ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B.Tech., Artificial Intelligence and Data Science **Regulations:** 2025

Abbreviations:

HUM – Humanities (Languages, Management, Heritage, and others)

BS – Basic Science (Mathematics, Physics, Chemistry)

ES – Engineering Science (General (**G**), Programme Core (**PC**), Programme Elective (**PE**) & Emerging Technology (**ET**))

SD – Skill Development

SL – Self Learning

CDP – Capstone Design Project

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

IPW – Internship cum Project Work

DIC – Department Introductory Course

TCP – Total Contact Period(s)

Program Outcomes

1. **Engineering Knowledge**: Apply math, science, and engineering fundamentals to complex problems.
2. **Problem Analysis**: Identify and analyze complex problems using research and sustainability principles.
3. **Design Solutions**: Design systems and processes considering health, safety, cost, culture, and environment.
4. **Investigations**: Use experiments, modelling, and data analysis to reach valid conclusions.
5. **Engineering Tools**: Apply modern tools for modelling and problem-solving, recognizing their limits.
6. **Society & Environment**: Assess societal, legal, and environmental impacts of engineering solutions.
7. **Ethics**: Commit to ethics, human values, diversity, and legal compliance.
8. **Teamwork**: Work effectively as an individual and in multidisciplinary teams.
9. **Communication**: Communicate clearly in reports, presentations, and documentation across diverse groups.
10. **Management & Finance**: Apply management and economic principles in projects and teamwork.

11. **Lifelong Learning**: Engage in continuous learning, adapt to new technologies, and think critically.

Program Specific Outcomes:

1. Design, develop, and deploy intelligent systems for real-world applications.
2. Utilize modern tools for innovative solutions in the field of AI and Data Science.
3. Demonstrate research aptitude, implement ethical practices and collaborate in multidisciplinary teams.

Semester – I							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods/ Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.	MA25C01	Applied Calculus	T	3-1-0	4	4	BS
2.	EN25C01	English Essentials – I	T	2-0-0	2	2	HUM
3.	UC25H01	தமிழர் மரபு / Heritage of Tamils	T	1-0-0	1	1	HUM
4.	PH25C01	Applied Physics – I	LIT	2-0-2	4	3	BS
5.	CY25C01	Applied Chemistry – I	LIT	2-0-2	4	3	BS
6.	CS25C01	Computer Programming: C	LIT	2-0-2	4	3	ES (PC)
7.	CS25C03	Essentials of Computing	LIT	2-0-2	4	3	ES (PC)-DIC
8.	ME25C04	Makerspace	L	0-0-4	4	2	SD
9.	UC25A01	Life Skills for Engineers – I	---	1-0-2	3	1	HUM
10.	UC25A02	Physical Education – I	---	0-0-4	4	1	HUM
11.		NCC / NSS / NSO / YRC	---	---	---	---	---
Total Credits					**34**	**23**	

Semester – II							
S. No.	Course Code	Course Name	Course Type	Periods/ Week		Credits	Category
				L-T-P	TCP		
1.	MA25C02	Linear Algebra	T	3-1-0	4	4	BS
2.	EE25C01	Basic Electrical and Electronics Engineering	T	3-0-0	3	3	ES (G)
3.	CS25C06	Digital Principles and Computer Organization	T	3-1-0	4	4	ES (PC)
4.	UC25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	HUM
5.	PH25C03	Applied Physics (CSIE) – II	T	2-1-0	3	3	BS
6.	AD25201	Python for Data Science	LIT	3-0-2	5	4	ES (PC)
7.	EN25C02	English Essentials – II	LIT	1-0-2	3	2	HUM
8.	ME25C05	Re-Engineering for Innovation	L	0-0-4	4	2	SD
9.	UC25A03	Life Skills for Engineers – II	---	1-0-2	3	1	HUM
10.	UC25A04	Physical Education – II	---	0-0-4	4	1	HUM
11.		Foreign Language^	LIT	1-0-2	3	1	HUM
				Total Credits	**37**	**26**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No.	Course Code	Course Name	Course Type	Periods/Week		Credits	Category
				L-T- P	TCP		
1.	MA25C08	Discrete Mathematics	T	3-1-0	4	4	BS
2.	CS25C08	Data Structures	LIT	3-0-4	7	5	ES (PC)
3.	CS25C09	Java Programming	LIT	3-0-4	7	5	ES (PC)
4.	AD25C01	Exploratory Data Analysis	LIT	3-0-2	5	4	ES (PC)
5.	CS25C11	Operating Systems	LIT	3-0-2	5	4	ES (PC)
6.		Skill Development Course – I	L	1-0-2	3	2	SD
7.	EN25C03	English Communication Skills Laboratory – I	LIT	0-0-2	2	1	HUM
				Total Credits	**33**	**25**	

Semester – IV							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods/Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C07	Probability and Statistics	T	3-1-0	4	4	BS
2.	CS25C12	Algorithms	T	3-0-0	3	3	ES (PC)
3.	AD25401	Artificial Intelligence Essentials	T	3-0-0	3	3	ES (PC)
4.	AD25402	Data Privacy and Security	T	3-0-0	3	3	ES (PC)
5.	AD25403	Standards in Artificial Intelligence	T	1-0-0	1	1	ES (PC)
6.	CS25C13	Database Management Systems	LIT	3-0-4	7	5	ES (PC)
7.		Skill Development Course – II	LIT	1-0-2	3	2	SD
8.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
			Total Credits		**26**	**22**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods/Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Optimisation Techniques	T	2-0-0	2	2	BS
2.		Natural Language Processing	T	3-0-0	3	3	ES (PC)
3.		Programme Elective – I	T	3-0-0	3	3	ES (PE)
4.		Programme Elective – II	T	3-0-0	3	3	ES (PE)
5.		Machine Learning	LIT	3-0-2	5	4	ES (PC)
6.		Computer Networks	LIT	3-0-2	5	4	ES (PC)
7.		Internet of Things	LIT	2-0-2	4	3	ES (PC)
8.		Skill Development Course – III	LIT	1-0-2	3	2	SD
9.		Industry Oriented Course – I	LIT	1-0-2	3	1	SD
				Total Credits	**31**	**25**	
For Honours Degree							
1.		Capstone Design Project - Level I	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – I	T	3-0-0	3	3	
2.		Honours Elective – II	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – I	T	3-0-0	3	3	
2.		Minor Elective – II	T	3-0-0	3	3	

Semester – VI							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods/Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Compiler Design	T	3-0-0	3	3	ES (PC)
2.		Programme Elective – III	T	3-0-0	3	3	ES (PE)
3.		Open Elective	T	3-0-0	3	3	--
4.		Deep Learning	LIT	3-0-2	5	4	ES (PC)
5.		Image Processing	LIT	2-0-2	4	3	ES (PC)
6.		UI/UX Design and Human Centered Design	LIT	2-0-2	4	3	ES (PC)
7.		Industry Oriented Course - II	LIT	1-0-2	3	1	SD
8.		Full Stack Development Laboratory	L	0-0-4	4	2	ES (PC)
9.		Self-Learning Course	---	0-0-0	-	1	--
Total Credits					**29**	**23**	
For Honours Degree							
1.		Capstone Design Project - Level I	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – I	T	3-0-0	3	3	
2.		Honours Elective – II	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – I	T	3-0-0	3	3	
2.		Minor Elective – II	T	3-0-0	3	3	

Semester – VII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.		Programme Elective – IV	T	3-0-0	3	3	ES (PE)
2.		Programme Elective – V	T	3-0-0	3	3	ES (PE)
3.		Climate Change and Sustainability	T	2-0-0	2	2	HUM
4.		Ethical Hacking and Penetration Testing	LIT	2-0-2	4	3	ES (PC)
5.		Engineering Entrepreneurship Development	LIT	2-0-2	4	3	HUM
6.		Summer Internship		---	---	1	SD
Total Credits					**16**	**15**	

Semester – VII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
For Honours Degree							
1.		Capstone Design Project – Level III	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – V	T	3-0-0	3	3	
2.		Honours Elective – VI	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – V	T	3-0-0	3	3	
2.		Minor Elective – VI	T	3-0-0	3	3	

Semester – VIII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1		Project Work / Internship cum Project Work	PW / IPW	0-0-16	16	8	SD
				Total Credits	**16**	**8**	

Total Credits of the Programme = 167

Programme Electives Courses – Streams

Intelligent Computing	Data Analytics	Robotics	Data Storage and Security	Emerging Technology	Internet of Things and Smart Applications
Reinforcement Learning	Data Curation and Visualization	Robot Operating System	Big Data Frameworks	Quantum Computing	Dynamic Paradigm for IoT
Explainable AI	Stream Data Analytics	Materials Informatics	Cloud Computing	Vibe Coding	Smart IoT Architecture
Computational Neuroscience	Social Network Analytics	Robotics Vision and Sensing	Cyber Security	GPU Programming	Wearable Computing
Generative AI	Bioinformatics	Expert Systems	Cyber Forensics	Real Time Operating Systems	IoT in 5G Networks
MLOps	Edge AI	Multiagent Systems	Quantum Cryptographic Techniques	Hardware Architectures for AI	IoT and Smart Cities

Semester I

MA25C01	Applied Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide technical competence of modelling engineering problems using calculus.
- To apply the calculus concepts in solving engineering problems using analytical methods and computational tools.

Differential Calculus: Functions, graph of functions, New functions from old functions, Limit of a function, Continuity, Limits at infinity, Derivative as a function, Maxima and Minima of functions of single variable, Mean value theorem, Effect of derivatives on the shape of a graph.

Activities: Visualization of the functions, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Functions of Several Variables: Partial derivatives, Chain rule, Total derivative, Maxima and minima of functions of two variables, Method of Lagrange's Multipliers, Application problems in engineering.

Activities: Partial Derivatives with two or three variables, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Integral Calculus: Fundamental theorem of Calculus, Indefinite integrals and the Net Change Theorem, Improper integrals, Arc Length, Area of Region, Area of surface of revolution.

Activities: Definite and Indefinite Integrals, Determination of Area, Solving of Competitive Examination questions (Ex. GATE).

Multiple Integrals: Iterated integrals and Fubini's theorem, Evaluation of double integrals, change of order of integration, change of variables between Cartesian and polar co-ordinates, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Activities: Double integrals and triple integrals using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Solution to application-oriented problems using software (20%), Solving of GATE questions (20%), Internal Examinations (40%).

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals. John Wiley & Sons.

2. Ron Larson and David C. Falvo, (2013), Calculus: an Applied Approach. Cengage Learning.
3. Stewart, J., Clegg, D., & Watson, S. (2019). Calculus: Early transcendentals.
4. Thomas, G. B., Jr., Weir, M. D., Hass, J., & Heil, C. (2018). Thomas' calculus: Early transcendentals. Pearson.
5. Singh, K. (2019). Engineering mathematics through applications. Bloomsbury Publishing.
6. Grewal, B. S. (2012). Higher engineering mathematics. Khanna Publishers.

E-resources:

1. https://math.libretexts.org/Bookshelves/Calculus/Map%3A_Calculus__Early_Transcendentals_(Stewart)/
2. https://openstax.org/books/calculus-volume-1/
3. https://tutorial.math.lamar.edu/Classes/CalcII/CalcII.aspx
4. SCILAB, https://www.scilab.org/

	Description of CO	PO	PSO
CO1	Explain the meaning of derivative, integral, and their geometric and physical interpretations.	---	---
CO2	Apply differentiation and integration techniques to compute maxima, minima, and area.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyze the behavior of single and multivariable functions using derivatives and partial derivatives.	PO2(3)	PSO1(2) PSO3(1)
CO4	Utilize modern computational software and online platforms to deepen understanding, perform complex calculations, and visualize mathematical concepts.	PO5(2) PO11(1)	PSO2(3) PSO3(1)

EN25C01	English Essentials – I	L	T	P	C
		2	0	0	2

Course Objectives:

- Enhance learners' listening and speaking skills to understand and deliver speeches effectively
- Equip students with the skills to write clear, coherent, and grammatically correct texts for various purposes.
- Strengthen the ability to comprehend, interpret, and analyse written English across diverse contexts.

Speaking Skills: Self-Introduction (Tenses, Adjectives) Expressing opinions (Subject-Verb Agreement), Participating in Conversations (Speech Acts - agreeing & disagreeing – synonyms and antonyms**)**

Suggested Activities: Self-Introduction, Just a Minute (JAM) Video recording, Situational role plays, Spell Bee, Word Substitution, Usage of Apps.

Listening Skills: Listening to Simple Conversations (Understanding tone and intent), Short Speeches / Stories, Extracting information, Pronunciation, Listening to Various Accents.

Suggested Activities: Listening and Repeating, Gap fill exercises, Note-taking

Reading Skills: Reading Strategies – (Skimming, scanning, predicting) intensive reading - short passages and long passages on suggested themes (Sentence Patterns, Prefixes and suffixes, idioms and phrases).

Activities: Reading - newspaper and digital articles, Cloze, Reading comprehension, note making and summarising,

Writing Skills: Word Substitution, Sentence Formation, Hints Development (Guided Writing), Writing Different Types of Paragraphs - (Sentence Structure) – Letter Writing / Emails (Informal)

Activities: Error Detection, Picture and poster description, Descriptive, Narrative and Comparative paragraphs, Brainstorming and Mind Mapping - Informal letters/ Emails

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (20%), Speaking Task (10%), Reading Task (10%), Writing Task (10%), Internal Examinations (40%).

References:

1. Miller, K. Q., & Wahl, S. T. (2023). *Business and Professional Communication: KEYS for Workplace Excellence* (5th ed.). SAGE Publications.
2. Kumar, Sanjay & Pushpalatha. (2018). *English Language and Communication Skills for Engineers*. India: Oxford University Press.
3. Sharma, S., & Mishra, B. (2024). *Communication Skills for Engineers and Scientists* (2nd ed.). PHI Learning.

E-resources:

1. Cambridge English – https://www.cambridgeenglish.org/learning-english/grammar-and-vocabulary/
2. Perfect English Grammar – https://www.perfect-english-grammar.com/
3. British Council – Learn English - https://learnenglish.britishcouncil.org/grammar
4. Speechling – https://speechling.com/
5. mePro by Pearson – https://mepro.pearson.com/
6. TED Talks – https://www.ted.com/

	Description of CO	**PO**	**PSO**
CO1	Listen and comprehend spoken English, take and draft notes.	---	---
CO2	Apply vocabulary and grammar appropriately to communicate in written and spoken forms.	PO1(3)	PSO1(2) PSO3(3)
CO3	Analyze texts in different contexts using appropriate reading strategies.	PO2(2)	PSO2(1)
CO4	Communicate thoughts and ideas in real life situations.	PO9(2)	PSO3(2)
CO5	Develop communication skills relevant to engineering and technology.	PO11(1)	PSO3(3)

UC25H01	தமிழர் மரபு	L	T	P	C
		1	0	0	1

மொழி மற்றும் இலக்கியம்: இந்திய மொழிக் குடும்பங்கள், திராவிட மொழிகள், தமிழ் ஒரு செம்மொழி, தமிழ் செவ்விலக்கியங்கள், சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை, சங்க இலக்கியத்தில் பகிர்தல் அறம், திருக்குறளில் மேலாண்மைக் கருத்துக்கள், தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம், பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள், சிற்றிலக்கியங்கள், தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி, தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

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

நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

தமிழர்களின் திணைக் கோட்பாடுகள்: தமிழகத்தின் தாவரங்களும், விலங்குகளும், தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள், தமிழர்கள் போற்றிய அறக்கோட்பாடு, சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும், சங்ககால நகரங்களும் துறை முகங்களும், சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி, கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு, இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் , சுயமரியாதை இயக்கம் இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு, கல்வெட்டுகள், கையெழுத்துப்படிகள், தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

References:

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

UC25H01	Heritage of Tamils	L	T	P	C
		1	0	0	1

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

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

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

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

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

References:

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

PH25C01	Applied Physics – I	L	T	P	C
		2	0	2	3

Course Objective(s):

- To impart knowledge and expose the essentials of physics in various engineering applications.

Properties of Matter: Elasticity, Cantilever, Young's modulus (non-uniform bending), Girders: Bridges and buildings, Viscosity: Stokes method, Surface tension: drop weight method, Thermal expansion, Thermal stress, Bimetallic strips, Expansion joints

Practical: Non-Uniform bending, Young's modulus of the material, Torsional pendulum, Rigidity modulus of the wire and moment of inertia of the disc.

Activities: Virtual demonstration of thermal stress.

Oscillations: Simple Harmonic motion, Torsional pendulum, Couple per unit twist, Damped and Forced Oscillation

Waves: Waves on a stretched string, Energy and Power, standing waves, Ultrasonics, piezo, electric method, Acoustic grating, Electromagnetic waves: Maxwell equation, Production of EM waves by dipole antenna, Propagation of EM waves in free space , wave equation, Cell phone reception

Practical: Melde's string experiment – Frequency of an electrically vibrating metal tip.

Activities: Virtual demonstration of propagation of EM waves

Quantum Mechanics: Black body radiation, Photoelectric effect, de Broglie hypothesis, Schrodinger Wave equation, Particle in a box (infinite potential well - three-dimensional box), Barrier penetration and quantum tunnelling.

Practical: Photo-electric effect, Determination of Planck's constant.

Activities: Virtual demonstration of Scanning Transmission Electron Microscope

Applied Optics: Interference: Air wedge, Michelson's Interferometer, Fiber optics: Structure of a fiber, Fiber Optic Communication System, Fiber Sensors (Virtual demo), Displacement, pressure sensor and Temperature sensor, Einstein Co-efficient, Nd:YAG laser, CO_2 laser (construction, functioning and applications), dye laser

Practical: Ruling width of Compact disc using Laser, Thickness of a thin sheet/wire using Air wedge Method.

Activities: Demonstration of sensors and applications of Lasers

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References:

1. Young, H. D., & Freedman, R. A. (2020). University physics with modern physics. Pearson.
2. Gaur, R. K., & Gupta, S. L. (2022). Engineering physics. Dhanpat Rai Publications.
3. Mathur, D. S. (2010). Elements of properties of matter. S. Chand Publishing.
4. Griffiths, D. J. (2018). Introduction to quantum mechanics. Cambridge University Press.

Silfvast, W. T. (2008). Laser fundamentals (2nd ed.). Cambridge University Press.

E-Resources:

1. Barrier penetration problem and Quantum tunnelling: https://archive.nptel.ac.in/courses/115/104/115104096/
2. EM waves and wireless channelling: https://onlinecourses.nptel.ac.in/noc24_ee31/preview
3. CO2 Laser: https://onlinecourses.nptel.ac.in/noc25_ph03/preview
4. Bimetallic Strips _ https://www.youtube.com/watch?v=WZQ8lvxdzDk
5. Cell phone Reception_ https://www.youtube.com/watch?v=1JZG9x_VOwA
6. Dipole Antenna_ https://www.youtube.com/watch?v=4xF1Fq2wB1I
7. Optical Sensors_ https://auece.digimat.in/nptel/courses/video/108106173/L02.html
8. Scanning Tunnelling Electron Microscope_ https://www.youtube.com/watch?v=XNYZYbXNWQA

	Description of CO	PO	PSO1	PSO2	PSO3
CO1	Explain the physics concepts in various applications.	---			
CO2	Apply the principles of wave optics and laser physics in practical systems.	PO1(3)			
CO3	Analyse the behaviour of materials under different conditions.	PO2(2)			
CO4	Conduct experiments in groups and interpret the data.	PO4(3) PO8(1)			

CY25C01	Applied Chemistry – I	L	T	P	C
		2	0	2	3

Course Objectives:

- To provide students with a solid understanding of the chemical principles for engineering applications.
- To introduce the chemical properties of materials and how these properties influence the selection and use of materials in engineering systems.
- To impart practical applications of chemistry in commonly used engineering devices

Water Technology: Water quality parameters and standards. Industrial feed water, Remediation. Municipal water treatment. Desalination.

Practical: Analysis of alkalinity, hardness and dissolved oxygen.

Activity: Coagulation of water sample using Alum

Nano-chemistry: Classification, Size, dependent properties. Preparation of nanomaterials, Top-down and Bottom-Up approaches, Applications (Flipped classroom).

Practical: Preparation of nanoparticles by Sol-Gel method.

Electrochemistry: Electrochemical cell, Electrode potential., Redox reaction. Conductivity of electrolytes, Factors.

Practical: Conductometric titrations

Activity: Electrochemical cell demonstration

Corrosion & Control: Chemical and electrochemical corrosions, galvanic series, factors influencing corrosion, Electrochemical protection. Organic and Inorganic coating.

Practical:

- Corrosion study by weight loss and salt spray method.
- Potentiometry/UV-visible spectrophotometer.

Activities: Case Study on Corrosion in Pipelines and Electronics, Control measures for a corroded metal

Batteries

Conventional, Contemporary and Emerging battery storage technologies, Primary & Secondary Batteries, Battery Pack, Battery Materials, Performance Parameters, Testing, Safety aspects.

Practical: Measurement of EMF, Internal Resistance, Charge and Discharge Characteristics.

Activities: Demonstration of battery pack in e-vehicles.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References:

1. Jain, P. C., & Jain, M. (2015). Engineering Chemistry. Dhanpat Rai Publishing Company (P) Ltd.
2. Dara, S. S. (2004). A Textbook of Engineering Chemistry. Chand Publications.
3. Sachdeva, M. V. (2011). Basics of Nano Chemistry. Anmol Publications Pvt Ltd.
4. Friedrich, E. (2014). Engineering Chemistry. Medtech.

E-Resources:

1. Water and Wastewater Engineering (Prof. Ligy Philip, IIT Madras) – https://nptel.ac.in/courses/105106202.
2. Electrochemical Energy Systems (Prof. S. Mitra, IIT Madras) – https://nptel.ac.in/courses/113106028.
3. Corrosion (Prof. Kallol Mondal, IIT Kanpur) – https://nptel.ac.in/courses/112104088
4. Chemistry of Battery Systems (Prof. V. R. Marathe, IIT Madras) – https://nptel.ac.in/courses/115106130
5. Resource on all battery types, testing, and safety – https://batteryuniversity.com/articles

	Description of CO	PO	PSO1	PSO2	PSO3
CO1	Understand the importance of chemistry applications with underlying mechanisms.	---			
CO2	Apply the chemistry concepts in widely used devices.	PO1(3)			
CO3	Analyse the effect of various chemical parameters on performance of engineering systems.	PO2(2)			
CO4	Perform experimentations as a group and interpret the results.	PO4(3) PO8(1)			
CO5	Communicate findings through case studies and reports	PO9(1)			

CS25C01	Computer Programming: C	L	T	P	C
		2	0	2	3

Course Objectives:

- To equip engineering students with the foundational knowledge and practical skills in 'C' programming to analyse and solve computational problems effectively.
- To foster problem-solving, critical thinking, and modular programming skills essential for engineering domains.

Introduction to C: Problem Solving, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode, program structure, Compilation & Execution process, Interactive and Script mode, Comments, Indentation, Error messages, Primitive data types, Constants, Variables, Reserved words, Arithmetic, Relational, Logical, Bitwise, Assignment, Conditional operators, Input/Output Functions, Built-in Functions.

Practical: Create Problem Analysis Charts, Flowcharts and Pseudocode for simple C programs (Minimum three).

Control Structures: if, if-else, nested if, switch-case, while, do-while, for, nested loops, Jump statements.

Practical: Usage of conditional logics in programs. (Minimum three)

Functions: Function Declaration, Definition and Calling, Function Parameters and Return Types, Call by Value and Call by Reference, Recursive Functions, Scope and Lifetime of Variables, Header files and Modular Programming.

Practical: Usage of functions in programs. (Minimum three)

Strings & Pointers: One-dimensional and Multi-dimensional Arrays, Array operations and traversals, String Handling: String declaration, input/output, string library functions, Pointer arithmetic, Pointers and Arrays, Pointers to function, Dynamic memory allocation.

Practical: Programs using pointers, dynamic memory, pointer arithmetic, string manipulations, array operations. (Minimum three)

Structures & Unions: Defining and using structures, Array of structures, Pointers to structures, Unions and their uses, Enumerations.

Practical: Program to use structures and unions

File Operations: Open, read, write, close file operations, Binary vs Text files, File pointers, Error handling in file operations.

Practical: Programs reading/writing data in text and binary files (Minimum three).

Standard Libraries & Header Files: Using standard libraries like stdio.h, stdlib.h, string.h, math.h, Creating and using user-defined header files and libraries.

Practical: Use of standard and user-defined libraries in solving problems. (Minimum three), Project (Minimum Two)
Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%
Assessment Methodology: Quiz (5%), Project (15%), Assignment Programs (25%), Practical (25%), Internal Examinations (30%)
References: 1. Thareja, R. (2021). Programming in C . Oxford University Press. 2. Balagurusamy, E. (2019). Programming in ANSI C. McGraw Hill Education. 3. Kanetkar, Y. (2020). Let us C. BPB Publications. 4. Kalicharan, N. (2022). Learn to program with C: An introduction to programming using the C language. Apress. 5. Forouzan, B. A., & Afyouni, H. (2023). Computer science: A structured programming approach in C. Cengage.
E-resources: 1. Learn-C.org - https://www.learn-c.org/ 2. GeeksforGeeks - C Programming - https://www.geeksforgeeks.org/c-programming-language/ 3. GNU C Library Documentation - https://www.gnu.org/software/libc/manual/ 4. “Introduction to C Programming”, Swayam MOOC Course, https://onlinecourses.swayam2.ac.in/imb25_mg71/

	Description of CO	PO	PSO1	PSO2	PSO3
CO1	Explain the potential usage of ‘C’ in engineering applications	---			
CO2	To apply the concepts of ‘C’ in solving engineering problems and formulate new projects.	PO1 (2) PO5 (2)			
CO3	To interpret the data and effectively communicate in groups.	PO2 (3) PO8 (1) PO9 (1)			
CO4	Adapt new programming concepts and technologies in the profession.	PO11 (1)			

CS25C03	Essentials of Computing	L	T	P	C
		2	0	2	3

Course Objectives:

1. To introduce the basic components and operations of computers.
2. To develop problem-solving and computational thinking skills.
3. To enable learners to design simple solutions using algorithms and flowcharts.
4. To provide hands-on experience in visual programming and basic app development.

Computers: Computer, Characteristics of Computers, History of Computers, Classification of Computers, Applications of Computers, Basic Organization of a Computer. Data Representation, Using spread sheets for basic operations on data and visualize the data.

Practical:

1. Office Software for documentation and presentation
2. Spread sheets for calculations and data. Visualization

Computational Thinking: What is Computational Thinking, Decomposition, Abstraction, Real World Information to Computable Data, Number Systems, Conversions among Number systems, what is Logic, Boolean Logic, Applications of Propositional Logic.

Activities:

1. Solving problems based on number systems and logics.
2. Virtual Demonstration of Computational thinking

Problem Solving Basics: Problem Definition, Logical Reasoning, Decomposition, Software Design Concept of an Algorithm, Algorithm Representation – Algorithm Discovery – Iterative Structures – Recursive Structures – Efficiency and Correctness - Implementation of Algorithms - Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial computation, Generation of Fibonacci Sequence, Reversing the digits of an Integer, Base Conversion.

Activities: Algorithm Development for simple mathematical problems

Programming Languages: Program Development Life Cycle, Program Design Tools, Algorithms, Flowcharts, Pseudocodes, Role of Algorithms, Programming Languages, Programming Paradigms Traditional Programming Concepts, Procedural Units, Language Implementation, Declarative Programming.

Activities: Flowchart design for simple mathematical problems

Scratch Programming: What is Scratch, Scratch Programming Environment, Paint Editor, Scratch Blocks, Arithmetic Operators and Functions, Use Motion Commands, Pen Commands and Easy Draw, Looks Palette, Sound Palette, Power of Repeat, Data Types, Variables, Getting Input from Users.

Making Decisions, Comparison Operators, Decision Structures, Logical Operators, Repetition, Loop Blocks, Stop Commands, Counters, Nested Loops, Recursion, String Processing, String Manipulation, Lists, Dynamic Lists, Numerical Lists, Searching and Sorting Lists.

Activities:

1. Creation of Functional Block for simple mathematical problems
2. Drawing and Painting operations
3. Scratch Animation for understanding Conditional and Loop statements.
4. Draw artistic, geometric patterns and create games.
5. Scratch Programs for applied scientific computing and data manipulations

App Development: Building Apps using problem, solving techniques on any app development platform, Modeling, incremental and iterative, reuse, modularization, algorithmic thinking, abstracting and modularizing, decomposition, testing and debugging.

Activities: Sample App Developments for societal problems.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Assignments (10%), Quiz (5%), Project based learning (20%), Flipped Classroom (5%), Review of GATE questions (10%) & Internal Assessment: 50%

References:

1. Thareja, R. (2020). Fundamentals of computers. Oxford University Press.
2. Rajaraman, V., & Adabala, N. (2014). Fundamentals of computers. PHI Learning.
3. Brookshear, J. G., & Brylow, D. (2015). Computer science: An overview. Pearson.
4. Dromey, R. G. (1982). How to solve it by computer. Prentice Hall International.
5. Marji, M. (2014). Learn to program with Scratch: A visual introduction to programming with games, art, science and math. No Starch Press.
6. Riley, D. D., & Hunt, K. A. (2014). Computational thinking for the modern problem solver. CRC Press.
7. Venkatesh, G., & Mukund, M. (2021). Computational thinking. Notion Press.

E-Resources:

1. Brennan and Resnick's CT Framework 2012: https://scratched.gse.harvard.edu/ct/files/AERA2012.pdf
2. CS50X 2025 Scratch YouTube lectures by Prof. David J Malan, Harvard University: https://www.youtube.com/watch?v=2WtPyqwTLKM
3. https://teachinglondoncomputing.org/resources/developing-computational-thinking/
4. Scratch software: https://scratch.mit.edu/
5. MIT APP INVENTOR software: https://appinventor.mit.edu/
6. app.diagrams.net

	Description of CO	PO	PSO1	PSO2	PSO3
CO1	Describe the basic components and functioning of computers, number systems, and data representation.				
CO2	Apply computational thinking and problem-solving techniques to design simple algorithms for real-world problems	PO1(3)			
CO3	Design and represent solutions using flowcharts, pseudocode, and basic visual programming tools.	PO2 (2)			
CO4	Demonstrate the ability to independently learn new computing tools and practices essential for life-long learning	PO11(1)			

ME25C04	Makerspace	L	T	P	C
		0	0	4	2

Course Objectives:

1. To impart practical skills in the assembly, disassembly, and welding of components using appropriate tools and techniques.
2. To provide hands-on training in electrical wiring practices, and the use of electronic components, sensors, and actuators.

List of Activities

(A). Dis-assembly & Assembly Practices

i. Tools and its handling techniques.
ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.
iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.
iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

i. Welding Procedure, Selection & Safety Measures.
ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.
iii. Hands-on session of preparing base material & Joint groove for welding.
iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Stell plates / pipes, for fabrication of a simple part.

(C). Electrical Wiring Practices

i. Electrical Installation tools, equipment & safety measures.
ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box.
iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.
iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

i. Electronic components, equipment & safety measures.
ii. Dis-assembly and assembly of Computers.
iii. Hands-on session of Soldering Practices in a Printed Circuit Board.
iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.
v. Hands-on session of integration of sensors and actuators with a Microcontroller.
vi. Demonstration of Programmable Logic Control Circuit.

(E). Contemporary Systems

i. Demonstration of Solid Modelling of components.
ii. Demonstration of Assembly Modelling of components.
iii. Fabrication of simple components / parts using 3D Printers.
iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

References:

1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)

Course Outcomes:

	Description of CO	PO	PSO
CO1	Demonstrate proper use and handling of basic hand and power tools.	---	---
CO2	Carry out electrical wiring installations and repairs, applying safety measures in domestic applications.	PO1(3)	PSO2(1)
CO3	Develop solid innovative models through software.	PO5(2)	PSO2(2)
CO4	Adapt and follow safety protocols in the work environment.	PO11(2)	PSO3(2)

UC25A01	Life Skills for Engineers – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To equip engineering students with essential life skills encompassing personal and emotional development, effective management of time and stress, financial literacy, digital safety, and civic responsibility.
- To enhance self-awareness, interpersonal skills, and resilience to prepare students for the professional and personal challenges of engineering careers and life beyond academics**.**

Personal and Emotional Development: Self-Awareness & Personality, Emotional Intelligence & Empathy, Positive thinking, Right attitude, Stress & Anger Management, Goal-Setting & Time Management, Growth Mindset & Resilience.

Activities: Personality tests (MBTI, DISC), reflection journals, Empathy circle, role-playing difficult conversations, Guided mindfulness sessions, stress relief toolkit creation, Vision board creation, weekly time audit and planner, Group challenge scenarios, resilience journal

Management Skills: Financial Literacy: Budgeting & Saving, Nutrition, Health, and Hygiene, Digital Literacy & Online Safety, Civic Responsibility & Ethics

Activities: Create a monthly budget, financial simulation game, Meal planning workshop, physical wellness challenge, Social media audit, privacy and safety scenarios, Community service, values debate.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (20%), Flipped Class & Worksheets (10%), Practical (30%), Internal Examinations (40%)

References:

1. Khera, S. (2003). You can win. Macmillan.
2. Levesque, H. (n.d.). Life skills 101: A practical guide to leaving home and living on your own. (Publication year not specified)
3. Mitra, B. K. (2017). Personality development & soft skills (3rd impression). Oxford University Press.
4. ICT Academy of Kerala. (2016). Life skills for engineers. McGraw Hill Education (India) Private Ltd.

	Description of CO	PO	PSO
CO1	Understand personality traits and emotional intelligence, in interpersonal interactions.	---	---
CO2	To work and execute as a team through successful implementation of set goals.	PO7 (1) PO8 (2) PO9 (2)	PSO3(2)
CO3	Develop and implement best practices in day-to-day life, in terms of planning and execution.	PO11 (3)	PSO3(2)

UC25A02	Physical Education - I	L	T	P	C
		0	0	4	1

Course Objectives:

- To impart the fundamentals of physical education for development of students' physical, mental, and social well-being.
- To instill a lifelong appreciation for physical activity towards the development of positive attitude and fostering values of team work and sportsmanship.

Introduction to physical education: Exercise for Good Posture – Conditioning and Calisthenics for Before start, Jogging, Bending, Twisting, Standing, Sitting and Relaxation, Training on First Aid Practices.

Participation of athletic events: Rules and regulations of important athletic events, Sprint, Jumps, Throws and Hurdles.

Skill development in any one of the following outdoor games: Basket Ball, Volley Ball, Ball Badminton, Football, Hockey, Kho-Kho, Kabaddi, Cricket, Hand ball and Tennis.

Skill development in any one of the following indoor games: Shuttle Badminton, Chess and Table Tennis.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Attendance (60%), Quiz (10%), Participation in Sports and Games (20%) and Viva Voce (10%)

References:

1. Singh, A. (2008). Essentials of physical education. Kalyani Publishers.
2. Kamlesh, M. L. (2006). Psychology in physical education and sport (3rd ed.). Metropolitan Book Co.
3. Mangal, S. K. (2009). *Psychology of sports performance*. Sports Publication.

E-resources:

https://www.who.int/health-topics/physical-activity

	CO Description	PO	PSO
CO1	Understand and explain the importance of physical activity for mental and physical health.	---	---
CO2	Apply basic principles of exercise science in the routine life.	PO1(3)	PSO1(1)
CO3	Develop teamwork, discipline, and leadership through sports and group activities and collaborate effectively.	PO8(3)	PSO3(2)
CO4	Demonstrate independent learning in health, nutrition, and fitness-related topics.	PO11(2)	PSO3(2)

Semester II

MA25C02	Linear Algebra	L	T	P	C
		3	1	0	4

Course Objectives:

- To impart foundational knowledge in linear algebra essential for analysing and solving problems in engineering applications.
- To provide the knowledge on computation using software and interpret key linear algebra concepts using software.

Vector Spaces Introduction to Vector Spaces, Examples, Subspaces, Linear Combinations, Span, Generating Sets, Linear Dependence and Independence, Basis and Dimension, Dimension of Subspaces.

Activities: Open-Source software, exercises to test linear dependence and independence using rank, compute span and basis of a set of vectors, determine the dimension of subspaces, and illustrate the concept of subspace and basis in $\boldsymbol{R^2}/\boldsymbol{R^3}$ with visualization.

Linear Transformations and Diagonalization: Null space, Range, Dimension Theorem (statement only), Matrix representation of a linear transformation, Eigenvalues & Eigenvectors, Diagonalizability.

Activities: Open-Source software, exercises to compute the matrix representation of a linear transformation, find the null space and range of a matrix, and compute eigenvalues and eigenvectors of a matrix.

Inner Product Spaces: Inner product, Norms, Cauchy, Schwarz inequality, Gram, Schmidt orthogonalization, Simple problems (up to $\boldsymbol{R^3}$).

Activities: Open-Source software, exercises to compute inner products and vector norms.

Matrix Decomposition: Orthogonal transformation of a symmetric matrix to diagonal form - Positive definite matrices, QR decomposition, Singular Value Decomposition (SVD), Least squares solutions- simple problems (up to $3 \times 3\ matrices$).

Activities: Open-Source software, exercises to check if a matrix is positive definite, perform QR decomposition and SVD using built-in functions.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

References:

1. Friedberg, S. H., Insel, A. J., & Spence, L. E. (2022). Linear algebra. Pearson.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). Linear algebra and its applications with MATLAB. Pearson.
3. Bronson, R. (2011). Schaum’s outline of matrix operations. McGraw-Hill Education.
4. Strang, G., & Thomson, R. (2005). Linear algebra and its applications. Brooks/Cole.
5. Lipschutz, S., & Lipson, M. (2009). Schaum's outline of linear algebra. McGraw-Hill.
6. Kreyszig, E. (2018). Advanced engineering mathematics. Wiley India.

	Description of CO	PO	PSO
CO1	Explain the fundamental concepts of Linear Algebra.	---	
CO2	Compute and interpret eigenvalues and eigenvectors.	PO1(3)	PSO1(2)
CO3	Apply inner product concepts and perform orthogonalization.	PO1 (3)	PSO1(1)
CO4	Compute least squares solutions of linear system of equations.	PO1 (2) PO2 (2)	PSO3(1)
CO5	Use MATLAB to implement and validate key linear algebra concepts	PO5 (1) PO11 (1)	PSO2(2)

EE25C01	Basic Electrical and Electronics Engineering	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart foundational knowledge in principles and applications of electrical and electronics engineering.

DC Fundamentals: Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Series parallel combination of R, L and C components, Voltage Divider and Current Divider Rules.

Activities: Virtual Demonstration of electrical laws & circuits, Hands-on Breadboarding, Solving GATE questions.

AC Fundamentals: Faraday's Laws of Electro-magnetic Induction, Definition of Self and Mutual Inductances, Generation of sinusoidal voltage, Instantaneous & RMS values of sinusoidal signals, Introduction to 3-phase systems, Electrical Safety, Fuses and Earthing.

Activities: Virtual Demonstration of electromagnetic induction, Measurement of instantaneous and RMS values of AC signals, Solving GATE questions.

Electric Machines: DC Machines, Transformers, Star and delta Connections, Three phase Induction motors, Synchronous Generators, Single Phase Induction Motors, Stepper Motor, Universal Motor and BLDC motor.

Activities: Virtual demonstration of step-up and step-down transformers, Virtual working models of Universal and BLDC motors, Solving GATE questions.

Semiconductor Devices: PN junction diodes, Zener Diode, Voltage regulator, BJT & FET Transistors, Timers, Operational Amplifiers.

Activities: Virtual demonstration of V-I characteristics of PN junction and Zener diodes using simulation, inverting/non-inverting amplifiers, Solving GATE questions.

Digital Electronics: Boolean algebra, Basic and Universal Gates, adders, multiplexers, demultiplexers and flip-flops.

Activity: Online logic gate simulators, Solving GATE questions.

Microcontrollers: Introduction, Architecture, Potential Applications.

Activities: Physical demonstration of a microcontroller and online simulation of microcontroller.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (25%), GATE Questions (20%), Internal Examinations (50%)

References:

1. Del Toro, V. (2022). Electrical engineering fundamentals. Pearson Education.
2. Hambley, A. R. (Year). Electrical engineering: Principles and applications (Edition if known). Publisher.
   (Note: Please provide the year and edition for complete citation)
3. Mehta, V. K., & Mehta, R. (2006). Principles of electrical engineering and electronics. S. Chand Publishing.

E-resources:

1. https://archive.nptel.ac.in/courses/108/106/108106172/
2. Circuit Simulator – https://www.falstad.com/circuit/

	Description of CO	PO	PSO
CO1	Understand and explain basic electrical and electronic concepts.	---	
CO2	Apply and analyse electrical circuits in real-time applications.	PO1 (3) PO2 (1)	PSO1(2)
CO3	Identify and utilise key electronic devices used in engineering applications	PO2 (2)	PSO1(2)

CS25C06	Digital Principles and Computer Organization	L	T	P	C
		3	1	0	4

Course Objective:

- To impart knowledge on digital logic and provide functional concepts of computer systems with necessary illustrations.

Digital Logic: Digital Systems, Integer Arithmetic, Addition and Subtraction of Signed Numbers, Boolean Algebra, Theorems and Postulates, Functions, Truth Table, Canonical and Standard Forms, Simplification using K-Maps, Digital Logic Gates, Universal gates, Implementation of Logic Gates, Integrated Circuits.

Activities:

- Assignment on Karnaugh Map.
- Build logic circuits.
- Virtual demonstration of logical gates.

Computer System: Basic structure of a computer, Classes of Computer, Functional units - Interconnection of components, Von Neumann architecture and Harvard architecture - Instruction execution cycle, Performance metrics: MIPS, MFLOPS, CPI, throughput.

Activities:

- MIPS, MFLOPS, and CPI calculations.
- Preparations of report on comparison of two CPU from different manufacturing.

Arithmetic and Logic Unit: Combinational Circuits: Adders, Binary Adder, Binary Parallel Adder, Subtractor, Multiplexers, Decoders, Design of Fast Adder, Multiplication of Signed and Unsigned Numbers, Fast Multiplication - Integer Division, Floating Point Numbers and Operations, Booth's algorithm for signed multiplication, Sequential Circuits: Flip-Flops, Registers, Counters.

Activities:

- Virtual demonstration on Binary adder.
- Build a parallel order.

Processing and Pipelining: Instruction Set Architecture: RISC vs CISC, Addressing modes, Hardwired control and Micro programmed control unit, Concepts of Pipelining, Pipeline stages and Timing diagram, Hazards: Structural, Data and Control Hazards, Instruction-level parallelism, Parallel processing concepts: SIMD, MIMD, Superscalar processors, Vector and Array Processor.

Activities:

- Comparison of RISC-V and x86 ISAs; present findings on their relevance to AI accelerators.
- Spot and resolve different types of pipeline hazards in given scenarios.

Memory: Memory hierarchy: Registers, Cache, Main Memory- RAM- ROM: PROM, EPROM, EEPROM-Secondary storage, HDD, SSD, Cache Organization, Cache replacement policies, NUMA- DMA- ECC.

I/O Systems

I/O Techniques: Programmed, Interrupt-Driven, DMA, I/O Devices and Interface Standards: PCI, USB, SATA, Interrupt Types and Priority Handling, Buses and Bus Arbitration, Peripheral Communication.

Activities:

- Virtual demonstration of DMA.
- I/O in Real AI Systems.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (5%), Assignments (10%), Flipped Classroom (5%), Project (20%), Review of GATE questions (10%) & Internal Assessment (50%).

References:

1. Mano, M. M., & Ciletti, M. D. (2018). Digital design: With an introduction to the Verilog HDL, VHDL, and System Verilog. Pearson.
2. Patterson, D. A., & Hennessy, J. L. (2012). Computer organization and design: The hardware/software interface. Morgan Kaufmann.
3. Stallings, W. (2015). Computer organization and architecture: Designing for performance. Pearson.

E resources/E materials:

1. NPTEL Courses (Indian MOOCs – Free & Government Certified):
    a. Computer Architecture: Computer Architecture - Course
    b. Computer Architecture and Organization: Computer Architecture and Organization - Course
2. Digital Circuit Simulator: CircuitVerse - Online Digital Logic Circuit Simulator
3. Cloud environment: https://www.cloudbus.org/cloudsim/

CO	Description of CO	PO	PSO
CO1	Identify basic digital components and their functions in a computer system	---	---
CO2	Apply Boolean algebra and number systems to design simple digital circuits and simulate them using tools	PO1 (3)	PSO1(3)
CO3	Analyze instruction sets, arithmetic units, and performance metrics to evaluate processor design	PO2 (2)	PSO2(3) PSO3(1)
CO4	Engage in continuous learning to update with advancements through evolving computing trends.	PO11 (1)	PSO3(3)

UC25H02	தமிழர்களும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

நெசவு மற்றும் பானைத் தொழில்நுட்பம்: சங்க காலத்தில் நெசவுத் தொழில், பானைத் தொழில்நுட்பம், கருப்பு சிவப்பு பாண்டங்கள், பாண்டங்களில் கீறல் குறியீடுகள்.

வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும், சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள், மாமல்லபுரச் சிற்பங்களும், கோவில்களும், சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள், நாயக்கர் காலக் கோயில்கள், மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால், செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

உற்பத்தித் தொழில் நுட்பம்: கப்பல் கட்டும் கலை, உலோகவியல், இரும்புத் தொழிற்சாலை, இரும்பை உருக்குதல், எஃகு, வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள், நாணயங்கள் அச்சடித்தல், மணி உருவாக்கும் தொழிற்சாலைகள், கல்மணிகள், கண்ணாடி மணிகள், சுடுமண் மணிகள், சங்கு மணிகள், எலும்புத்துண்டுகள், தொல்லியல் சான்றுகள், சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: அணை, ஏரி, குளங்கள், மதகு, சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம், கால்நடை பராமரிப்பு, கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள், வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள், கடல்சார் அறிவு, மீன்வளம், முத்து மற்றும் முத்துக்குளித்தல், பெருங்கடல் குறித்த பண்டைய அறிவு, அறிவுசார் சமூகம்.

அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: அறிவியல் தமிழின் வளர்ச்சி, கணித்தமிழ் வளர்ச்சி, தமிழ் நூல்களை மின்பதிப்பு செய்தல், தமிழ் மென்பொருட்கள் உருவாக்கம், தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம், இணையத்தில் தமிழ் அகராதிகள், சொற்குவைத் திட்டம்.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References:

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

UC25H02	Tamils and Technology	L	T	P	C
		1	0	0	1

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

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

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

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

Scientific Tamil & Tamil Computing: Development of Scientific Tamil, Tamil computing, Digitalization of Tamil Books, Development of Tamil Software, Tamil Virtual Academy, Tamil Digital Library, Online Tamil Dictionaries, Sorkuvai Project.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References:

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

PH25C03	Applied Physics (CSIE) – II	L	T	P	C
		2	1	0	3

Course Objectives:

- To provide a comprehensive understanding of physics concepts in computer science and engineering applications.

Magnetic Materials: Parameters, Ferromagnetic materials, Ferrites - Soft and Hard magnetic materials – GMR sensors - magnetic disk memories – Principle of magnetic recording – Magnetic data storage.

Activities: Determination of Hysteresis loop for ferromagnetic materials.

Logic Gates: Conversion of Binary to decimal - decimal to binary – binary coded decimal code-logic gates (OR, AND, NOT, NAND and NOR)–Exclusive OR gate-simplification based on basic Boolean theorems (sum of products, product of sums expression)- simplification by Karnaugh Map method (don't care conditions).

Activities: Virtual demonstration of Logic Gates.

Nano-Devices: Introduction – electron density in bulk material – size dependence of Fermi energy-quantum confinement – quantum structures: quantum wells, wires and dots – band gap of nanomaterials. Tunneling- Coulomb blockade - single electron transistor - resonant-tunneling diode- Carbon nanotubes: Properties and applications.

Activities: Virtual demonstration of single electron transistor

Quantum Computing: Quantum system for information processing - quantum states – classical bits – quantum bits or qubits – Bloch sphere -CNOT gate – Single and multiple qubits – quantum gates (Pauli – X, Y and Z Gates, Hadamard Gate, Phase gate - T gate CNOT Gate)– advantage of quantum computing over classical computing.

Activities: Virtual demonstration of quantum computing

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (30%), Flipped Class (10%), Internal Examinations (50%)

References:

1. Kasap, S. O. (2007). Principles of electronic materials and devices. McGraw-Hill Education.
2. Bernhardt, C. (2019). Quantum computing for everyone. MIT Press.
3. Hanson, G. W. (2009). Fundamentals of nanoelectronics. Pearson Education.

E-Resources:

1. Single electron Transistor: https://youtu.be/MTT729LtB-o?si=RGaEhGgmyWJWcZib
2. Basics of quantum computing- https://lab.quantumflytrap.com
3. Single electron transistor - http://vlabs.iitkgp.ac.in/tcad
4. Quantum Computing: http://www.digimat.in/nptel/courses/video/106106232/L01.html
5. Review article: Claude Chappert, Albert Fert and Frédéric Nguyen Van Dau, "The emergence of spin electronics in data storage" Nature Publishing 2007

	Description of CO	**PO**	**PSO**
CO1	Explain the concepts of physics in computer science stream.	---	
CO2	Apply appropriate techniques in physics to solve engineering problems.	PO1(3)	PSO1(3)
CO3	Analyse physical systems and interpret data from the virtual studies in the core branches in computer science and engineering.	PO2(2)	PSO1(2)

AD25201	Python for Data Science	L	T	P	C
		3	0	2	4

Course Objectives:

- To impart knowledge on Python programming and how it can be used for solving problems.
- To illustrate how to handle, clean, and analyze data using Python libraries
- To make use of Python tools and open datasets for real-world data science applications.

Basics of Python: What is Python, Python Interpreter, Python language basics: Language Semantics, Data Types, Variables, Basic Functions, Operators, Flow Control Statements, Data Structures and Sequences: List, Tuple, Set, Dictionaries.

Practical:

1. Programs using conditional and looping constructs
2. Programs using different data frames like list, tuple, set and dictionary.

Functions and Files: Defining a Function, Passing Arguments, Return Values, Passing a List, Creating and Using a Class, Strings: Working with Strings, String Methods, Files: Reading from a File, Writing to a File, Exceptions, Python Libraries: Importing libraries.

Practical:

1. Programs using functions and classes.
2. Programs using strings and files

Foundations of Data Science: Introduction to Data Science- Applications of Data Science - Data Science Process: Overview, Defining Research Goals, Retrieving Data - Data Preparation: Data Wrangling- Handling Missing Data- Data Transformation, Outlier/Noise and Anomalies, Exploratory Data Analysis, Build the Model, Present Findings, Data Mining, Data Warehousing.

Practical:

1. Data Creation and Mathematical operations.
2. Graphs and Plotting.

Descriptive Analytics: Facets of Data, Types of Variables, Statistical Description of Data, Describing Data with Tables and Graphs, Describing Data with Averages, Describing Variability, Normal Distributions and Standard (z) Scores, Correlation, Scatter plots, correlation coefficient for quantitative data –computational formula for correlation coefficient, Regression, Regression line, least squares regression line.

Practical:

1. Statistical description of data without libraries
2. Generation of correlation coefficient.

3. Linear regression model.

Numpy and Pandas Libraries: Creating Arrays, attributes, Numpy Arrays objects, Basic operations (Array Join- split- search- sort), Indexing, Slicing and Iterating, Copying Arrays, Arrays shape Manipulation, Identity Array, eye function. Exploring Data using Series- Exploring Data using Data Frames, Index objects- reindex, Drop Entry, Selecting Entries- Data Alignment, Rank and Sort, Summary Statistics, Index Hierarchy.

Practical:

1. Creation of 1D, 2D, and 3D NumPy arrays
2. Array Slicing and Indexing operations
3. Reindexing, and aligning data across multiple Data Frames.

Data Visualization: Introduction to Matplotlib, Plots, making subplots, Controlling axes, Ticks, Labels and legends, Annotations and drawing on subplots, Saving plots to files, Seaborn library, Making sense of data through advanced visualization, Controlling the properties of Chart, Scatter plot, Line plot, Bar plot, Histogram, Box plot, Pair plot, Styling your plot, 3D plot of surface.

Practical:

1. Line plot, bar plot, histogram, and box plot.
2. Seaborn plots, plot styling and customization

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Assignments (10%), Quiz (5%), Project based learning (20%), Flipped Classroom (5%), Review of GATE questions (10%) & Internal Assessment: 50%

References:

1. Grus, J. (2019). Data science from scratch (2nd ed.). O'Reilly Media, Inc.
2. McKinney, W. (2018). Python for data analysis: Data wrangling with pandas, NumPy, and IPython. O'Reilly Media, Inc.
3. VanderPlas, J. T. (2017). Python data science handbook: Essential tools for working with data. O'Reilly Media, Inc.

   Thereja, R. (2022). Data science and machine learning using Python (1st ed.). Tata McGraw Hill.

E-Resources:

1. https://numpy.org/doc/
2. https://pandas.pydata.org/docs/
3. NPTEL course in Python for Data Science by Prof. Ragunathan Rengasamy- IIT Madras. https://onlinecourses.nptel.ac.in/noc22_cs32/preview.

4. Coursera course in Python for Data Science by Fractal Analytics. https://www.coursera.org/learn/python-data-science.
5. Coursera course in Introduction to Data Science in Python by Christopher Brooks. https://www.coursera.org/learn/python-data-analysis.

	Description of CO	PO	PSO1
CO1	Understand basic Python syntax and write simple programs	---	---
CO2	Apply Python functions, file handling, and object-oriented programming to solve structured problems.	PO1 (3)	PSO1(3)
CO3	Design and analyze data-driven solutions using NumPy, Pandas, and Matplotlib.	PO2 (2), PO3 (2)	PSO1(1) PSO2(3)
CO4	Develop continuous learning skills to use open-source tools and public datasets for data science tasks.	PO11(3)	PSO3(3)

EN25C02	English Essentials – II	L	T	P	C
		1	0	2	2

Course Objectives:

- Enable learners to improve fluency and accuracy in spoken and written communication.
- Develop learners' ability to articulate ideas clearly and effectively in formal and informal spoken interactions.
- Help learners construct well-organised written documents relevant to academic and workplace contexts.

Oral Communication: Types (Verbal and Nonverbal), Interpersonal and group communication, Telephonic conversation.

Suggested Activities: Short presentations, Debates, Formal Speeches (Welcome, Vote of Thanks and introducing guests), Listen and respond to short podcasts.

Business Correspondence: Email Communication, Formal Letters (Types), Business Meeting.

Suggested Activities: Email and letter writing (Complaint, request, permission), Agenda, minutes of the meeting.

Academic Writing: Paraphrasing, Summarizing, Essay Writing, Instructions and Recommendations.

Suggested Activities: Essay writing (Cause and effect, argumentative, persuasive), User guides/ manuals, policy document.

Team Work: Leadership Skills (Team building, Team Leader, Team player), Negotiation and Problem solving skills

Suggested Activities: SWOT Analysis, Brainstorming and Group discussions.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Worksheets (10%), Group Activity (20%), Report Writing (20%), Internal Examinations (50%)

References:

1. Koneru Aruna. (2020*). English Language Skills for Engineers*. McGraw Hill Education.
2. Taylor, Shirley & Chandra .V. (2010). *Communication for Business A Practical Approach*. India: Pearson Longman.
3. Ian Badger, et al., (2014). *Listening: B2 (Collins English for Life: Skills)*, Collins.
4. Raymond Murphy (2019), *Grammar in Use*, Cambridge University Press.

E-Resources:

1. Communication for Business Success - https://open.umn.edu/opentextbooks/textbooks/8
2. TED Talks – https://www.ted.com/

	Description of CO	PO	PSO
CO1	Understand the importance of communication and drafting skills in engineering and technology.	---	
CO2	Apply listening strategies to comprehend spoken English in various contexts.	PO1(3)	PSO3(2)
CO3	Participate actively in group discussions by analysing critically from different views.	PO2(2) PO8(1)	PSO3(3)
CO4	Create written reports coherently for various purposes.	PO9(2)	PSO3(2)
CO5	Adapt communication styles to global, multicultural environments.	PO11(1)	PSO2(2)

ME25C05	Re-Engineering for Innovation	L	T	P	C
		0	0	4	2

Course Objectives:

- To cultivate foundational skills in prototyping- and automation for development of prototypes with real-world applications.
- To provide a comprehensive- hands-on exposure to product development through reverse engineering concepts.

Bootcamp 1: Introduction to Product Development- Reverse Engineering- Overview of the product lifecycle- Hands-on disassembly of simple products- Practice of basic measurements and sketching- Introduction to CAD modeling of disassembled parts- Virtual assembly of parts.

Bootcamp 2: Embedded System Programming (Open-source platforms)- Practice of interfacing sensors- reading data- automation in home- healthcare and agriculture.

Reverse Engineering: Sketch and prototype alternative designs- Group brainstorming sessions- Manufacture prototype parts using 3D printing and / or workshop tools- Assemble prototype product.

Weightage: Continuous Assessment: 60%- End Semester Examinations: 40%

Assessment Methodology: Project (30%)- Assignment (10%)- Practical (30%)- Internal Examinations (30%)

References:

1. Wang- W. (2010). Reverse engineering: Mechanisms- structures- systems & materials. CRC Press.
2. Margolis- M. (2020). Arduino cookbook: Recipes to begin- expand- and enhance your projects. O'Reilly Media.

E-Resources:

1. GrabCAD – https://grabcad.com/
2. GitHub – https://github.com/

	Description of CO	PO	PSO
CO1	Understand the product development lifecycle, including stages such as concept generation, design, prototyping, and testing.	---	
CO2	Apply reverse engineering techniques to analyze and document existing products.	PO1 (3) PO2 (2)	PSO1(2)
CO3	Collaborate in teams to fabricate prototypes using appropriate tools.	PO5 (2) PO8 (1) PO9 (1)	PSO3(3)
CO4	Engage in independent learning and continuously adapt to emerging technologies in product design	PO11(2)	PSO2(2) PSO3(2)

UC25A03	Life Skills for Engineers – II	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart and cultivate analytical reasoning, innovative thinking, effective collaboration, and ethical leadership to prepare students for complex challenges in professional and personal environments**.**

Critical Thinking: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Activities: Two-Brainstorm Method, “30 Circles” Challenge, “Desert Survival” Simulation, Lateral thinking riddles and puzzles, "What If?" Scenario Writing, Fast vs. Slow Thinking Game, Creativity Myth Busters

Problem Solving: Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Activities: Case study analysis, Escape Room challenge.

Leadership: Leadership Styles & Self-Assessment, Communication & Active Listening, Decision-Making & Responsibility, Teamwork & Delegation, Empathy, Integrity & Conflict Management, Vision, Motivation & Goal-Setting.

Activities: Crisis Leadership Simulation, Tower Challenge, Leadership Dilemmas Role-Play, Team Vision Board

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (20%), Flipped Class & Worksheets (10%), Practical (30%), Internal Examinations (40%)

References:

1. De Bono, E. (2017). Six thinking hats, Little, Brown Book Group.
2. Facione, P. A. (2015). Critical thinking: What it is and why it counts. Insight Assessment.
3. Kahneman, D. (2011). Thinking, fast and slow. Farrar, Straus and Giroux.
4. Whetten, D. A., & Cameron, K. S. (2016). Developing management skills. Pearson

	Description of CO	PO	PSO
CO1	Explain the importance of leadership and management skills in life.	---	
CO2	Apply and demonstrate creative thinking techniques to generate innovative solutions.	PO7 (3)	PSO1(1) PSO2(1)
CO3	Exhibit effective collaboration and communication skills through teamwork, active listening, and conflict resolution strategies.	PO8 (2)	PSO3(3)
CO4	Integrate scientific temperament and logical reasoning into c problem solving in engineering and real-world contexts.	PO11 (2)	PSO2(1) PSO3(2)

UC25A04	Physical Education - II	L	T	P	C
		0	0	4	1

Course Objectives:

- To impart knowledge on gymnastic exercises and pressing needs for upskilling in a particular game.

Basic gymnastics exercises: Warming up, Suitable exercise, Lead up games, Safety education, Movement education, Balanced Walk, execution, floor exercise, tumbling/acrobatics, grip, release, swinging, parallel bar exercise, horizontal bar exercise, flic-flac-walk and pyramids.

Upskilling in any one of the athletics: Broad Jump, High Jump, Triple Jump, Relay Sprints, Javelin Throw, Discuss Throw, Shot Put, Short and Long-distance Running.

Advance skills in any one of the indoor/outdoor games, which has been opted by the student in the I semester.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Attendance (60%), Quiz (10%), Participation in Sports and Games (20%) and Viva Voce (10%)

References:

1. Singh, A. (2008). Essentials of physical education. Kalyani Publishers.
2. Kamlesh, M. L. (2006). Psychology in physical education and sport (3rd ed.). Metropolitan Book Co.
3. Mangal, S. K. (2009). *Psychology of sports performance*. Sports Publication.
4. Kandappan, K. (2004). *Foundations of physical education*. Friends Publications.

E-resources:

https://www.who.int/health-topics/physical-activity

	CO Description	PO	PSO
CO1	Understand and explain the importance of physical activity for mental and physical health.	---	
CO2	Apply safety principles and methods during sports activities.	PO1(3)	PSO3(1)
CO3	Develop teamwork, discipline, and leadership through sports and group activities and collaborate effectively.	PO8 (3)	PSO3(2)
CO4	Demonstrate the advanced technical skills and strategic understanding in the game of their interest.	PO11(1)	PSO3(2)

Foreign Language^

UC25F01	Deutsch – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Deutsch language- including reading- writing systems- pronunciation- and speaking.

Basics & Introduction: German alphabet and pronunciation- Basic greetings and farewells- Introducing yourself and others (Ich heiße…- Wer bist du?)- Numbers 1–100 and days of the week- Personal pronouns (ich- du- er- sie…)- Sentence structure (SVO word order).

Activities: Alphabet spelling game- short skits- Use color-coded cards for SVO sentences.

Grammar Essentials & Everyday Vocabulary: Present tense of regular verbs (spielen- arbeiten- machen…)- Common irregular verbs: sein (to be)- haben (to have)- gehen- kommen- Articles and gender (der- die- das; ein- eine)- Simple questions and negation (nicht- kein)- Describing people and things: adjectives and colors- Family- school- food- and common objects vocabulary.

Activities: Conjugate regular and irregular verbs- “Question Chain” game- Create a simple family tree.

Everyday Communication in German: Asking for and giving directions- Telling the time and talking about schedules- Ordering food and drinks at a café or restaurant- Talking about hobbies- weather- and daily routines- Listening to short conversations and responding appropriately- Introduction to German culture and formal/informal language use (du vs Sie).

Activities: Ordering food and drinks- Give directions- Formal / Informal greetings- Do’s and Don’ts.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%)- Quiz (10%) and Internal Examinations 60%

References:

1. Funk- H.- Kuhn- C.- & Demme- S. (2015). Menschen A1: Deutsch als Fremdsprache Kursbuch. Hueber Verlag.

	CO Description	PO	PSO
CO1	Understand simple spoken Deutsch in everyday contexts.	---	
CO2	Communicate with widely used Deutsch words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Deutsch language.	PO11 (1)	PSO3(2)

UC25F02	Japanese – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Japanese language- including reading- writing systems- pronunciation- and speaking.

Writing Systems & Basic Communication: Introduction to Hiragana: vowels- basic characters- reading & writing- Introduction to Katakana: basic characters and usage- Basic greetings and farewells (こんにちは- おはようございます- さようなら)- Introducing yourself (名前、出身、年齢)- Basic sentence structure: Subject–Object–Verb- Numbers 1–100- days of the week- classroom expressions.

Activities: Flashcard games and writing drills- Self-introduction- Numbers & date-matching- Greeting expressions- Listening to audio.

Grammar & Everyday Vocabulary: Particles: は (wa)- を (wo)- の (no)- へ (e)- に (ni)- Present tense verbs: です- ます-form conjugation (たべます、のみます)- Negative forms: ではありません- ません- Describing people and objects using adjectives (い and な)- Question formation: なに、どこ、だれ、いつ- Vocabulary for family- food- colors- and basic actions.

Activities: Verb conjugation drills- Guessing game- Picture description- “Shopping” with food vocab and counters

Conversation & Cultural Etiquette: Talking about routines and schedules (daily verbs- time expressions)- Asking and giving simple directions (〜はどこですか？)- Ordering food and making polite requests (〜をください、〜をおねがいします)- Expressing likes and dislikes (すき・きらい)- Listening to short conversations and identifying key phrases- Introduction to formal/informal speech and Japanese etiquette.

Activities: Skits and role-plays- daily schedule- beginner-level dialogue- Group discussion on etiquette.

Activities: Practice worksheets and flashcards for hiragana- Writing drills and reading simple katakana words- Dialogue practice for greetings and self-introduction- Sentence construction exercises with basic SOV structure- Particle usage exercises and short dialogues- Role-play scheduling- shopping- and telling time- Verb conjugation drills for common verbs- Descriptive sentence exercises using adjectives- Practice Q&A dialogues forming questions and negations- Kanji writing practice and quizzes for basic characters- Vocabulary tests and conversational practice on daily topics- Oral presentations and listening comprehension quizzes.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%)- Quiz (10%) and Internal Examinations 60%
References: 1. Banno- E.- Ikeda- Y.- Ohno- Y.- Shinagawa- C.- & Tokashiki- K. (2011). Genki I: An integrated course in elementary Japanese. The Japan Times. 2. The Japan Foundation. (2017). Marugoto Japanese language and culture starter (A1) course book for communicative language activities. Goyal Publishers.

	CO Description	PO	PSO
CO1	Understand simple spoken Japanese in everyday contexts.	---	
CO2	Communicate with widely used Japanese words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Japanese language.	PO11 (1)	PSO3(2)

UC25F03	Korean – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Korean language- including reading- writing systems- pronunciation- and speaking.

Fundamentals of Korean: Introduction to Hangul: consonants and vowels- Basic pronunciation and syllable formation- Common greetings and self-introductions- Numbers (Sino-Korean and Native Korean basics)- Basic sentence structure (Subject-Object-Verb)- Simple expressions (e.g.- 감사합니다- 안녕하세요).

Activities: Writing and reading Hangul practice sheets- Pronunciation drills and audio repetition- Dialogue practice for greetings and self-introduction- Counting and number exercises.

Essential Grammar and Vocabulary: Particles (은/는- 이/가- 을/를) and usage- Basic verbs and present tense conjugation- Sentence patterns: affirmative- negative- interrogative- Common adjectives and descriptive sentences- Expressing possession and location- Asking simple questions (어디- 뭐- 누구).

Activities: Verb conjugation and sentence formation drills- Role-play conversations for shopping and daily routines- Descriptive writing and speaking exercises- Question and answer practice.

Everyday Korean Communication: Polite speech levels and honorifics introduction- Talking about time- dates- and schedules- Ordering food- shopping phrases- counting objects- Simple directions and transportation vocabulary- Listening practice with short dialogues- Cultural notes on etiquette and communication.

Activities: Role-play ordering at a restaurant or buying items- Listening comprehension exercises- Giving and asking for directions practice- Group conversations and presentations.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%)- Quiz (10%) and Internal Examinations 60%

References:

1. King- R.- Yeon- J.- & Brown- A. (2015). Elementary Korean (2nd ed.). Tuttle Publishing.
2. Cho- Y.- Lee- H.- Schulz- C.- Sohn- H.-M.- & Sohn- S.-O. (2001). Integrated Korean: Beginning 1. University of Hawai‘i Press.

	CO Description	PO	PSO
CO1	Understand simple spoken Korean in everyday contexts.	---	
CO2	Communicate with widely used Korean words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Korean language.	PO11 (1)	PSO3(2)

Semester III

MA25C08	Discrete Mathematics	L	T	P	C
		3	1	0	4

Course Objective:

The Objectives of the course are to Introduce foundational concepts of set theory, relations, functions, and recurrence relations relevant to modeling data and algorithmic structures and to explain principles of propositional and predicate logic, Boolean algebra, and lattice theory for reasoning and decision-making in AI systems and to present core ideas of graph theory and its applications to analyze and optimize networks, data structures, and intelligent systems.

Set Theory, Relations and Functions: Set theory – inductive definition of sets and proof by induction– Peano postulates – Relations – equivalence relations and partitions. Functions –Type of functions: Injective, surjective and bijective functions –Composition of functions – Inverse functions – Permutation functions – Recurrence relations – Solving linear recurrence relations.

Activities: Create and present Venn diagrams to illustrate union, intersection. Categorize real-world mappings such as student-to-email ID, username-to-password, as injective, surjective, or bijective using role-play or sorting tasks.

Logic : Propositions – Logical operators – Normal forms – Rules of inference – Consistency and inconsistency-Propositional logic – Proofs – Predicates – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Rules of specification and generalization – Validity of arguments.

Activities: Conduct a truth table building competition for compound propositions using logical operators.

Boolean Algebra and Lattice Theory: Partial ordering – Posets – Lattices as Posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra – Sub Boolean Algebra – Boolean Homomorphism.

Activities*:* Draw Hasse diagrams for lattices from a given set and identify sublattices and lattice operations.

Graph Theory: Graphs – Types of graphs – Matrix representation of graphs- Graph isomorphism- Walk – Path – Cycles – Eulerian graphs – Hamiltonian graphs – Planar graphs – Euler formula – Shortest path algorithm: Dijkstra’s algorithm.

Activities: Implement Dijkstra’s algorithm to find the shortest path in a weighted AI decision graph.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Assignments (20%), Solution to application-oriented problems using software (20%), Solving Competitive Examination questions (20%), Internal Examinations (40%).

References:

1. Tremblay J.P., Manohar R., “Discrete Mathematical Structures with applications to Computer Science”, Tata McGraw-Hill, International Edition, 2017.
2. Kenneth H. Rosen, “Discrete Mathematics and its applications: With Combinatorics and Graph Theory (9th Edition)”, Tata McGraw-Hill, 2025.
3. Mott J.L, Kandel A. and Baker T.P., “Discrete Mathematics for Computer Scientists and Mathematicians”, 2nd Edition, Prentice Hall India, 2015.
4. Liu C.L, “Elements of Discrete Mathematics”, 4th Edition, McGraw Hill, 2017.
5. Grimaldi, R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, 5th Edition, Pearson Education Asia, Delhi, 2016.

E-resources:

1. E-Book **- "**Mathematics for Computer Science**"** – Eric Lehman, MI**T**: https://courses.csail.mit.edu/6.042/spring17/mcs.pdf
2. NPTEL – Discrete Mathematics (IIT Ropar) - https://nptel.ac.in/courses/106106183
3. NPTEL – Graph Theory (IIT Madras) - https://nptel.ac.in/courses/111106100
4. MIT OpenCourseWare – Mathematics for Computer Science (6.042J) - https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2005/

CO	CO Description	PO	PSO
CO1	Understand the concepts of sets, Functions, Recurrence Relations, Logic, Boolean algebra and graph theory.	-	-
CO2	Apply principles of logic, functions, Boolean algebra, lattices, recurrence relations, and graph theory to solve real world engineering problems.	PO1 (3)	PSO1(2) PSO2(2)
CO3	Employ discrete mathematical structures such as relations, recurrence relations, logical statements, lattices and graphs to analyze engineering problems.	PO2 (3) PO5(3) PO11(1)	PSO1(2) PSO2(1)
CO4	Model engineering problems and provide discrete mathematics based solutions.	PO5 (3) PO11 (1)	PSO2(3) PSO3(1)

CS25C08	Data Structures	L	T	P	C
		3	0	4	5

Course Objectives: This course presents various data structures and their importance to provide a comprehensive view about problem solving skills.

Linear Data Structures: Abstract Data Types- Internal Representation of Primitive Data Structures- One Dimensional and Multi-Dimensional Arrays- linear lists- Singly, doubly, Circular linked lists- Applications.

Practicals

- Single and Multidimensional arrays
- Singly, Doubly and Circular Linked Lists

Stacks and Queues: Stack: Representations – Operations – Implementations – Applications. Queue: Representations – Operations – Implementations – Types - Applications.

Practicals

- String reverse operations and Expression evaluation
- Circular Queue and Priority Queue

Trees: Representations – Types – Binary Search Trees (BSTs) - AVL Tree **– Operations: Search,** Traversals, Rotations - Balanced BSTs- Splay trees- B-trees- Binary Heaps.

Practicals

- Traversal operation
- AVL Tree rotations
- Query and Update operations on Balanced BSTs

Sorting, Searching & Hashing Techniques: Linear and Binary Search - Bubble Sort - Insertion Sort- Merge Sort- Bucket Sort- Quick Sort- Heap sort- Hashing techniques- Dictionaries- Hash function- Collision - Separate chaining- open addressing.

Practicals

- Quick and Heap Sort
- Binary Search and Hashing

Graphs: Representation - Types – Operations - Prim's, Kruskal algorithms - Dijikstra's algorithm – Connected and Biconnected Components.

Practicals

- BFS and DFS algorithms
- Minimum Spanning Tree and shortest path algorithms

Assessment Weightage:

Weightage:	Continuous Assessment: 50% (i). Activities: 10% (ii). Internal Theory Examinations: 30%	End Semester Theory Examination: 50%

	(iii). Internal Laboratory Examination: 10%	

Mandated Activities with marks:

Assignments (30), Quiz (10), Project based learning (25), Flipped Classroom (10), Review of GATE questions (25).

Internal Examinations: TWO tests

References

1. Gilberg, R. F., & Forouzan, B. A, "Data Structures: A Pseudocode Approach", Cengage Learning India Private Limited, 2023
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson, 2014.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson, 2001.
4. D.S. Malik, Data Structures Using C++, 2nd Edition, Cengage, 2012.

e- Resources

- https://nptel.ac.in/courses/106102064
- https://nptel.ac.in/courses/106105085
- https://leetcode.com/

CO	Description of CO	PO	PSO
CO1	Describe the concepts and operations of data structures for efficient data organization and manipulation.	--	--
CO2	Analyze data structures to understand their performance and application suitability.	PO1 (3)	PSO1 (3)
CO3	Evaluate data structure algorithms in terms of time and space complexity for solving computational problems.	PO3 (2)	PSO2 (2)
CO4	Design appropriate data structures and algorithms for real-world problem scenarios.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to apply emerging data structures through continuous self-learning and practice.	PO11 (2)	---

CS25C09	Java Programming	L	T	P	C
		3	0	4	5

Course Objective:

- The objective of this course is to impart knowledge on the fundamentals of Java programming and explore conceptual capabilities of Java Language.

Foundations of OOP and Java : Principles of OOP – Java Development Kit(JDK) – Data Types, Variables and Arrays – Operators – Control Statements –Classes & Objects – Constructors– Method Overriding – Access specifiers – Static Members – Inheritance.

Practicals

- Constructors and Static Members
- Inheritance

Java Conceptual Foundations and Capabilities : Packages and Interfaces – Exception Handling – Multithreaded Programming – Enumerations, Autoboxing, and Annotations – Generics – Lambda Expressions.

Practicals

- Packages and Interfaces with Access specifiers.
- Creation of user defined exception and Multiple threads.

Java Core Libraries : String Handling – java.lang – Utility Classes – java.io – Event Handling – Working with AWT Controls – Layout Managers.

Practicals

- String Handling.
- Event Handling.

I/O and GUI Programming in Java : Reading and Writing Console I/O - Files –Swing – Menus.

Practicals

- Files I/O.
- Swing Application.

Database Connectivity Using Java : JDBC – Types of JDBC Drivers - JDBC Packages - JDBC API and Driver – Associating the JDBC/ODBC bridge with the Database - Database Connections and Operations.

Practicals

- Database Connections and Operations

Java Collection Frame Work: Collection framework - Regex – java.util package - arrays and collections - Map interfaces - iterators- generics.

Practicals

Array List and Map Interfaces.

References:

1. Herbert Schildt and Danny Coward, “Java: The Complete Reference”, 13th Edition, McGraw Hill Education, New Delhi, 2024.
2. Aamer Khan, “Java Programming Language | Learn Java from Basic to Advance”, Code Academy, 2022.
3. Tripti Paul, “Object-Oriented Programming Using Java”, Cengage Learning, 2018.

e-Resources:

1. https://www.tpointtech.com/java-tutorial
2. https://www.tutorialspoint.com/java/index.htm
3. https://onlinecourses.nptel.ac.in/noc22_cs47

Assessment Weightage:

Weightage:	Continuous Assessment: 50% (i). Activities: 10% (ii). Internal Theory Examinations: 30% (iii). Internal Laboratory Examination: 10%	End Semester Theory Examination: 50%
Mandated Activities with marks: Assignments (30), Quiz (10), Project based learning (25), Flipped Classroom (10), Review of GATE questions (25).		
Internal Examinations: TWO tests		

CO	Description of CO	PO	PSO
CO1	Describe the object-oriented features of Java programming for developing robust applications.	--	--
CO2	Analyze object-oriented constructs to understand program flow, data handling, and exception management.	PO1 (3)	PSO1 (3)
CO3	Evaluate appropriate Java programming constructs in different scenarios.	PO3 (2)	PSO2 (2)
CO4	Design Java applications to solve real-world problems.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to adapt to emerging Java frameworks and tools.	PO11 (2)	---

AD25C01	Exploratory Data Analysis	L	T	P	C
		3	0	2	4

Course Objectives:

This course aims to provide in-depth knowledge and practical skills in performing Exploratory Data Analysis (EDA), using statistical and graphical techniques.

Introduction: Purpose and goals of EDA - Mindset for effective data exploration - Significance of EDA in the data science lifecycle - Types of data and quality issues - EDA vs. Classical and Bayesian approaches - Tools and libraries for EDA - Visual techniques for initial insights.

Practicals:

1. Load a real-world dataset (CSV/JSON) into a Pandas DataFrame and inspect its structure using .head(), .info(), .shape, and .describe().
2. Choose one dataset and create a “data story” using 3 to 5 visualizations that highlight trends, patterns, or anomalies.

Data Wrangling: Importing, loading, and cleaning datasets - Merging, reshaping, and pivoting data - Handling missing values and outliers - Renaming, deduplication, discretization, and binning - Permutation and random sampling - Challenges in real-world data preprocessing.

Practicals:

1. Load a messy dataset with missing values, duplicates, and incorrect data types. Identify and handle missing values using Pandas functions, applying mean or median for numeric data and mode for categorical data. Remove duplicates and verify data consistency.
2. Rename ambiguous column names to meaningful ones and convert improperly inferred data types to suitable formats (e.g., object to float). Apply binning (equal-width/equal-frequency) on a continuous column such as age or income. Display the new binned column and analyze its utility.

Multivariate Analysis, Relationship Exploration and Causal Inference: Univariate, Bivariate, and Multivariate Analysis - Interpreting relationships and Simpson’s Paradox - Multicollinearity and correlation pitfalls - Visualizing multivariate data using pair plots and heatmaps - Causal inference in data science: correlation vs. causation, confounding variables

Practicals:

1. Create and analyze a detailed correlation matrix. Identify and explain variable pairs with high correlation coefficients ($r > 0.8$ or $r < –0.8$).
2. Construct a sns.pairplot() for 4–6 numerical columns with an additional categorical hue to observe grouped patterns across variables.

Time-Oriented Data Exploration: Time-series data - Time-based indexing and date time conversion in pandas - Seasonal patterns, resampling (up/down), and aggregations - Line plots, rolling statistics, and anomaly spotting.

Practicals:

1. Perform both down-sampling (e.g., daily to monthly) and up-sampling (conceptual/fill methods) usingresample() and aggregate meaningful summaries.
2. Compute rolling mean and standard deviation for a chosen variable (e.g., 7-day moving average). Use plots to identify anomalies or trend shifts.

Statistical Testing for Insights: Hypothesis Testing: Null vs. Alternative, Type I & II Errors - Statistical tests: t-tests, p-values using scipy and statsmodels - Interpreting test results in the context of EDA.

Practicals:

1. Perform t-tests or other appropriate statistical tests using scipy.stats. Record t-values, p-values, and significance level conclusions.
2. Interpret test results in layman terms: Report whether the difference is statistically significant, and what it implies for decision-making.

From EDA to Model Deployment: Supervised vs. unsupervised models - Simple and Multiple Linear Regression -Train/Test Split, Cross-validation - Evaluation metrics: MAE, RMSE, R^2, Accuracy, F1-score - Saving models using pickle or joblib - Basic deployment using Flask for local predictions.

Practicals:

1. Load a dataset and select suitable independent and dependent variables for simple linear regression. Split the dataset into training and testing sets. Train a linear regression model using sklearn, evaluate it with MAE, RMSE, and R^2. Interpret the model's performance.
2. Save the trained model using pickle or joblib. Build a minimal Flask application with a /predict route that takes input and returns a prediction. Test locally.

Weightage:	Continuous Assessment: 50% (i). Activities: 10% (ii). Internal Theory Examinations: 30% (iii). Internal Laboratory Examination: 10%	End Semester Theory Examination: 50%

Mandated Activities with marks:

Assignments (30), Quiz (10), Virtual demonstration (25), Flipped Classroom (10), Review of GATE & IES questions (25).

Internal Examinations: TWO tests

References:

1. Mukhiya, S. K., & Ahmed, U. (2020). Hands-On Exploratory Data Analysis with Python. Packt Publishing.
2. Wes McKinney (2022), *Python for Data Analysis*, O'Reilly Media (3rd Edition)
3. Grus, J. (2019). Data science from scratch: First principles with Python. O'Reilly Media.

4. Sandhya Arora and Latesh Malik, (2023) Data Science and Analytics with Python, Universities Press.
5. Kyla Mcmullen, Elizabeth Matthews, Programming with Python with MindTap, Cengage, 1st Edition, (2023).

E-Resources/E Materials:

1. https://www.youtube.com/user/joshstarmer
2. https://www.kaggle.com/learn
3. https://www.coursera.org/specializations/jhu-data-science
4. https://www.analyticsvidhya.com/blog/2021/06/exploratory-data-analysis-eda-step-by-step/

CO	Description of CO	PO	PSO
CO1	Describe the importance of exploratory data analysis in understanding and summarizing datasets.	--	--
CO2	Analyze datasets identify patterns, trends, anomalies, and relationships among variables.	PO1 (3)	PSO1 (3)
CO3	Evaluate data quality and extract meaningful insights for decision-making.	PO3 (2)	PSO2 (2)
CO4	Design effective exploratory data analysis workflows for real-world datasets.	PO2 (1)	PSO1 (3)
CO5	Recognize the importance of continuous learning by adapting to emerging tools and evolving data-driven practices.	PO11 (2	--

CS25C11	Operating Systems	L	T	P	C
		3	0	2	4

Course objectives: This course presents core principles of modern operating systems and analyses components such as process management, CPU scheduling, synchronization, memory, file systems, and I/O.

Basics Of Operating Systems: History and Evolution of Operating Systems-Types of Operating Systems – Operating Systems structures- Functions of Operating Systems-challenges of Operating Systems- Unix & Linux Operating Systems

Practicals

- Installation of a Linux OS
- Linux commands and shell scripting

System Calls and Process Management: System Calls-Process Concepts and Lifecycle, Process Control Block (PCB)- Context Switching - Threading Models, Process vs Thread-Process Creation and Termination- Case study.

Practicals

- Process Creation using fork(), exec(), wait()
- Multi-threading using POSIX threads

CPU Scheduling: Scheduling Criteria and Objectives-Scheduling Algorithms - Preemptive and non-preemptive scheduling

Practicals

- Implementation and generation of Gantt chart
    - FCFS and SJF
    - Round Robin, Priority and Multilevel Queue

Synchronization and Deadlocks: Concurrency Issues and Critical Section Problem-Synchronization Tools: Mutex, Semaphores-Deadlock: Necessary Conditions, Prevention, Avoidance, Detection, and Recovery

Practicals

- Producer-Consumer and Readers-Writers problem
- Dead Lock

Memory Management: Memory Allocation: Contiguous, Paging, Segmentation-Virtual Memory, Demand Paging, Page Replacement Algorithms (FIFO, LRU, Optimal)

Practicals

- Page replacement algorithms
- Dynamic memory allocation and deallocation

File Systems and I/O Management: File System Concepts – Directory and File Access Control - I/O Management - Disk Scheduling Buffering, Caching - Case study.

Practicals

- File operations and file buffering.
- Disk scheduling algorithms

Assessment Weightage:

Weightage:	Continuous Assessment: 50%	End Semester Theory Examination: 50%
	(i). Activities: 10% (ii). Internal Theory Examinations: 30% (iii). Internal Laboratory Examination: 10%	
Mandated Activities with marks: Assignments (30), Quiz (10), Project based learning (25), Flipped Classroom (10), Review of GATE questions (25).		
Internal Examinations: TWO tests		

References:

1. Silberschatz, A., Galvin, P. B., & Gagne, G. “Operating System Concepts”, 10th Edition, Wiley, 2021.
2. H. M. Deitel, P. J. Deitel, and D. R. Choffnes,”Operating Systems”, 3rd edition Boston, MA, Pearson Education, 2003.
3. Mauerer, W. Professional “Linux Kernel Architecture”, Wiley, 2017.
4. Greg Tomsho, Guide to Operating Systems, 5th Edition, Cengage, 2017.

e-Resources

1. Title: Operating System Fundamentals (Prof. P. S. Grover, IIT Kanpur)
   Platform: SWAYAM
   Link: https://onlinecourses.swayam2.ac.in/cec20_cs06/preview
2. Title: Linux Programming and Scripting (Prof. Abhiram Ranade, IIT Bombay)
   Platform: NPTEL/SWAYAM
   Link: https://nptel.ac.in/courses/117106113
3. Resource: Linux Kernel Explained – NPTEL YouTube Lecture

CO	Description of CO	PO	PSO
CO1	Describe the operating systems concepts in managing computer hardware and software resources.	--	--
CO2	Analyze operating system components and file systems	PO1 (3)	PSO1 (3)
CO3	Evaluate operating system algorithms in different computing environments.	PO3 (2)	PSO2 (2)
CO4	Design operating system solutions for managing system resources in real-world scenarios.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to adapt to emerging trends, tools, and technologies.	PO11(2)	--

EN25C03	English Communication Skills Laboratory– I	L	T	P	C
		0	0	2	1

Course Objectives: The objectives of the course are to foster students' confidence and fluency in professional and social communication and to bridge the gap between academic English and industry expectations.

List of Activities

A. Elements of Effective Speaking and Listening

(i) Sharing life experience/ turning point in their life – SATORI

(ii) Situational Conversation – eg. Talking to a Senior about Internship Tips

(iii) Welcoming a Guest Speaker at a Seminar

(iv) Pictography to represent data using images or symbols

(v) B2-C1 Listening exercises include lectures, interviews, and discussions.

B. Mastering Presentations

(i) Presentation Skills – Non-verbal communication

(ii) Mini-Presentations: Topics like "My Dream Project," "Engineering in 2050,"3-minute technical pitches with logical flow

(iii) Technical Presentations with PPT

C. Group Discussion Strategies:

(i) Introduction to Group Discussions - Key skills for effective participation

(ii) Phases in a GD and Conversational Phrases in GD.

(iii) Group Discussions – Abstract and Factual topics

D. Resume & LinkedIn Optimization

(i) Building LinkedIn Profile – Drafting headlines and summaries

(ii) Social Media Optimisation

(iii) Preparing Video Resume

E. Podcast-Based Language Learning:

(i) Listening to podcast (motivational, career oriented, success stories)

(ii) Podcast Preparation – Purpose – Topic – Structure – Recording Tips - Publication of the Podcast

F. Mock Interviews and Communication Strategies:

(i) Listening – Job interview

(ii) Speaking – Mock interviews

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%.

Internal Assessment: 1. Listening (20 marks)
2. Video Resume (20 marks)
3. Creating a Podcast (30 marks)
4. Mock interview (30 marks)

End Semester Assessment: 1. Presentation with PPT (50 marks)
2. Group Discussion (50 marks)

References:

1. Floyd Kory, “Interpersonal Communication”, McGraw Hill Publication, 2023.
2. Bharadwaj Apoorva, “Leadership Communication Skills for Intercultural Management: Strategies for Effective Intercultural Management (Contemporary Themes in Business and Management)”, Routledge India; 1st edition, 2024.
3. Helen Spencer-Oatey and DomnaLazidou**, “**Making Working Relationships Work: The TRIPS Toolkit for Handling Relationship Challenges and Promoting Rapport”,Castledown Publishers,2023.
4. Presentations - Cambridge
5. Speaking Extra -
6. Listening Extra – Miles Craven by Cambridge University Press
7. CVs, Resumes, and LinkedIn: A Guide to Professional English – Springer International Publishing

E-resources:

1. Train your mind to perform under pressure- Simon Sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2. Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3. Will Smith's Top Ten rules for success https://www.youtube.com/watch?v=bBsT9omTeh0

CO	Description of CO	PO	PSO1
CO1	Communicate effectively in everyday professional situations with confidence		
CO2	Deliver well-organised and effective presentations.	PO9(3)	PSO1(1) PSO3(2)
CO3	Participate in group discussions and express ideas clearly and confidently.	PO8(2) PO9(3)	PSO3(2)
CO4	Create professional video resumes and participate in interviews effectively.	PO9(2)	PSO3(3)
CO5	Create, record and publish motivational podcasts.	PO9(2) PO11(1)	PSO2(2) PSO3(3)

SEMESTER IV

MA25C07	Probability and Statistics	L	T	P	C
		3	1	0	4

Course Objectives: The Objectives of the course are to introduce data collection methods, classification techniques, and graphical representation of data using charts and plots, to explain the fundamental concepts of descriptive statistics, probability theory, random variables, and hypothesis testing for analyzing data and to demonstrate the application of statistical techniques such as experimental design and process control using R/Python for data-driven decision-making.

Descriptive Statistics: Collection of Data-Classification-Tabulation-Graphical Representation – Simple Bar Chart – Pie Chart -Measures of Central Tendency: Arithmetic Mean, Median and Mode – Measures of Variation: Range, Quartile Deviation - Standard Deviation and Coefficient of Variation – Five Number Summary – Box Plot Technique.

Activities: Application of descriptive statistics and data presentation methods using R/ Python programming and Analysing data using Box Plots using R/ Python programming.

Probability and Random Variables: Axioms of probability - Conditional probability – Total probability – Bayes' theorem Random variable – Distribution function – properties – Probability mass function – Probability density function – Moments - Standard Distributions - Binomial, Poisson and Normal Distributions-Problems, Uniform Distribution and Exponential Distribution (Simple Problems)

Activities*:* Application of various distributions using R/ Python programming.

Two-Dimensional Random Variables : Joint distributions – Marginal and conditional distributions – Expected values of functions of two variables– Correlation and regression (for discrete data only) - Central limit theorem – Statement and Simple Problems

Activities: Applications of Correlation and Regression using R/ Python programming.

Testing of Hypothesis: Large sample tests for single mean and difference of means – Small samples tests based on t and F distributions (single mean, difference of means, paired t- test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit.

Activities: Application of Student – t test, F test ,Chi –s square test using R/ Python programming.

Design of Experiments: Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD)

Activities: Application and visualization of One-way ANOVA and Two -way ANOVA using R/ Python programming.

Weightage: Continuous Theory Assessment: 20%, Continuous Lab Assessment: 20%, End Semester Examinations: 60%

Assessment Methodology: Quiz - 10%, Assignments - 20%, Lab Manual - 15%

Lab Examination - 15%, Internal Examinations - 40%

References:

1. Walpole R. E., Myers S.L. & Keying Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education Inc, 9th edition, 2024.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, “An Introduction to Statistical Learning with Applications in R”, Springer, 2021.
3. Johnson R. A., Miller & Freund’s, “Probability and Statistics for Engineers”, 9th Edition, Pearson Education, Delhi, 2020.
4. Charles Henry Brase and Corrinne Pellillo Brase, “Understandable Statistics: Concepts and Methods”, Cengage Learning, 12th Edition, 2018.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, 6th Edition, Pearson Education, Asia, 2012.
6. Anderson, T. W, “An Introduction to Multivariate Statistical Analysis”, 3rd edition, John Wiley and Sons, 2009.

E-resources:

1. NPTEL – Descriptive Statistics with R Software - https://onlinecourses.nptel.ac.in/noc22_mg87/preview
2. MIT OCW – Introduction to Probability and Statistics (18.05, Spring 2022) - https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/
3. MIT OCW – Statistics for Applications (18.650, Fall 2016) - https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/
4. Control Charts – Coursera: https://www.coursera.org/learn/stability-and-capability-in-quality-improvement#modules

	CO Description	PO	PSO
CO1	Understand concepts of descriptive statistics, probability theory and testing of hypothesis.	-	-
CO2	Apply probability distributions and statistical methods to solve engineering problems	PO1(3)	PSO1(1)
CO3	Analyze data using correlation, regression, and probability models.	PO2(3)	PSO1(2) PSO3(1)
CO4	Utilize hypothesis testing, ANOVA for data-driven decision-making.	PO5 (3) PO11 (2)	PSO2(2)

CS25C12	Algorithms	L	T	P	C
		3	0	0	3

Course Objectives: This course aims at providing the fundamentals of algorithm design and analysis and explains the concepts greedy method and dynamic programming. Also, this course illustrates the methods of backtracking and branch bound techniques to solve the problems.

Foundations of Algorithm Analysis: Performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation, theta notation and little (o) notation, recurrences, probabilistic analysis.

Activities:

- Assignment
  - Time and Space Complexity calculation for a given Logic
  - Usage of loops and conditionals and mathematical principles

Divide & Conquer Methods: Merge sort, Long Integer Multiplication, Strassen's matrix multiplication, Master method, Job Sequencing Problem with Deadlines

Activities:

- Flipped Class Room: Solving a puzzle.
- Review of GATE Questions

Greedy Methods and Dynamic Programming: Activity Selection Problem, Huffman Codes and Knapsack fractional. Dynamic Programming Method: Knapsack 0 – 1, Matrix Chain Multiplication, Optimal Binary Search Tree and Longest Common Subsequence.

Activities:

- Project based experiential learning: Creation of treasure hunt.
- Quiz: State Transition and Recurrence Relations - Space Optimization Technique

String Matching and Convex Hull Algorithms: Multithreaded algorithms, Polynomial Multiplication, Fast Fourier Transform, Extended Euclid Algorithm. Naïve's algorithm, Rabin Karp algorithm - Graham's Scan and Jarvi's March method.

Activities:

- Assignment: Rabin Karp algorithm
- Quiz: Multithreaded and Euclid algorithms

Solvability And Tractability: The classes P and NP, NP Hard and NP Complete Problems. vertex-cover, travelling-salesman, set-covering, subset-sum Problem - N Queen Problem, Graph Coloring, Hamiltonian Cycle Problem - Assignment Problem, Travelling Salesman and Knapsack Problem.

Activities:

- Assignment: Approximation and randomized Algorithms
- Review of GATE Questions.

Network Flow Algorithms: Flow Networks, Maximum Flows: Ford-Fulkerson, Edmond-Karp, Push relabel Algorithm, Relabel-to-front algorithm, Minimum Cost flows, Cycle Cancelling Algorithm.

Activities:

- Flipped Class Room: Relabel Algorithm
- Review of GATE Questions.

Assessment Weightage:

Weightage:	Continuous Assessment: 40% (i). Activities: 30% (ii). Internal Examinations – 70%	End Semester Theory Examination: 60%

Mandated Activities with marks:

Assignments (30), Quiz (10), Project based learning (25), Flipped Classroom (10), Review of GATE questions (25).

Internal Examinations: TWO tests

References

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2014.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Computer Algorithms/ C++", Second Edition, Universities Press, 2007.
3. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. "Introduction to algorithms". MIT press, 2022.

E- Resources

- https://archive.nptel.ac.in/courses/106/105/106105164/
- https://nptel.ac.in/courses/106106131
- https://nptel.ac.in/courses/106105157
- https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-spring-2020/

CO	Description of CO	PO	PSO
CO1	Describe the fundamental concepts of algorithms for solving computational problems.	--	--
CO2	Analyze various algorithmic approaches and dynamic programming to understand their efficiency and applicability.	PO1 (3)	PSO1 (3)
CO3	Evaluate algorithms based on time and space complexity to determine their effectiveness for different problem scenarios.	PO3 (2)	PSO2 (2)
CO4	Design appropriate design paradigms and optimization techniques to solve real-world computational problems.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to apply advanced algorithmic techniques through continuous self-learning.	PO11 (2)	---

AD25401	Artificial Intelligence Essentials	L	T	P	C
		3	0	0	3

Course Objectives:

This course aims to introduce the essential concepts of Artificial Intelligence, covering key areas such as search strategies, knowledge representation, planning, learning and communication.

Introduction: Artificial Intelligence (AI) – Applications and Future - Intelligent Agents: Agents and Environments – Characteristics - Task Environments & their properties – Types – Architecture – Problem solving approach to AI problems.

Activities

- Assignment: Impact of AI in the next 10 years.
- Quiz: Agents and Environments.

Search Strategies: Uninformed Search: Breadth First Search (BFS) – Depth First Search (DFS) - Depth-Limited Search (DLS) - Informed Search: Greedy Best First Search – A* Search – Iterative Deepening A* Search (IDA*). Local Search Algorithms and Optimization Problems: Hill Climbing - Simulated Annealing – Genetic Algorithms – Beam Search – Local Beam Search - Constraint Satisfaction Problems (CSPs) - Adversarial Search.

Activities:

- Project based learning:
  - Solve a CSP like Sudoku.
  - Develop a Tic-Tac-Toe AI.

Knowledge Representation in Logic

Propositional Logic Vs Predicate Logic - First Order Predicate Logic: Syntax - Semantics – Usage - Knowledge Representation. Inference in First Order Logic: Unification - Resolution – Forward Chaining - Backward Chaining - Simple Logic programming using Prolog for Unification, Resolution, Forward and Backward Chaining.

Activities:

- Review of GATE Questions.
- Assignment: Building a Simple Rule based expert system.

Semantic Modelling and Planning

Knowledge Representation: Ontological Engineering - Categories and Objects – Events - Mental Events and Mental Objects. Reasoning Systems for Categories - Reasoning with Default Information. Planning in AI: Problems – Algorithms – Forward State Space Search – Backward State Space Search – Heuristics – Graphs.

Activities:

- Flipped Class Room: For a given scenario, identify the different objects, events, categories and their relationships.
  Quiz: Planning problems.

Learning and Communication

Learning in AI: Supervised Learning – Unsupervised Learning – Reinforcement Learning. Agent communication – Criteria for evaluation – Conceptual Foundations – Traditional Software Engineering Approaches – Agent Communication Languages (ACL) – Commitment Protocols – Modelling Communications.

Activities:

- Assignment: Real world applications of different learning models.
- Quiz: Agent Communication.

Weightage:	Continuous Assessment: 40% (i).Activities: 30% (ii).Internal Examinations: 70%	End Semester Theory Examination: 60%

Mandated Activities with marks:

Assignments (30), Quiz (10), Project based Learning (25), Flipped Classroom (10), Review of GATE & IES questions (25).

Internal Examinations: TWO tests

References:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, Fourth Edition, 2020.
2. Gerhard Weiss, “Multiagent Systems”, Second Edition, MIT Press, 2016.
3. Chandramouli Subramanian and Asha A George, Artificial Intelligence: Principles & Application, Universities Press India Pvt. Ltd. 1st Edition, 2026.
4. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison Wesley Educational Publishers Inc., 2011.
5. M. Tim Jones, “Artificial Intelligence: A Systems Approach (Computer Science)”, Jones and Bartlett Learning, Second Edition, 2019.
6. Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press, Second Edition, 2020.

E-Resources:

- NPTEL - Artificial Intelligence: Knowledge Representation and Reasoning by Prof. Deepak Khemani, IIT Madras https://onlinecourses.nptel.ac.in/noc23_cs09/preview
- NPTEL - Fundamentals Of Artificial Intelligence by Prof. Shyamanta M. Hazarika, IIT Guwahati https://onlinecourses.nptel.ac.in/noc24_ge47/preview

CO	Description of CO	PO	PSO
CO1	Describe Artificial Intelligence for solving real-world problems.	--	--
CO2	Analyze Artificial Intelligence algorithms for effective design of search techniques and knowledge representation methods.	PO1 (3)	PSO1 (3)
CO3	Evaluate suitability of Artificial Intelligence models for different problem scenarios.	PO3 (2)	PSO2 (2)
CO4	Design appropriate Artificial Intelligence-based solutions using learning and reasoning techniques.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to apply emerging Artificial Intelligence tools through continuous self-learning.	PO11 (2)	---

AD25402	Data Privacy and Security	L	T	P	C
		3	0	0	3

Course Objectives:

To develop knowledge of data privacy and security principles, apply protection mechanisms and cryptographic techniques, and design secure systems that ensure data confidentiality, integrity, and compliance with regulations.

Data Privacy & Risk Models: CIA triad – Confidentiality, Integrity, Availability. Data privacy vs. Data security – Cyber threats – Malware, Phishing, Denial-of-Service (DoS), Man-In-The-Middle (MITM). Vulnerabilities, Threat modeling, and Privacy Risk Categories.

Activities

Assignment: Map threats to CIA violations using current events.

Quiz: Cyber threats

Cryptographic Techniques for Data Security: Symmetric encryption: AES, DES, Public-key cryptography: RSA, ECC, Hashing: SHA, HMAC, Key exchange: Diffie-Hellman, Digital signatures. Block cipher modes of operation, key management protocols, elliptic curve cryptography with algebraic foundations. Number theory, Fermat's/Euler's theorems, Chinese Remainder Theorem algebraic structures, primality testing, and factorization.

Activities

Project Based Experiential Learning:

- Implementation of RSA and SHA for secure message exchange.
- Secure multicast key distribution using Chinese Remainder Theorem

Secure Data Storage: Secure file systems, Disk encryption, Database encryption Secure API access, Cloud data security, Token-based authentication : OAuth, JWT, Application Layer Security, Transport Layer Security, IP Security.

Activities

Review of GATE Questions: SSL/TLS concepts, IPSec

Assignment: Cloud data security

Privacy-Preserving Computation : Homomorphic encryption, Secure Multi-party Computation (SMPC), Federated Learning, Local differential privacy.

Activities:
Project Based Experiential Learning: Federated learning using the Flower framework.
Flipped Class Room: Cryptographic foundations

Legal and Regulatory Frameworks : Data protection laws: GDPR, NIS2; Indian regulations: IT Act, CERT-In, DPDP Act 2023, Aadhaar guidelines; Compliance standards: ENISA, eIDAS, ISO 27001.

Activities
Assignment: Real-world GDPR violation case and its legal impact.
Quiz: Indian Regulations

Emerging Topics in Privacy : Ethics of data privacy; Privacy Impact Assessment (PIA); Privacy in online social media; Case studies in privacy violations and impact; Secure data sharing in federated systems; Advances in privacy technologies.

Activities
Flipped Class Room: Privacy in Online Social Media
Quiz: Privacy Technologies

Weightage:	Continuous Assessment: 40% (i). Activities: 30% (ii). Internal Examinations: 70%	End Semester Theory Examination: 60%

Mandated Activities with marks:

Assignments (30), Quiz (10), Project Based Experiential Learning (25), Flipped Classroom (10), Review of GATE Questions (25).

Internal Examinations: TWO tests

References:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education, 8th Edition, 2023.
2. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India, 2nd Edition, 2020.
3. Arvind Narayanan et al., A Primer on Differential Privacy, 2017.
4. S. Bose and P.Vijay Kumar, Cryptography and Network Security, Pearson Education, 1st Edition, 2016.

E-Resources:

1. NPTEL: Cyber Security and Privacy- Prof. Saji K Mathew , IIT Madras https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. NPTEL: Privacy and Security in Online Social Media – Prof. P. Kumaraguru, IIT Madras https://onlinecourses.nptel.ac.in/noc23_cs13/preview
3. Coursera: IBM Cybersecurity Analyst Professional Certificate
4. OWASP Foundation – Resources on secure coding, privacy-by-design, and vulnerability testing

CO	Description of CO	PO	PSO
CO1	Describe the fundamental concepts of data privacy, information security, and cyber threats in digital systems.	--	--
CO2	Analyze data protection mechanisms and security policies to understand their applicability.	PO1 (3)	PSO1 (3)
CO3	Evaluate privacy-preserving techniques and security frameworks for diverse application scenarios.	PO3 (2)	PSO2 (2)
CO4	Design appropriate data privacy and security solutions for real-world systems.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to apply emerging security practices through continuous self-learning.	PO11 (2)	---

AD25403	Standards in Artificial Intelligence	L	T	P	C
		1	0	0	1

Overview of Standards

Basic concepts of standardization: Purpose of Standardization, marking and certification of articles and processes; Importance of standards to industry, policy makers, trade, sustainability and innovation. Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/IEC Directives; WTO Good Practices for Standardization. Important Indian and International Standards.

International Standards in Artificial Intelligence

Introduction - Importance of standards in IT-Overview of key international standards organizations **ISO Standards** – ISO/IEC 23053:2022 Framework for AI systems using machine learning, ISO/IEC 42001:2023AI management systems, ISO/IEC 23894:2023AI – Guidance on risk management,

IEEE Standards IEEE P3123™ – Standard for Artificial Intelligence and Machine Learning (AI/ML) Terminology and Data Formats, IEEE P7015™ – Standard for Data and Artificial Intelligence (AI) Literacy, Skills, and Readiness, IEEE P3198™ – Standard for Evaluation Method of Machine Learning Fairness, IEEE P1948.1™ – Standard for Artificial Intelligence Based Network Applications in 5G and Beyond Mobile Networks, IEEE 2801™-2022 – IEEE Recommended Practice for the Quality Management of Datasets for Medical Artificial Intelligence, IEEE 2941™-2021 – IEEE Standard for Artificial Intelligence (AI) Model Representation, Compression, Distribution, and Management, IEEE 2941.2™-2023 – IEEE Standard for Application Programming Interfaces (APIs) for Deep Learning (DL) Inference Engines, IEEE P2975.2™ – Standard for Model Verification & Validation of Industrial Artificial Intelligence Systems, IEEE P2976™ – Standard for XAI – eXplainable Artificial Intelligence – for Achieving Clarity and Interoperability of AI Systems Design, IEEE P3127™ – Guide for an Architectural Framework for Blockchain-based Federated Machine Learning, IEEE 3129™-2023 – IEEE Standard for Robustness Testing and Evaluation of Artificial Intelligence (AI)-based Image Recognition Service, IEEE 3333.1.3™-2022 – IEEE Standard for the Deep Learning-Based Assessment of Visual Experience Based on Human Factors, IEEE P3157™ – Recommended Practice for Vulnerability Test for Machine Learning Models for Computer Vision Applications, IEEE 3168™-2024 – IEEE Standard for Robustness Evaluation Test Methods for a Natural Language Processing Service That Uses Machine Learning, IEEE P3419™ – Standard for Large Language Model Evaluation, IEEE 7010™-2020 – IEEE Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-Being, IEEE P7018™ – Standard for Security and Trustworthiness Requirements in Generative Pretrained Artificial Intelligence (AI) Models,IEEE P7100™ – Standard for Measurement of Environmental Impacts of Artificial Intelligence Systems,

ACM Standards and Guidelines -ACM Code of Ethics and Professional Conduct-ACM Computing Classification System (CCS) and its role in standardization

References:

1. Manual for Standards Formulation 2022, Bureau of Indian Standards
2. Kunas, Michael, “Implementing service quality based on ISO/IEC 20000: A management guide” IT Governance publishing, 2012.
3. Sid Ahmed Benraouane, AI Management System Certification According to the ISO/IEC 42001 Standard: How to Audit, Certify, and Build Responsible AI Systems, Productivity Press; 1st edition, June 2024.
4. ISO/IEC 42001:2023 Information technology — Artificial intelligence — Management system, Edition 1, 2023.
5. ISO/IEC 23894:2023 Information technology — Artificial intelligence — Guidance on risk management, Edition 1, 2023.
6. ISO/IEC 23053:2022 Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML), Edition 1, 2022.
7. IEEE portfolio of AIS technology and impact standards and standards projects [https://standards.ieee.org/initiatives/autonomous-intelligence-systems/standards/]
8. Kan, S. H. “Standards for Information Technology and Systems”, Prentice Hall, 2017.
9. Association for Computing Machinery. “ACM Code of Ethics and Professional Conduct: A Guide” ACM, 2018.

CS25C13	Database Management Systems	L	T	P	C
		3	0	4	5

Course objectives: This course provides a comprehensive **foundation in** database system concepts, including architecture, data modeling, and query languages. The course discusses the concepts of transaction management, concurrency control and query optimization.

DBMS and Data Modeling: Purpose- architecture and types of DBMS-Data models: traditional, hierarchical, network, relational, object-oriented-DBMS architecture-Database users and languages (DDL, DML, DCL) – basic SQL queries

Practicals

- Installation and configuration of open-source DBMS
- Creation of databases and SQL operations

Data Modeling and Relational Design: Entity Types, Entity Sets-Attributes-Keys: Candidate, Primary, Foreign-Relationship Types & Roles - Constraints: Participation, Degree-Weak Entities & Keys - Converting ER Diagrams to Relations-Handling M:N relationships, ISA hierarchies-EER Extensions: Specialization/Generalization

Practicals

- Creation of ER Model for a real world scenario using Draw.io and Lucidchart
- Convertion of ER Diagram to Relational Schema

SQL Commands : Primary key, foreign key, unique, not null, check, IN operator, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-Queries: Use of group by, having, order by,join and its types, Exist, Any, All, view and its types. Transaction control commands

Practicals

- Creation of sample database and perform CRUD operations
- Combining data from multiple tables and perform complex data retrieval.

Database Design and Normalization : Functional dependencies-Normal forms: 1NF,2NF,3NF,4NF, BCNF-Decomposition, lossless joins-Impact of normalization on schema.

Practicals

- Identification of functional dependency, entities and attributes
- Implementation of the schema in SQL tool and populate with sample data.

Transactions, Concurrency and Recovery : ACID Properties-Transaction States (active, committed, aborted)-System and User Transactions **-** Serializability-Locking Protocols (2PL), Timestamp Ordering, Deadlocks-Isolation Levels - Log-Based Recovery: Write-Ahead Logging-Checkpoints-ARIES-Shadow Paging.

Practicals

- ACID properties (e.g., missing commit, unhandled rollback).
- Simulation of transaction in SQL

Query Processing and Indexing : Parsing, Validation, Query Trees-Query Execution Plans - Cost Estimation-Physical Plan Strategies-Heuristics and Cost-Based Optimization - Disk Storage, RAID-File Organization- B+-Tree Indexes-Hash-Based Indexing: Static & Dynamic-NoSQL

Practicals

- Query Optimization Simulation Using Query Trees
- Analyze and compare execution plans in MySQL/PostgreSQL

Assessment Weightage:

Weightage:	Continuous Assessment: 50% (i). Activities: 10% (ii). Internal Theory Examinations: 30% (iii). Internal Laboratory Examination: 10%	End Semester Theory Examination: 50%

Mandated Activities with marks:

Assignments (30), Quiz (10), Project based learning (25), Flipped Classroom (10), Review of GATE questions (25).

Internal Examinations: TWO tests

References:

1. **Abraham Silberschatz, Henry F. Korth, S. Sudarshan,** *Database System Concepts,* McGraw-Hill Education, **2021**.
2. **Carlos Coronel, Steven Morris,** *Database Systems: Design, Implementation, and Management,* Cengage Learning, **2024**.
3. **RamezElmasri, Shamkant B. Navathe,** *Fundamentals of Database Systems*, Pearson Education, **2015**.

E resources/E materials:

1.Link: https://nptel.ac.in/courses/106105175
2.Link : https://nptel.ac.in/courses/106106095
3.Link: https://ocw.mit.edu/courses/6-5830-database-systems-fall-2010/
4.Link: https://online.stanford.edu/courses/soe-ydatabases0005-databases-relational-databases-and-sql
5.Link :http//university.mongodb.com

CO	Description of CO	PO	PSO
CO1	Describe the fundamental concepts, of database management systems and data models.	--	--
CO2	Analyze database methods to ensure efficient data organization and retrieval.	PO1 (3)	PSO1 (3)
CO3	Evaluate database design approaches in maintaining data integrity	PO3 (2)	PSO2 (2)
CO4	Design database solutions for real-world applications.	PO2 (1)	PSO1 (3)
CO5	Develop the ability to apply emerging topics through continuous self-learning.	PO11(2)	--

EN25C04	English Communication Skills Laboratory–II	L	T	P	C
		0	0	2	1

Course Objectives: The objectives of the course are to build students' advanced communication skills for workplace readiness and develop intercultural competence for effective collaboration in global and virtual teams. Prepare students for competitive exams with focused skill-building and test-oriented practice.

List of Activities

Stage Ready – Impactful Public Speaking .

(i) Simulate a formal event such as an academic conference, convocation, or awards ceremony, where students roles including Master of Ceremonies (MC), Role as a dignitary, and a Commentator

(ii) Visual Prompt Storytelling: Use random images to create spontaneous stories, focusing on plot, setting, and character,

(iii) **Digital Presentation - Record** a short video explaining a project or technical concept, using slides, voiceover, and visual aids (to be uploaded using google classroom or drive link)

Professional and Application-Oriented Writing

(i) Résumé Preparation: Design ATS-friendly résumés tailored to various job descriptions, using action verbs and quantifiable impact. ·

(ii) Design engaging content for poster presentation relevant to their domain.

Receptive Skills in Workplace Communication·

(i) Reading articles related to their domain and discuss in groups

(ii) Visit company websites, make inferences and present in the class

(iii) Listen to recorded mock interviews and take detailed notes. Summaries key points and action items in a professional format and make a presentation.

Intercultural Communication

(i) Assertive vs Aggressive communication

(ii) Role play activities – workplace communication in intercultural/crosscultural contexts

From Campus to Career: Industry Skills and Global Exam Preparation

(i) Participate in HR interviews using AI tools or peer interviewers, responding to behavioural questions using methods like STAR (Situation, Task, Action, Result)

(ii) Practice Verbal Ability in competitive exams like UPSC, SSC, CDS, TNPSC, etc.

Weightage: Continuous Assessment: 60%, End Semester Lab Examinations: 40%.

Internal Assessment Methodology: 1. Oral story telling using visual prompts (30 marks)

2. Poster presentation (40 marks)

3. ATS resume writing (30 marks)

End Semester Assessment:

1. Interview (50 marks)
2. Verbal Ability test (50 marks)

(students must bring the resume but evaluation must be done based on the performance in the interview)

References:

1. Lucas, Stephen, and Paul Stob. The Art of Public Speaking. Thirteenth edition, McGraw- Hill Education, 2020.
2. Abrahams, Matt. Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot. Simon & Schuster, 2023.
3.. Beshara, Tony. Powerful Phrases for Successful Interviews, Rev. ed., McGraw-Hill, 2023.
4. Papalia, Anna. Interviewology: The New Science of Interviewing. Harper Business, 2024.
5. Verbal Ability and Reading Comprehension by Ajay Singh McGraw Hill Education 2020.

E-resources:

1. Purdue OWL – Online Writing Lab (Academic and professional writing help) https://owl.purdue.edu/
2. Canva Resume Builder (Creative, ATS-friendly resume design) https://www.canva.com/resumes/
3. BBC Learning English – Pronunciation https://www.bbc.co.uk/learningenglish/english/features/pronunciation
4. India Bix website

CO	Description of CO	PO	PSO1
CO1	Understand basic industry-related reading materials.	-	-
CO2	Design and present a domain specific poster	PO9(3)	PSO1(2) PSO3(3)
CO3	Deliver effective digital presentations	PO9(3)	PSO2(1)
CO4	Communicate appropriately in intercultural/cross cultural contexts	PO9(3)& PO11(1)	PSO3(3)
CO5	Perform in interviews and competitive exams successfully	PO9(3)	PSO3(1)