic implementation of forward propagation and backpropagation for a simple neural network.
4. Train the same neural network using sigmoid, tanh and ReLU activation functions and compare performance.
5. Train a deep neural network with and without regularization techniques such as dropout or L2 regularization
6. Design a CNN for image classification using a standard dataset (e.g., MNIST or CIFAR-10)
7. Use a pre-trained CNN model (VGG, ResNet or MobileNet) and fine-tune it for a new dataset.
8. Implement a basic RNN for sequence prediction or text classification.
9. Build an LSTM-based model for sentiment analysis or time-series forecasting.

Total Notional Hours:90				
L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1. *Ian Goodfellow, Yoshua Bengio & Aaron Courville*,” Deep Learning (Adaptive Computation and Machine Learning)”, MIT Press, 2016.
2. *Sudharsan Ravichandiran*,”Hands-On Deep Learning Algorithms with Python”, Packt Publishing, 2020.

REFERENCE BOOKS:

1. *François Chollet*,” Deep Learning with Python”, 2nd edition, Manning Publications, 2021.
2. *Denis Rothman*,” *Transformers* for Natural Language Processing: Build BERT, GPT”, 2nd edition, Packt Publishing, 2022.
3. *William L. Hamilton*,Morgan & Claypool.,”Graph Representation Learning”, 2020(graph neural networks)

WEB REFERENCES:

<https://nptel.ac.in/courses/106105215>
<https://nptel.ac.in/courses/108103192>
<https://www.datacamp.com/tutorial/tutorial-deep-learning-tutorial>

25IT257	CLOUD COMPUTING AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational concepts, architecture models (NIST), service and deployment models of cloud computing, along with its key characteristics, benefits, and challenges in modern IT infrastructure	1	1
CO2	Apply principles of virtualization, containerization, and web service architectures to design, configure, and manage virtualized cloud environments using appropriate platforms and tools.	1,2,3,5	1
CO3	Recommend cloud storage solutions, interoperability standards, and deployment strategies to evaluate performance, cost, and suitability for different application scenarios across major cloud platforms	1,2,3,4,5	1
CO4	Utilize cloud security frameworks, identity and access management (IAM) policies, and governance models to implement secure, compliant, and resilient cloud-based systems.	1,2,3,4,5	1
CO5	Evaluate the architectural trade-offs, security threats, and operational governance of virtualized and containerized cloud environments to recommend solutions that balance performance, cost, and risk.	1,2,3,4,5	1

COURSE CONTENT

CLOUD ARCHITECTURE AND INFRASTRUCTURE [6]

Introduction to Cloud Computing – Need and Evolution of Cloud – Cloud Architecture – NIST Reference Model – Service Models (IaaS, PaaS, SaaS) – Deployment Models (Public, Private, Hybrid, Community Cloud) – Characteristics and Benefits of Cloud – Cloud Infrastructure Components – Cloud Challenges and Applications.

WEB SERVICES AND VIRTUALIZATION BASICS [6]

Service-Oriented Architecture – SOAP & REST – Basics of Virtualization – Virtual Machine Concepts – Hypervisors (Type 1 & Type 2) – Virtualization Techniques: Full, Para and Hardware Virtualization – CPU, Memory and I/O Virtualization – Resource Allocation and Performance Considerations.

CLOUD STORAGE AND CONTAINERIZATION

[6]

Cloud Storage Fundamentals – Storage Provisioning – Managed vs Unmanaged Storage – Cloud Backup Strategies – Cloud Storage Interoperability (CDMI, OCCI) – Introduction to Containers – Docker Architecture – Docker Images, Containers and Repositories – Basics of Kubernetes.

CLOUD PLATFORMS AND DEPLOYMENT

[6]

Google App Engine – Amazon AWS – Microsoft Azure – OpenStack Overview and Architecture – Eucalyptus and OpenNebula – Programming on EC2 and S3 – Application Deployment Models – Performance Evaluation Parameters – Cost Optimization Concepts.

CLOUD SECURITY AND GOVERNANCE

[6]

Security Challenges in Virtualized Environments – VM Attacks: VM Escape, Guest Hopping, VM Migration Attacks – Hypervisor Threats – Data Security and Storage Security – Identity and Access Management (IAM) – IAM Architecture, Policies and Best Practices – Cloud Compliance and Governance.

LAB EXPERIMENTS

1. Study of Cloud Models – Demonstration of IaaS / PaaS / SaaS and Deployment Models
2. Creation and Management of Virtual Machines using VMware / VirtualBox
3. Study and Comparison of Hypervisors and Virtualization Types
4. Docker Installation and Basic Container Operations
5. Docker Image Building and Application Deployment
6. Implementation of Cloud Storage & Basic IAM Configuration on AWS / Azure.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. *Mastering Cloud Computing: Foundations and Application Programming*. Elsevier, 2021.

REFERENCES:

1. Kai Hwang, Jack Dongarra, Geoffrey Fox. *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*. Morgan Kaufmann, 2022.
2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood. *Cloud Computing: Concepts, Technology & Architecture*. Pearson, 2020.
3. Chris Dotson. *Practical Cloud Security*, O'Reilly, 2019.

ONLINE RESOURCES:

1. Cloud Computing. <https://nptel.ac.in/courses/106105167>
2. Cloud Computing and Distributed Systems. <https://nptel.ac.in/courses/106104182>

25CS265	DEVOPS SKILLS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Define the fundamental concepts, evolution, and principles of DevOps and modern software delivery models.	1,2,5	1
CO2	Explain version control mechanisms and collaborative workflows using Git, GitHub, and GitLab.	1,3,4	1,3
CO3	Apply build automation tools such as Maven and Gradle to manage dependencies and integrate with CI/CD pipelines.	2,3,5,9	2
CO4	Demonstrate the setup of Continuous Integration and Delivery pipelines using Jenkins for automated builds and deployments.	2,3,4,5,9	1,2
CO5	Analyse the efficiency of containerized and automated infrastructure solutions using Docker, Kubernetes, and Terraform.	1,2,3,4,5,7,8,9,10,11	2,3

COURSE CONTENT:

INTRODUCTION TO DEVOPS AND SOFTWARE DELIVERY MODELS [6]

Software Development Life Cycle – Evolution of DevOps – DevOps culture and principles – Agile vs DevOps – Key concepts of Continuous Integration (CI), Continuous Delivery (CD), and Continuous Deployment (CDp) – DevOps lifecycle – Benefits and challenges of DevOps adoption.

VERSION CONTROL [6]

Version control systems – Git fundamentals (init, commit, branch, merge, revert) – Local and remote repositories – GitHub / GitLab workflow – Collaboration and branching strategies – Code versioning best practices.

BUILD AUTOMATION AND DEPENDENCY MANAGEMENT [6]

Introduction to build tools – Maven and Gradle fundamentals – Build lifecycle, dependency management – Integration of build tools with version control – Introduction to artifact repositories (Nexus, JFrog) – Build reporting and maintenance.

CONTINUOUS INTEGRATION AND DELIVERY PIPELINES

[6]

Jenkins fundamentals – CI/CD architecture – Pipeline as Code (Jenkins file) – Automated builds and testing – Environment management – Rollback and recovery strategies – Case study: CI/CD workflow implementation.

CONTAINERIZATION AND INFRASTRUCTURE AUTOMATION

[6]

Introduction to containers and Docker – Docker file creation and image management – Container orchestration with Kubernetes – Infrastructure as Code (IaC) using Terraform basics – Overview of DevOps monitoring and security practices

LAB EXPERIMENTS:

[30]

1. Install Git and create a local repository, and to perform basic version control operations such as initialization, committing changes, and viewing repository status and history.
2. implement branching, merging, and conflict resolution techniques in Git for effective collaborative software development.
3. create and manage remote repositories using GitHub or GitLab, and to practice pushing, pulling, and collaborating on source code using distributed version control workflows.
4. automate the build process of a software application using Maven and to manage project dependencies through the Maven build lifecycle.
5. implement build automation using Gradle, configure build scripts, and analyze the differences between Maven and Gradle build mechanisms.
6. install and configure Jenkins and create a basic Continuous Integration job by integrating Jenkins with a version control repository.
7. design and implement a Continuous Integration pipeline using Jenkins Pipeline as Code by defining build and test stages in a Jenkinsfile.
8. extend the CI pipeline into a Continuous Delivery pipeline by automating testing, artifact management, and implementing rollback strategies for build failures.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

1. Gene Kim, Jez Humble, Patrick Debois, and John Willis, “The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations”, 2nd Edition, IT Revolution Press, 2021.

REFERENCE BOOKS:

1. Jez Humble and David Farley, “Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation”, Addison-Wesley Professional, 1st Edition, Reprint 2020.
2. Nigel Poulton, “Docker Deep Dive”, 5th Edition, Independently Published, 2023.
3. Yevgeniy Brikman, “Terraform: Up & Running – Writing Infrastructure as Code”, 3rd Edition, O’Reilly Media, 2022.
4. Kelsey Hightower, Brendan Burns, and Joe Beda, “Kubernetes: Up and Running – Dive into the Future of Infrastructure”, 3rd Edition, O’Reilly Media, 2021.

WEB REFERENCES:

1. <https://www.eicta.iitk.ac.in/courses/professional-certificate-program-in-cloud-computing-devops>
2. <https://nptel.ac.in/courses/128106012>
3. <https://www.geeksforgeeks.org/devops/devops-tutorial/>

25CS259	INTERNET OF THINGS AND SMART SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply networking principles and addressing strategies to configure IoT systems using layered models and TCP/IP protocols.	1,5	1
CO2	Implement sensor and actuator modules in IoT devices, considering characteristics, deviations, and interfacing requirements.	1,5	1,2
CO3	Develop IoT applications using Raspberry Pi and Python, integrating cloud and fog computing platforms for data processing.	1,5	1,2,3
CO4	Utilize appropriate communication protocols and semantic frameworks to enable interoperability across diverse IoT devices.	1, 5	1,2
CO5	Design and deploy IoT solutions for real-world domains such as agriculture, healthcare, and smart environments, addressing security and privacy challenges.	1, 5	1,2,3

INTRODUCTION

[6]

Basics of Networking - Introduction – Network Types- Layered Networks Models- Addressing-TCP/IP Transport layer– Predecessors of IoT-Wireless sensor Networks-M2M communications-Cyber Physical Systems- Emergence of IoT- Evolution of IoT-Enabling IoT and complex independence of Technologies-IoT Networking Components-Addressing Strategies in IoT – IoT sensing and actuation –Sensors-Sensor characteristics-Sensorial Deviations-Sensing Types-Sensing Considerations-Actuators- Actuator Types-Actuator Characteristics.

INTERNET OF THINGS

[6]

IoT processing and topologies and types-Data Format-Importance of Processing in IoT- Processing Topologies-IoT Device Design and Selection Considerations-Processing Offloading – IoT connectivity Technologies

COMMUNICATION TECHNOLOGIES

[6]

IoT communication Technologies –Introduction-Infrastructure Protocols-Discovery Protocols- Data Protocols-Identification Protocols-Device Management-Semantic Protocols- IoT interoperability –Introduction-Standards-Frameworks

ASSOCIATED IOT TECHNOLOGIES

[6]

Cloud computing – Virtualization-Cloud Models-Service-Level Agreement in Cloud Computing-Cloud Implementation-Sensor-Cloud: Sensors as service-Fog computing and its

applications- Introduction-View of Fog Computing Architecture-Fog Computing in IoT-
Selected Applications of fog computing- -Beginning IoT Hardware Projects –IoT Analytics

IOT CASE STUDIES AND FUTURE TRENDS

[6]

Agriculture IoT –Vehicular IoT – Healthcare IoT –Paradigms, challenges and Future

LAB EXPERIMENTS:

[30]

1. Installation and Configuration of Raspberry Pi
2. Python Programming Basics on Raspberry Pi
3. PIO Programming with LED Interfacing
4. Push Button Interfacing
5. Temperature and Humidity Monitoring using DHT11/DHT22
6. Ultrasonic Sensor Interfacing
7. PIR Motion Sensor Interfacing

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1.Sudip Misra, Anandarup Mukherjee – Arijit Roy – “Introduction to IoT – Cambridge University Press,2022

REFERENCE BOOKS:

- 1.Arshdeep Bahga, Vijay Madiseti, “Internet of Things-A hands-on approach”, Universities Press, 2015.
- 2.Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd edition, 2013.
- 3.Raj Kamal, “Internet of Things – Architecture and Design Principles”, Mc Graw Hill Education Pvt. Ltd., 2017.
- 4.“Internet of Things and Data Analytics”, HwaiyuGeng, P.E, Wiley Publications, 2017.

WEB REFERENCES:

- 1.https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. <https://nptel.ac.in/courses/106105166>
3. <https://nptel.ac.in/courses/108108098>

25AI204	REINFORCEMENT LEARNING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of reinforcement learning, including the agent–environment interaction, reward structures, and Markov Decision Processes, using appropriate mathematical formulations.	1,3,5	1
CO2	Analyse and solve reinforcement learning problems using dynamic programming, Monte Carlo methods, and temporal-difference learning for tabular environments.	1,3,5	1,2
CO3	Apply model-free control algorithms such as SARSA and Q-learning with suitable exploration strategies to obtain optimal policies in discrete state-action spaces.	1,3,5	1,2
CO4	Design and implement policy gradient and actor–critic methods using function approximation techniques for continuous or large-scale reinforcement learning problems.	1,3,5	2
CO5	Evaluate and implement deep reinforcement learning approaches, including Deep Q-Networks, and assess their applicability, limitations, and ethical considerations in real-world decision-making systems.	1,2,3,4	1,2,3

FUNDAMENTALS AND MATHEMATICAL TOOLS

[6]

What is Reinforcement Learning? Agent–Environment paradigm, Rewards, returns, episodic vs continuing tasks, Markov Decision Processes (MDPs): definitions, state/action spaces, Value functions (V, Q), optimality, Bellman equations for V and Basics of Probability & Dynamic Programming prerequisites

TABULAR METHODS AND PLANNING

[6]

Dynamic Programming: Policy evaluation, policy improvement, value iteration, Monte Carlo methods: prediction & control, Temporal-Difference (TD) learning (TD(0), TD(λ)), Combining planning and learning (Dyna approach basics)

CONTROL, Q-LEARNING AND FUNCTION APPROXIMATION

[6]

Control in RL: Exploration vs Exploitation, SARSA, Q-Learning, Off-Policy learning, Function approximation: linear approx. & basics, Issues in approximators (bias vs variance)

POLICY GRADIENT AND ACTOR-CRITIC METHODS

[6]

Policy parameterization and gradient theorem, REINFORCE, Actor-Critic methods, Advantage functions, Brief intro to **Deep Policy Gradient**

DEEP RL, MODERN TOPICS AND RESEARCH

[6]

Deep Q Networks (DQN) basics, Exploration techniques in Deep RL, Model-based RL vs Model-free, Safety, RL with Human Feedback (RLHF), offline RL (intro level)

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. *Richard S. Sutton & Andrew G. Barto* ,”**Reinforcement Learning: An Introduction (2nd Ed.)**” (MIT Press, 2020).

REFERENCE BOOKS:

1. *Belousov et al.* ,**Reinforcement Learning Algorithms: Analysis & Applications** — (Springer, 2021).

2. *Graesser & Keng* ,**Foundations of Deep Reinforcement Learning** — (Addison-Wesley, 2020).

25AI257	NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of NLP including text pre-processing, language models, and vector representations.	1,2,11	1
CO2	Apply sequence labelling and parsing techniques for syntactic analysis of text.	1,2,3,4,5	1,2
CO3	Analyse semantic processing and information extraction techniques in NLP applications.	1,2,4,5	1,2
CO4	Implement neural NLP models including attention mechanisms and transformer architectures.	1,2,3,5	2
CO5	Evaluate large language models using appropriate metrics and address ethical and deployment issues.	1,2,6,8,11	1,2,3

COURSE CONTENT:

FOUNDATIONS AND TRADITIONAL METHODS [6]

text pre-processing, tokenization, morphology, n-gram language models, smoothing, vector semantics (word embeddings, Word2Vec, Glove), classical classifiers (Naive Bayes, logistic regression)

SEQUENCE LABELLING AND PARSING [6]

POS tagging, sequence models (HMM, CRF), sequence-to-sequence basics, constituency and dependency parsing, transition and graph-based parsers.

SEMANTICS, INFORMATION EXTRACTION AND APPLICATIONS [6]

word sense disambiguation, lexical semantics (WordNet), semantic role labelling, coreference resolution, named entity recognition, relation extraction, information retrieval basics, topic modelling. Applications: sentiment analysis, summarization

NEURAL METHODS AND TRANSFORMERS [6]

neural sequential models (RNN/LSTM brief), attention mechanism, Transformer architecture (encoder/decoder, self-attention), pretrained language models, fine-tuning and adapters (LoRA/PEFT), tokenization strategies. Hands-on: fine-tune a transformer (Hugging Face) for classification/generation

LARGE LANGUAGE MODELS, EVALUATION, ETHICS AND DEPLOYMENT [6]

LLM behaviors (hallucination, calibration), prompt engineering, retrieval-augmented generation (RAG), evaluation metrics (perplexity, BLEU, ROUGE, BERT Score, human eval), bias/fairness, privacy, model compression and inference serving.

LAB MODULE:

[30]

1. Data pre-processing, tokenization, embeddings exploration (word2vec/Glove).
2. Implement HMM/CRF POS tagger on tagged corpus.
3. Train a simple sequence-to-sequence model for translation/summary (toy corpora).
4. Implement dependency parser (transition-based).
5. Fine-tune BERT/Distil BERT for classification.
6. Fine-tune a small decoder model for text generation / evaluate perplexity & generation quality.
7. Build an RAG prototype: embeddings + FAISS + small LLM.
8. Project lab: final demo + reproducible code

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

1. Daniel Jurafsky & James H. Martin, “**Speech and Language Processing**” — 3rd ed. (online manuscript, 2025). (*Comprehensive; updated for language models.*)

REFERENCE BOOKS:

- 1.Lewis Tunstall, Leandro von Werra, Thomas Wolf,” **Natural Language Processing with Transformers (Revised)**”, (O’Reilly, 2023/2024). (*Practical, Hugging Face centric; excellent for labs.*) O’Reilly Media
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville,” **Deep Learning**” —. (*Foundations for neural models.*)

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106105158>
2. <https://nptel.ac.in/courses/106101007>
3. <https://www.deeplearning.ai/resources/natural-language-processing/>

SEMESTER-VI

25HS209	PROBLEM SOLVING AND DATA STRUCTURES (CDPC-2)	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of C programming including variables, operators, control structures, and functions for problem solving.	1,2,4,5	-
CO2	Apply arrays, strings, pointers, and user-defined functions to develop efficient C programs.	1,2,3,4,5	-
CO3	Analyse linear data structures such as stacks, queues, and linked lists for computational problem solving.	1,2,3,4,5	-
CO4	Evaluate non-linear data structures including trees and graphs for searching and traversal operations.	1,2,4,5,11	-
CO5	Develop optimized programs using sorting, searching, and placement-oriented coding techniques for technical interviews and assessments.	3,4,5,9,10,11	-

COURSE CONTENT

FUNDAMENTALS OF C PROGRAMMING

[6]

Introduction to programming; algorithms and flowcharts; structure of C program; data types; variables and constants; input and output statements; operators and expressions; decision making statements; looping statements; break and continue statements.

FUNCTIONS, ARRAYS AND POINTERS

[6]

Functions and recursion; storage classes; arrays and multidimensional arrays; strings and string handling functions; pointers and pointer arithmetic; pointers with arrays and functions; structures and unions; file handling concepts.

LINEAR DATA STRUCTURES

[6]

Introduction to data structures; arrays as data structures; stack operations and applications; queue operations and circular queues; linked lists – singly, doubly, and circular linked lists; applications of linked lists.

TREES AND GRAPHS

[6]

Tree concepts and terminology; binary trees; binary search trees; tree traversals; heap and priority queue; graph representation; graph traversal using BFS and DFS; shortest path concepts and applications.

SEARCHING, SORTING AND PLACEMENT CODING

[6]

Searching techniques – linear and binary search; sorting techniques – bubble sort, selection sort, insertion sort, merge sort, quick sort; complexity analysis; problem-solving approaches; placement-oriented coding exercises and mock programming tests.

Total Notional Hours: 30

L	T	P	TW+SL	C
30	0	0	0	1

TEXT BOOKS

1. E. Balagurusamy, Programming in ANSI C, McGraw Hill Education.
2. Reema Thareja, Programming in C, Oxford University Press.
3. Seymour Lipschutz, Data Structures with C, Schaum's Outline Series.

REFERENCE BOOKS

1. Yashavant Kanetkar, Let Us C, BPB Publications.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.
3. Aho, Hopcroft and Ullman, Data Structures and Algorithms, Pearson.

WEB REFERENCES

1. GeeksforGeeks C Programming and Data Structures Tutorials
2. Tutorialspoint C Programming Resources
3. HackerRank Practice Problems
4. LeetCode Coding Interview Preparation

25CS215	SOFTWARE DEVELOPMENT STANDARDS(ISO)	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamental concepts of information security as defined by the ISO 27k series of standards.	1	1
CO2	Understand the organizational context requirements for establishing an ISMS.	1	1
CO3	Describe the complete ISMS lifecycle.	1	1
CO4	Apply risk assessment methodologies to identify, analyse, and evaluate information security risks based on organizational risk appetite and tolerance	1, 2, 3, 4, 5	1
CO5	Apply the ISO 27001 control framework across various domains to establish comprehensive information security controls.	1, 2, 3, 4, 5	1

INFORMATION SECURITY MANAGEMENT SYSTEMS

[15]

The CIA Triad (Confidentiality, Integrity, Availability) - Introduction to Management Systems - The ISO 27k Series - The Plan-Do-Check-Act (PDCA) Model - Business Benefits of an ISMS - Understanding the organization, interested parties, and defining the ISMS scope - Leadership & commitment, Policy, Roles - Addressing risks/opportunities, setting security objectives - Resources, Competence, Awareness, Communication, Documented Information - Operational Planning & Control - Risk Identification, Analysis, and Evaluation - Risk Assessment Methodologies (Qualitative vs. Quantitative) - Risk Appetite and Tolerance - The risk assessment process - Risk treatment options (Modify, Retain, Avoid, Share) - The Statement of Applicability (SoA) and Risk Treatment Plan (RTP) - Policies, Roles, Segregation of Duties, Asset Management, Access Control concepts - Supplier Relationships, Information Security Incident Management, Business Continuity, Compliance - HR Security, Training, Remote Work - Physical Perimeter, Secure Areas, Clear Desk/Screen - Endpoint Security, Privileged Access, Malware Protection, Vulnerability Management, Backup - Network Security, Cryptography, Secure Development Lifecycle (SDLC), Logging & Monitoring - Monitoring, Measurement, and Analysis - Conducting Internal Audits (Principles, Planning, Execution); Management Review - Nonconformity and Corrective Action; Continual Improvement - The 2-stage certification audit process; Maintaining certification - Review of the complete ISMS lifecycle - Integration with other frameworks (NIST, COBIT) - Future trends in information security management.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOK:

ISO/IEC 27001:2022 - Information security, cybersecurity and privacy protection — Information security management systems — Requirements. ISO, 2022

25AI275	COMPREHENSIVE VIVA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

COs	Course Outcomes	PO	PSO
CO1	Apply mathematical foundations and aptitude concepts to solve GATE-level problems.	1,2	1
CO2	analyse and implement data structures and algorithms for competitive examinations and technical interviews.	1,2,3	1
CO3	Demonstrate proficiency in core CSE subjects including OS, DBMS, CN and Computer Organization.	1,2	1,2
CO4	Apply data science and machine learning techniques to solve real-world analytical problems.	1,3,4	2
CO5	Evaluate GATE-level problems and develop effective strategies for CSE and Data Science examinations.	2,4,5	1,2

ENGINEERING MATHEMATICS AND APTITUDE FOR GATE [3]

Linear Algebra: matrices, determinants, eigenvalues and eigenvectors, Calculus: limits, continuity, differentiation, integration. Probability and Statistics: random variables, distributions, mean, variance. Numerical methods and basic optimization concepts. General Aptitude: quantitative aptitude, verbal ability, logical reasoning.

PROGRAMMING, DATA STRUCTURES AND ALGORITHMS [3]

C Programming fundamentals and problem solving, Arrays, linked lists, stacks, queues, trees and graphs, Algorithm analysis and asymptotic notations, Searching and sorting techniques, Recursion, greedy algorithms, divide-and-conquer, dynamic programming.

CORE COMPUTER SCIENCE FOR GATE CSE [3]

Discrete Mathematics: logic, sets, relations, combinatorics, graph theory, Computer Organization and Architecture, Operating Systems: processes, scheduling, memory management, Database Management Systems: ER model, SQL, normalization, transactions, Computer Networks: OSI/TCP-IP models, routing and transport protocols.

DATA SCIENCE AND MACHINE LEARNING FOUNDATIONS [3]

Data Science lifecycle and data preprocessing, Data visualization and exploratory data analysis, Supervised and unsupervised learning techniques, Regression, classification and clustering algorithms, Model evaluation metrics and validation techniques.

Deep Learning fundamentals and neural networks, Natural Language Processing and recommendation systems, Big Data concepts and distributed computing, Previous GATE CSE and Data Science question analysis, Mock tests, problem-solving strategies and revision.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS

1. GATE Computer Science and Information Technology 2026, Made Easy Publications, Latest Edition, 2026.
2. Introduction to Algorithms, 4th Edition, MIT Press, 2022.
3. Data Science for Business, Revised Edition, O'Reilly Media.
4. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, 3rd Edition, O'Reilly Media, 2022.
5. Data Mining: Concepts and Techniques, 4th Edition, Morgan Kaufmann, 2022.

REFERENCES

1. Computer Networking: A Top-Down Approach, 8th Edition, Pearson, 2021.
2. Operating System Concepts, 10th Edition, Wiley.
3. Database System Concepts, 7th Edition, McGraw-Hill.
4. Pattern Recognition and Machine Learning, Springer.
5. Deep Learning, MIT Press.

25AI215	ALGORITHM DESIGN AND PERFORMANCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply basic concepts of algorithm analysis, asymptotic notations, and recurrence relations to evaluate the efficiency of algorithms.	1,3,5	1
CO2	Analyse problems and design solutions using Divide-and-Conquer techniques such as Quick Sort, Merge Sort, Maximum/Minimum, Closest Pair, and Strassen's Matrix Multiplication.	1,3,5	1,2
CO3	Design and implement algorithms using Greedy and Dynamic Programming techniques to solve optimization problems including Knapsack, Dijkstra's Algorithm, Floyd's Algorithm, and Longest Common Subsequence.	1,3,5	1,2
CO4	Solve combinatorial and optimization problems using Backtracking and Branch-and-Bound approaches, including N-Queens, Sum of Subsets, Hamiltonian Cycle, and Traveling Salesman Problem.	1,3,5	2
CO5	Understand NP-Problems, NP-Complete problems, and apply Approximation Algorithms to solve computationally hard problems like Knapsack and Traveling Salesman Problem.	1,3,5	2,3

COURSE CONTENT

ALGORITHM ANALYSIS AND DIVIDE-AND-CONQUER

[6]

Algorithm analysis, Asymptotic notations, Recurrence relations, Divide-and-Conquer strategy, Merge Sort, Quick Sort.

ADVANCED DIVIDE-AND-CONQUER TECHNIQUES

[6]

Finding Maximum and Minimum, Strassen's Matrix Multiplication, Closest Pair Problem, Convex Hull.

GREEDY AND DYNAMIC PROGRAMMING

[6]

Greedy Method: Knapsack Problem, Dijkstra's Algorithm.

Dynamic Programming: Floyd's Algorithm, Longest Common Subsequence, Optimal Binary Search Trees.

BACKTRACKING AND BRANCH-AND-BOUND

[6]

N-Queens Problem, Sum of Subsets, Hamiltonian Cycle, Knapsack using Branch and Bound, Traveling Salesman Problem.

NP PROBLEMS AND APPROXIMATION ALGORITHMS

[6]

P and NP Problems, NP-Complete Problems, Cook's Theorem, Reducibility, Approximation Algorithms for Knapsack and Traveling Salesman Problems.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 3rd Edition, 2012. (ISBN 978 0132316811)
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2018.

REFERENCE BOOKS:

1. Sridhar S, "Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI Learning, 3rd Edition, 2010.
3. Kleinberg, "Algorithm Design", CRC Press, 1st Edition, 2013.

WEB RESOURCE:

1. https://onlinecourses.nptel.ac.in/noc25_cs23/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs88/preview
3. <https://nptel.ac.in/courses/106106131>
4. <https://nptel.ac.in/courses/106101060>
5. <https://nptel.ac.in/courses/106105157>

25AI207	COMPUTER NETWORKS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the principles of data communication and layered network architectures to configure and demonstrate basic network models.	1,2,3,5	1
CO2	Apply error detection, flow control, and medium access mechanisms to enhance reliable data transfer in LAN and WLAN environments.	1,2,3,4,5	1,2
CO3	Analyse the operation of IP addressing, subnetting, and routing algorithms to interpret packet forwarding and path selection in internetworks.	1,2,3,4,5,11	2
CO4	Analyse transport and application layer protocols to evaluate performance and reliability in real-time and secure communication scenarios.	1,2,3,5,10,11	2,3
CO5	Analyse the Realtime implications of the Application protocols	1,2,3,5,10,11	2

COURSE CONTENT:

FUNDAMENTALS AND PHYSICAL LAYER

[6]

Introduction to data communications and networking – network types – OSI and TCP/IP models – signals – bandwidth – data rate limits – transmission media – line coding – modulation techniques – multiplexing – circuit and packet switching.

THE PHYSICAL AND DATA LINK LAYERS

[6]

Error detection and correction – framing – flow control – MAC sublayer – channel access methods – Ethernet IEEE 802.3 – wireless LAN IEEE 802.11 – LAN switching and VLAN concepts.

NETWORK LAYER AND INTERNETWORKING

[6]

IPv4/IPv6 addressing – subnetting – CIDR – routing principles – distance vector and link state algorithms – router architecture – ARP, ICMP, NAT and forwarding.

TRANSPORT LAYER AND CONGESTION CONTROL

[6]

Transport layer services – UDP and TCP – connection establishment and release – reliable data transfer – flow and congestion control – SCTP overview – QoS basics.

APPLICATION LAYER, NETWORK MANAGEMENT AND SECURITY

[6]

Application protocols: HTTP, DNS, SMTP, FTP, DHCP – SNMP – network management – cryptography basics – TLS/SSL – firewalls – VPNs – introduction to IoT, SDN and network virtualization.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data Communications and Networking”, 6th Edition, McGraw-Hill Education, 2023.
2. James F. Kurose and Keith W. Ross, “Computer Networking: A Top-Down Approach”, 8th Edition, Pearson Education, 2021.
3. Andrew S. Tanenbaum and David J. Wetherall, “Computer Networks”, 5th Edition, Pearson Education, 2017.
4. William Stallings, “Data and Computer Communications”, 10th Edition, Pearson Education, 2020.
5. Larry L. Peterson and Bruce S. Davie, “Computer Networks: A Systems Approach”, 6th Edition, Morgan Kaufmann, 2022.

WEB REFERENCES:

- 1.<https://nptel.ac.in/courses/106105183>
- 2.<https://nptel.ac.in/courses/106105081>
- 3, <https://nptel.ac.in/courses/106106091>
- 4.<https://www.geeksforgeeks.org/computer-networks/computer-network-tutorials/>

25AI258	LARGE LANGUAGE MODEL	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain fundamentals of large language models and transformers.	1,2,11	1
CO2	Analyse tokenization methods and LLM architectures.	1,2,4	1,2
CO3	Apply fine-tuning and efficient adaptation techniques.	1,2,3,5	2
CO4	Implement prompt engineering and RAG-based applications.	1,2,3,5	1,2
CO5	Evaluate LLM performance, ethics, and deployment.	1,2,6,8,11	2,3

COURSE CONTENT:

FOUNDATIONS OF LARGE LANGUAGE MODELS AND TRANSFORMERS [6]

Introduction to Large Language Models, Transformer architecture, self-attention and multi-head attention, positional encoding, residual connections and layer normalization, basics of language modeling (causal and masked language models).

TOKENIZATION AND LLM ARCHITECTURES [6]

Tokenization techniques (BPE, SentencePiece), vocabulary design, LLM architectures: encoder-only (BERT), decoder-only (GPT), encoder–decoder (T5/BART), overview of large-scale training data and data preprocessing pipelines.

FINE-TUNING AND EFFICIENT ADAPTATION [6]

Fine-tuning approaches including full fine-tuning, adapters, LoRA, prompt and prefix tuning, efficient training techniques, domain adaptation, and instruction tuning.

PROMPTING AND RETRIEVAL-AUGMENTED GENERATION [6]

Prompt engineering methods (zero-shot, few-shot, chain-of-thought), Retrieval-Augmented Generation (RAG), vector retrieval, integration of LLMs with external tools and knowledge sources.

EVALUATION AND DEPLOYMENT OF LLM SYSTEMS

[6]

Evaluation metrics (perplexity, BLEU, ROUGE), benchmark frameworks, bias and hallucination mitigation, adversarial testing, and deployment considerations including inference, serving pipelines, and model compression techniques.

LAB MODULES:

[30 Hours]

- 1, Build a mini-Transformer block in PyTorch
2. Experiment with tokenization on a dataset; fine-tune a small pretrained model for classification or span generation.
3. Perform adapter/LoRA fine-tuning on a pretrained model for a downstream task; measure memory/compute trade-offs
4. Build a simple RAG system on a domain corpus; design prompting experiments and compare results; implement a small agent using an LLM with tool access.
5. Deploy a fine-tuned LLM behind an API; measure latency; perform red-teaming prompts and document failure modes.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS

1. Tunstall, L., von Werra, L., & Wolf, T., *Natural Language Processing with Transformers*, O'Reilly, 2022.
2. Jurafsky, D., & Martin, J., *Speech and Language Processing*, 3rd Edition draft.

REFERENCE BOOKS

1. Jain, S. M., *Introduction to Transformers for NLP*, Springer, 2022.
2. Xiao, T., & Zhu, J., *Natural Language Processing: Neural Networks and Large Language Models*.
3. Paaß, G., & Giesselbach, S., *Foundation Models for Natural Language Processing*, Springer.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106102576>
2. https://www.youtube.com/playlist?list=PLZ2ps_7DhBbaMNZoyW2Hizl8DG6ik_kjo
3. https://www.youtube.com/watch?v=Xpr8D6LeAtw&list=PLPTV0NXA_ZSgsLAR8YCGCwhPIJNNtexWu

25AI205	PREDICTIVE ANALYTICS	L	T	P	C
		2	0	0	2

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the concepts, process, and tools used in predictive analytics.	1, 2,11	1
CO2	Apply data preprocessing techniques for preparing datasets for predictive modeling.	1,2, 3, 5	1,2
CO3	Analyze regression-based statistical models for prediction tasks.	1, 2,4	1
CO4	Implement classification and machine learning models for predictive analysis.	1, 2, 3,5	1,2
CO5	Evaluate predictive models using ensemble techniques, validation methods, and performance metrics.	1,2,4,5,11	1,2,3

INTRODUCTION TO PREDICTIVE ANALYTICS [6]

Definition and scope of predictive analytics, Predictive modelling process, Types of predictive models, Performance metrics and validation, Overview of tools (R, Python, SAS, SPSS)

DATA PREPARATION AND PREPROCESSING [6]

Handling missing data, outliers, Data transformation and feature scaling, Variable creation and selection, Binning, encoding, normalization

REGRESSION AND STATISTICAL MODELS [6]

Linear regression and its assumptions, Multiple regression, Logistic regression, Regression diagnostics and evaluation (R^2 , RMSE, accuracy)

CLASSIFICATION AND MACHINE LEARNING MODELS [6]

Decision Trees, Random Forests, Support Vector Machines (SVM), k-Nearest Neighbours (kNN), Naïve Bayes classifiers

ADVANCED TOPICS AND MODEL EVALUATION [6]

Ensemble methods (Bagging, Boosting), Cross-validation techniques, Overfitting vs. generalization, Model tuning (Grid Search, Random Search), Time-Series Forecasting basics (ARIMA)

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS

1.Jeffrey Strickland, “*Predictive Analytics Using R*”,Lulu.com,2015

A practical guide to predictive modelling using R

2.Max Kuhn & Kjell Johnson,”*Applied Predictive Modeling*”,springer,2013

Covers key predictive modelling techniques with R.

25AI206	GENERATIVE AI	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain fundamentals of generative models.	1,2	1
CO2	Analyse GANs, VAEs, diffusion, and flow models.	1,2,4	1,2
CO3	Apply generative AI for image, text, and multimodal tasks.	2,3,5	1,2
CO4	Implement LLMs and prompt engineering techniques.	3,5,10	1,2
CO5	Evaluate deployment, security, and ethics in generative AI.	6,8,11	2,3

FOUNDATIONS OF GENERATIVE MODELS

[6]

Introduction to generative vs discriminative models, probabilistic foundations, latent variable models, autoencoders and variational autoencoders (VAE), sampling methods, evaluation metrics for generative models.

GENERATIVE ADVERSARIAL NETWORKS

[6]

GAN architecture and working principle, variants such as DCGAN and Conditional GAN, basic training techniques and stabilization methods, applications in image synthesis and data augmentation.

DIFFUSION MODELS AND OTHER GENERATIVE METHODS

[6]

Overview of normalizing flows, denoising diffusion probabilistic models (DDPM), score-based models, comparison of GANs, flows, and diffusion models.

LARGE LANGUAGE MODELS AND MULTIMODAL GENERATIVE AI [6]

Transformer architecture recap, large language models and training approaches, prompt engineering basics, multimodal generative models such as text-to-image systems.

PRODUCTION, SECURITY AND ETHICS IN GENERATIVE AI

[6]

Model fine-tuning and compression techniques, retrieval augmented generation (RAG), deployment pipelines, evaluation and monitoring of generative models, bias, hallucination, security and ethical considerations.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

1. D. Foster, “*Generative Deep Learning* (2nd Ed., 2023/24)” — practical guide for VAEs, GANs, diffusion.

REFERENCE BOOKS:

1. Goodfellow, Y. Bengio, A. Courville ”*Deep Learning* “— MIT Press. (Foundations; GAN chapter).(<https://www.deeplearningbook.org>)

2. H. Wang et al., “*Transformers for Natural Language Processing* “— or Hugging Face & original Transformer papers.

WEB REFERENCES:

1. <https://microsoft.github.io/generative-ai-for-beginners/#/>
2. <https://cloud.google.com/vertex-ai/generative-ai/docs/learn/overview>
3. <https://www.geeksforgeeks.org/artificial-intelligence/what-is-generative-ai/>
4. <https://nptel.ac.in/courses/106108703>
5. <https://www.youtube.com/watch?v=mEsleV16qdo>

25IT259	CRYPTOGRAPHY AND CYBER SECURITY	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of cryptography	1	1
CO2	Recall the principles of data integrity mechanisms.	1	1
CO3	Apply symmetric and asymmetric cipher techniques for secure data transmission	1,2,3,5	1
CO4	Deploy cryptographic key management and distribution methods to establish mutual trust in networked environments.	1,2,3,4,5	1
CO5	Implement network and internet security protocols to protect data in transit across various network layers	1,2,3,4,5	1
CO6	Apply appropriate security measures for diverse technological contexts based on specific security requirements and constraints	1,2,3,4,5	1

CRYPTOGRAPHY FUNDAMENTALS

[5]

Cybersecurity, Information Security and Network Security - OSI Security Architecture – Cryptography – Network Security – Trust and Trustworthiness – Standards – Number Theory – Divisibility and Division Algorithm – Euclidean Algorithm – Modular Arithmetic – Prime Numbers – Fermat’s and Euler’s Theorem – Testing for primality – Chinese Remainder Theorem – Discrete Logarithms.

SYMMETRIC AND ASYMMETRIC CIPHERS

[7]

Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Data Encryption Standard – Block Cipher Design Principles – Finite Fields: Groups – Rings – Fields – Finite Fields of the Form $GF(p)$ – Polynomial Arithmetic – Finite Fields of the Form $GF(2^n)$ – Advanced Encryption Standard – Block Cipher Operation – Random Bit Generation and Stream Ciphers – Public Key Cryptography – RSA Algorithm – Diffie-Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic – Elliptic Curve Cryptography.

DATA INTEGRITY

[5]

Applications of Cryptographic Hash Functions – Requirements and Security – Secure Hash Algorithm – SHA-3 – Message Authentication Codes – Digital Signatures – Lightweight Cryptography – Post-Quantum Cryptography.

MUTUAL TRUST

[6]

Cryptographic Key Management and Distribution: Key distribution using symmetric and asymmetric encryption – Distribution of Public Keys – X.509 Certificates – Public Key infrastructure – Remote User-Authentication Principles – Remote User authentication using Symmetric and Asymmetric Encryption – Kerberos – Federated Identity Management.

NETWORK AND INTERNET SECURITY

[7]

Transport-level Security: Web Security Considerations – Transport Layer Security – HTTPS – SSH – Wireless Security – Mobile Device Security – IEEE 802.11i Wireless LAN Security – Electronic Mail Security – IP Security – Network Endpoint Security – Cloud Security – Internet of Things (IoT) Security.

LAB EXPERIMENTS

1. Classical and Modern Symmetric Ciphers.
2. Number Theory and Public-Key Cryptography.
3. Hash Functions and Digital Signatures.
4. PKI and Secure Communication.
5. Network Security Protocols and Attacks.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

1. Stallings, William. *Cryptography and Network security*, 8/E. Pearson Education India, 2023.

REFERENCES:

1. Forouzan, Behrouz A., and Debdeep Mukhopadhyay. *Cryptography and network security (SIE)*, 3/E. McGraw-Hill Education, 2023.
2. Kahate, Atul. *Cryptography and network security*, 4/E. McGraw-Hill Education, 2024.
3. Katz, Jonathan, and Yehuda Lindell. *Introduction to Modern Cryptography*, 4/E. Chapman and Hall/CRC, 2025.
4. Dholakia, Sandip. *Modern Cryptography: The Practical Guide*. Rheinwerk Publishing, 2024.

ONLINE RESOURCES:

1. Cryptography and Network Security. <https://nptel.ac.in/courses/106105162>
2. Computational Number Theory & Cryptography <https://nptel.ac.in/courses/106103015>
3. Cryptography and Network Security <https://nptel.ac.in/courses/106105031>

PROFESSIONAL ELECTIVES

25AI2E01	FEATURE ENGINEERING FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the significance of feature engineering and perform data cleaning, pre-processing, and transformation of raw data.	1,2,4,5	1,2
CO2	Apply numerical and categorical feature engineering techniques to construct meaningful features for machine learning models.	1,2,3,4,5	1,2
CO3	Engineer features from text, date-time, and time-series data for predictive analytics applications.	1,2,3,4,5,11	1,2
CO4	Select relevant features and apply dimensionality reduction techniques to improve model performance and interpretability.	1,2,4,5,11	1,2
CO5	Design end-to-end feature engineering pipelines and evaluate advanced feature engineering methods in production environments.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF FEATURE ENGINEERING AND DATA PREPROCESSING

[9]

Introduction to feature engineering; role of features in machine learning; data types and feature characteristics; data quality assessment; missing value treatment; outlier detection and handling; data leakage; train-test separation; exploratory data analysis for feature discovery; preprocessing workflows.

NUMERICAL AND CATEGORICAL FEATURE ENGINEERING [9]

Numerical feature transformation: scaling, normalization, standardization, robust scaling, log and power transformations, discretization and binning; interaction and polynomial features. Categorical feature encoding: label encoding, one-hot encoding, ordinal encoding, count/frequency encoding, target encoding, feature hashing.

TEXT, DATE-TIME AND TIME-SERIES FEATURE ENGINEERING [9]

Text preprocessing: tokenization, stop-word removal, stemming, lemmatization; Bag of Words, n-grams, TF-IDF, word embeddings overview. Date-time features: extracting year, month, day, weekday, quarter; cyclical encoding. Time-series features: lag features, rolling statistics, expanding windows.

FEATURE SELECTION AND DIMENSIONALITY REDUCTION [9]

Filter methods: variance threshold, correlation analysis, chi-square test, mutual information. Wrapper methods: recursive feature elimination. Embedded methods: L1 regularization, tree-based importance. Dimensionality reduction: Principal Component Analysis (PCA), Singular Value Decomposition (SVD), overview of t-SNE and UMAP.

ADVANCED FEATURE ENGINEERING AND PRODUCTION PIPELINES [9]

Automated feature engineering; Deep Feature Synthesis; feature crosses; clustering-based features; handling class imbalance and synthetic features; building reusable pipelines using [scikit-learn](#); feature validation, monitoring and drift detection; feature stores; MLOps considerations and case studies.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. Feature Engineering for Machine Learning, Alice Zheng and Amanda Casari, O'Reilly Media, 2018.
2. Python Feature Engineering Cookbook, Soledad Galli, 3rd Edition, Packt Publishing, 2023.

REFERENCE BOOKS:

1. Feature Engineering and Selection, Max Kuhn and Kjell Johnson, CRC Press, 2019.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 3rd Edition, O'Reilly Media, 2022.
3. Designing Machine Learning Systems, Chip Huyen, O'Reilly Media, 2022.

WEB REFERENCES:

1. [scikit-learn Documentation](#)
2. [Feature-engine Documentation](#)
3. [Pandas Documentation](#)
4. [Google Machine Learning Feature Engineering Guide](#)

25AI2E02	INFORMATION RETRIEVAL AND SEARCH ENGINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of information retrieval systems, document representation, and indexing techniques.	1,2,4,5	1,2
CO2	Apply term weighting models, vector space models, and query processing techniques for effective retrieval.	1,2,3,4,5	1,2
CO3	Design and evaluate web search engines, crawling strategies, and link analysis algorithms.	1,2,3,4,5,11	1,2
CO4	Analyze ranking methods, relevance feedback, and retrieval effectiveness using standard evaluation metrics.	1,2,4,5,11	1,2
CO5	Develop intelligent search applications incorporating semantic search, recommendation, and ethical considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF INFORMATION RETRIEVAL [9]

Introduction to information retrieval; information retrieval versus database systems; architecture of IR systems; document representation; tokenization; stop-word removal; stemming and lemmatization; inverted index; dictionary structures; postings lists; index construction and compression techniques.

RETRIEVAL MODELS AND QUERY PROCESSING [9]

Boolean retrieval model; ranked retrieval; term frequency and inverse document frequency (TF-IDF); vector space model; cosine similarity; probabilistic retrieval; BM25 ranking model; query parsing and optimization; phrase and proximity queries; spelling correction and query expansion.

WEB SEARCH ENGINES AND LINK ANALYSIS [9]

Web structure and characteristics; web crawling; crawler architecture; URL frontier and politeness policies; duplicate detection; web indexing; hyperlink analysis; PageRank; HITS; anchor text and metadata usage; focused crawling.

RELEVANCE FEEDBACK AND EVALUATION

[9]

User interaction and relevance feedback; Rocchio Algorithm; pseudo relevance feedback; learning to rank overview; evaluation metrics: precision, recall, F1-score, MAP, NDCG; test collections; significance testing; search quality assessment.

ADVANCED SEARCH AND MODERN INFORMATION RETRIEVAL

[9]

Semantic search; word embeddings; dense retrieval; transformer-based retrieval; question answering and retrieval-augmented generation (RAG); recommender systems and personalization; multilingual and cross-lingual retrieval; privacy, fairness, and ethics in search engines.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, Cambridge University Press.
2. Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson.

REFERENCE BOOKS:

1. Modern Information Retrieval, Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Addison-Wesley.
2. Neural Search, Tommaso Teofili, Manning Publications, 2024.

WEB REFERENCES:

1. Apache Lucene Documentation
2. Elasticsearch Guide
3. Stanford IR Book Resources
4. OpenSearch Documentation

25AI2E03	MACHINE TRANSLATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of machine translation, linguistic representations, and traditional translation models.	1,2,4,5	1,2
CO2	Apply statistical and phrase-based machine translation techniques for bilingual text processing.	1,2,3,4,5	1,2
CO3	Design and implement neural machine translation systems using recurrent and transformer architectures.	1,2,3,4,5,11	1,2
CO4	Analyze translation quality using automatic and human evaluation metrics and error analysis techniques.	1,2,4,5,11	1,2
CO5	Develop multilingual translation applications incorporating large language models, deployment strategies, and ethical considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF MACHINE TRANSLATION

[9]

Introduction to machine translation; challenges in translation; linguistic levels: morphology, syntax, semantics and pragmatics; rule-based machine translation; transfer-based and interlingua approaches; parallel corpora; tokenization; subword segmentation; alignment concepts.

STATISTICAL AND PHRASE-BASED MACHINE TRANSLATION

[9]

Noisy channel model; word alignment; IBM Models overview; expectation maximization; phrase extraction; phrase-based translation; language models; decoding algorithms; reordering models; domain adaptation for statistical translation systems.

NEURAL MACHINE TRANSLATION

[9]

Sequence-to-sequence models; encoder-decoder architecture; attention mechanism; recurrent neural networks; transformer architecture; self-attention; positional encoding; multilingual and low-resource neural machine translation; transfer learning and fine-tuning.

TRANSLATION EVALUATION AND ERROR ANALYSIS

[9]

Automatic evaluation metrics: BLEU, METEOR, TER, chrF; human evaluation methods; adequacy and fluency assessment; confidence estimation; error categorization; bias and hallucination analysis; robustness and quality assurance.

ADVANCED MACHINE TRANSLATION AND APPLICATIONS

[9]

Pretrained multilingual models; large language models for translation; retrieval-augmented

translation; speech translation overview; document-level translation; deployment and optimization; privacy, fairness, ethics, and real-world translation applications.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. Neural Machine Translation, Philipp Koehn, Cambridge University Press, 2020.
2. Statistical Machine Translation, Philipp Koehn, Cambridge University Press, 2010.

REFERENCE BOOKS:

1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd Edition (Draft), 2025.
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

WEB REFERENCES:

1. Hugging Face Transformers Documentation
2. OpenNMT Documentation
3. Marian NMT Documentation
4. SacreBLEU Evaluation Toolkit Documentation

25AI2E04	NATURAL LANGUAGE GENERATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of natural language generation, linguistic representations, and text generation paradigms.	1,2,4,5	1,2
CO2	Apply template-based, rule-based, and statistical methods to generate coherent text from structured data.	1,2,3,4,5	1,2
CO3	Design and implement neural text generation systems using recurrent, attention-based, and transformer architectures.	1,2,3,4,5,11	1,2
CO4	Analyse generated text using automatic evaluation metrics and human-centered quality assessment methods.	1,2,4,5,11	1,2
CO5	Develop advanced NLG applications using large language models while addressing ethical, safety, and deployment considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF NATURAL LANGUAGE GENERATION [9]

Introduction to natural language generation; NLG pipeline; content determination; document planning; sentence aggregation; lexicalization; referring expression generation; surface realization; applications of NLG in dialogue systems, summarization, and report generation.

TEMPLATE-BASED, RULE-BASED AND STATISTICAL NLG [9]

Template-based generation; grammar-based approaches; feature structures; statistical language models; n-gram models; probabilistic text generation; data-to-text generation; domain-specific report and description generation.

NEURAL NATURAL LANGUAGE GENERATION [9]

Sequence-to-sequence models; encoder-decoder architecture; recurrent neural networks; attention mechanism; transformer architecture; self-attention; positional encoding; decoding strategies: greedy search, beam search, top-k and nucleus sampling.

EVALUATION AND CONTROL OF GENERATED TEXT [9]

Automatic evaluation metrics: BLEU, ROUGE, METEOR, BERTScore; human evaluation for fluency, coherence, relevance, and factuality; controllable text generation; style transfer; hallucination detection and mitigation; bias and fairness assessment.

LARGE LANGUAGE MODELS AND ADVANCED NLG APPLICATIONS [9]

Pretrained language models; instruction tuning; prompt engineering; retrieval-augmented generation; multilingual and multimodal generation; conversational agents; deployment and optimization; privacy, ethics, safety, and real-world NLG applications.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. Building Natural Language Generation Systems, Ehud Reiter and Robert Dale, Cambridge University Press.
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

REFERENCE BOOKS:

1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd Edition (Draft), 2025.
2. Foundations of Statistical Natural Language Processing, Christopher D. Manning and Hinrich Schütze, MIT Press.

WEB REFERENCES:

1. Hugging Face Transformers Documentation
2. OpenAI API Documentation
3. LangChain Documentation
4. Stanford Natural Language Processing Resources

25AI2E05	NATURAL LANGUAGE UNDERSTANDING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of natural language understanding, linguistic structures, and semantic representations.	1,2,4,5	1,2
CO2	Apply syntactic and semantic analysis techniques for extracting meaning from text.	1,2,3,4,5	1,2
CO3	Design and implement neural language understanding models using recurrent and transformer architectures.	1,2,3,4,5,11	1,2
CO4	Analyze model performance using standard evaluation metrics and interpretability techniques for language understanding tasks.	1,2,4,5,11	1,2
CO5	Develop advanced NLU applications using large language models while addressing ethical, privacy, and deployment considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF NATURAL LANGUAGE UNDERSTANDING [9]

Introduction to natural language understanding; levels of linguistic analysis; morphology, syntax, semantics, and pragmatics; ambiguity and disambiguation; tokenization; part-of-speech tagging; named entity recognition; lexical resources and ontologies.

SYNTACTIC AND SEMANTIC ANALYSIS [9]

Constituency and dependency parsing; semantic role labeling; word sense disambiguation; coreference resolution; relation extraction; semantic parsing; knowledge representation; discourse analysis and contextual understanding.

STATISTICAL AND NEURAL METHODS FOR NLU [9]

Feature-based models; probabilistic classifiers; word embeddings; recurrent neural networks; LSTM and GRU; attention mechanisms; transformer architecture; pretrained language models such as BERT, RoBERTa, and T5.

NLU TASKS AND EVALUATION [9]

Text classification; sentiment analysis; intent detection; question answering; natural language inference; evaluation metrics: accuracy, precision, recall, F1-score, exact match, and calibration; error analysis and explainability techniques.

LARGE LANGUAGE MODELS AND ADVANCED NLU APPLICATIONS [9]

Instruction tuning; prompt engineering; retrieval-augmented understanding; multilingual and multimodal language understanding; conversational agents; privacy, fairness, robustness, ethics, and deployment of NLU systems.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd Edition (Draft), 2025.
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

REFERENCE BOOKS:

1. Foundations of Statistical Natural Language Processing, Christopher D. Manning and Hinrich Schütze, MIT Press.
2. Transformers for Natural Language Processing, Denis Rothman, Packt Publishing, 2024.

WEB REFERENCES:

1. Hugging Face Transformers Documentation
2. Stanford Natural Language Processing Resources
3. spaCy Documentation
4. TensorFlow Text Documentation

25AI2E06	NEURAL NETWORK FOR NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundations of neural networks and distributed representations used in natural language processing.	1,2,4,5	1,2
CO2	Apply recurrent and convolutional neural networks to solve sequence modeling and text classification tasks.	1,2,3,4,5	1,2
CO3	Design and implement attention-based and transformer models for advanced NLP applications.	1,2,3,4,5,11	1,2
CO4	Analyze model performance using standard evaluation metrics, error analysis, and interpretability methods.	1,2,4,5,11	1,2
CO5	Develop large language model applications with fine-tuning, retrieval, and ethical deployment considerations.	3,4,5,9,10,11	1,2,3

COURSE CONTENT:

Foundations of Neural Networks for NLP

[9]

Introduction to neural networks; perceptron and multilayer perceptron; activation functions; backpropagation; optimization algorithms; word representations; one-hot encoding; distributed embeddings; Word2Vec, GloVe, and FastText; sequence representation fundamentals.

Recurrent and Convolutional Models for NLP

[9]

Recurrent neural networks; vanishing and exploding gradients; LSTM and GRU architectures; bidirectional recurrent networks; convolutional neural networks for text classification; character-level and word-level models; sequence labeling applications.

Attention Mechanisms and Transformer Architectures

[9]

Attention mechanisms; self-attention; multi-head attention; positional encoding; encoder and decoder architectures; transformer models; pretrained transformers including BERT, GPT, T5, and RoBERTa; transfer learning in NLP.

Training, Evaluation and Fine-Tuning

[9]

Tokenization and subword methods; masked language modeling; causal language modeling; fine-tuning for classification, question answering, and generation; evaluation metrics; hyperparameter tuning; interpretability and error analysis.

Large Language Models and Advanced NLP Applications

[9]

Instruction tuning; prompt engineering; parameter-efficient fine-tuning (LoRA and adapters); retrieval-augmented generation; multilingual and multimodal models; model compression and deployment; privacy, bias, fairness, and ethics.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

Text books:

1. Neural Network Methods in Natural Language Processing, Yoav Goldberg, Morgan & Claypool Publishers.
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

Reference books:

1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd Edition (Draft), 2025.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.

Web references:

1. Hugging Face Transformers Documentation
2. PyTorch Documentation
3. Stanford CS224N Course Materials
4. TensorFlow Tutorials for Natural Language Processing

25AI2E07	RETRIEVAL AUGMENTED GENERATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundations of retrieval-augmented generation, information retrieval, and large language models.	1,2,4,5	1,2
CO2	Apply document processing, embedding, indexing, and vector search techniques to build retrieval systems.	1,2,3,4,5	1,2
CO3	Design and implement end-to-end RAG pipelines using large language models and prompt orchestration frameworks.	1,2,3,4,5,11	1,2
CO4	Analyze retrieval and generation quality using standard evaluation metrics, tracing, and error analysis.	1,2,4,5,11	1,2
CO5	Develop production-grade RAG applications addressing scalability, privacy, security, and ethical considerations.	3,4,5,9,10,11	1,2,3

COURSE CONTENT:

Foundations of Retrieval-Augmented Generation

[9]

Introduction to retrieval-augmented generation; limitations of standalone large language models; information retrieval fundamentals; dense and sparse retrieval; embeddings and semantic similarity; vector databases; chunking strategies; document ingestion and metadata management.

Document Indexing and Retrieval Techniques

[9]

Text preprocessing; tokenization; TF-IDF and BM25; sentence and document embeddings; approximate nearest neighbor search; hybrid search; reranking models; filtering and faceted retrieval; incremental indexing and update strategies.

RAG Pipeline Design and Implementation

[9]

Prompt templates; context construction; query rewriting; multi-query retrieval; compression and contextual summarization; orchestration using LangChain and LlamaIndex; grounding and citation; conversational memory; agentic retrieval workflows.

Evaluation, Monitoring and Optimization

[9]

Retrieval metrics: Recall@k, MRR, NDCG; generation metrics: faithfulness, relevance, answer correctness; hallucination detection; tracing and observability; latency and cost optimization; caching; hyperparameter tuning; benchmark datasets.

Production RAG, Security and Advanced Applications

[9]

Parameter-efficient fine-tuning; domain adaptation; multimodal RAG; graph-based retrieval; enterprise knowledge assistants; privacy-preserving retrieval; access control; prompt injection defense; responsible AI, ethics, and governance.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

Text books:

1. Designing Large Language Model Applications, Chip Huyen, O'Reilly Media, 2025.
2. AI Engineering, Chip Huyen, O'Reilly Media, 2025.

Reference books:

1. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.
2. Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson.

Web references:

1. LangChain Documentation
2. LlamaIndex Documentation
3. Pinecone Learning Center
4. Weaviate Documentation

