NATIONAL INSTITUTE OF ELECTRONICS AND INFORMATION TECHNOLOGY

DEEMED TO BE UNIVERSITY UNDER DISTINCT CATEGORY

(AN AUTONOMOUS INSTITUTION UNDER MINISTRY OF ELECTRONICS & IT, GOVT. OF INDIA)

Curriculum and Syllabi for

B.Tech - Electronics Engineering

(2026-27 Scheme)

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NIELIT

Deemed to be University

Main Campus at Ropar and Constituent Units at Aizawl, Agartala, Aurangabad, Calicut, Gorakhpur, Imphal, Itanagar, Kekri, Kohima, Patna and Srinagar

Vision

To be known globally for value-based education, research, and innovation through academic excellence to serve the needs of industry and society.

Mission

1. Develop a strong foundation on fundamentals of engineering through outcome-based teaching and learning process.
2. Provide opportunities for students to work on real-world issues and develop sustainable ethical solutions.
3. Involve the students in group activities, including those of professional bodies, to develop leadership, entrepreneurship, and good communication skills.

Program Education Objectives

PEO1: Graduates will demonstrate their professional knowledge in their area of specialization and allied fields.
PEO2: Graduates will contribute to research and innovation with the design and development of innovative products using emerging technologies.
PEO3: Graduates will become successful leaders and entrepreneurs through effective project management and contribute towards the growth & development of industry & society.
PEO4: Graduates will be involved in promoting professional and societal activities.

Program Outcomes

PO1: Engineering Knowledge Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis Identify, formulate, review research literature, and analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design and Development of Solutions Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct Investigations of Complex Problems Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern Tools Usage Create, select, and apply appropriate techniques, resources, and modern engineering & IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The Engineer and Society Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and Sustainability Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
PO9: Individual and Teamwork Function effectively as an individual, and as a member of leader in diverse terms, and in multidisciplinary settings.
PO10: Communication Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give & receive clear instructions.
PO11: Project Management and Finance Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long Learning Recognize the need and have the preparation & ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO 1: Apply fundamental concepts of electronics, semiconductor devices, and embedded systems to design and develop electronic circuits and systems.
PSO 2: Analyze, simulate, and implement analog and digital electronic systems using modern tools for applications in communication, automation, and signal processing.
PSO 3: Demonstrate technical competence in areas such as VLSI design, microelectronics, and PCB/system-level integration to meet industry and societal needs.
PSO 4: Engage in lifelong learning, innovation, and ethical engineering practices while contributing to research, entrepreneurship, or higher education in electronics and allied domains.

CATEGORY WISE CREDIT DISTRIBUTION

Category	Category Code	Credits
Audit Courses (without grade or credit)	AU	0
Value Added Courses	VA	9
Professional Elective Courses	PE	20
Open Elective Courses	OE	12
Skill / Employment Enhancement Courses (Project/Internship/Seminar/Dissertation/Research)	EE	31
Ability Enhancement Courses	AE	8
Program Core Courses	PC	88
	Total Credits (Common track)	**168**

EVALUATION AND ASSESSMENT

1. Performance of a student in a semester shall be evaluated through continuous Class assessment, Tutorial/Lab assessment, Mid-Semester Examination (MSE) and End-Semester Examination (ESE). Both the MSE and ESE shall be the University examination and will be conducted as notified by the Controller of Examinations (CoE) of the University.

2. The continuous assessment shall be based on assignments, tutorials, paper presentation / quizzes/ viva-voce / flipped classes, lab work / projects / fieldwork and attendance, etc.

3. The MSE/ESE shall be comprising of written papers.

4. The overall assessment of the students will be done as per the following scheme:

S. No.	Assessment Type	Marks Weightage
1.	Mid Semester Examination	20
2.	End Semester Examination	40
3.	Continuous Assessment - Practical /Lab/ Tutorial	25
4.	Continuous Assessment - Theory	15
	Total	**100**

For more details, please refer the applicable ordinance for this programme and Assessment SOPs.

CURRICULUM

Semester 1						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-101	DASH250038	Engineering Mathematics I	3	1	0	4
PC-BTEELE-102	DASH250042	Engineering Physics	3	0	2	4
AE-BTEELE-103	DASH250016	Communication Skills	1	0	2	2
EE-BTEELE-104	DCSE250039	Programming Fundamentals	2	0	4	4
PC-BTEELE-105	DOEE250033	Basic Electrical & Electronics Engineering	2	1	2	4
OE-BTEELE-106	Elective	Open Elective				4

Semester 2						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-201	DASH250039	Engineering Mathematics II	3	1	0	4
PC-BTEELE-202	DOEE250059	Digital Electronics	3	0	2	4
EE-BTEELE-203	DCSA250016	Computer Aided Graphics Design	1	1	4	4
PE-BTEELE-204	Elective	Program Elective				4
OE-BTEELE-205	Elective	Open Elective				4
VA-BTEELE-206	DASH250030	Economics for Engineers	1	1	0	2

Semester 3						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-301	DASH250040	Engineering Mathematics III	3	1	0	4
PC-BTEELE-302	DOEE250128	Linear Electrical Networks	2	2	0	4
EE-BTEELE-303	DOEE250080	Electronic Measurements and Instrumentation	2	0	4	4
PC-BTEELE-304	DOEE250078	Electronic Devices and Circuits	3	0	2	4
OE-BTEELE-305	Elective	Open Elective				4
AU-BTEELE-306	Elective	Audit Elective				0

Semester 4						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-401	DOEE250050	Control System Engineering	3	1	0	4
PC-BTEELE-402	DOEE250147	Microprocessors and Microcontrollers	2	1	2	4
PC-BTEELE-403	DOEE250183	Signals and Systems	2	1	2	4
PC-BTEELE-404	DOEE250012	Analog Electronics	2	1	2	4
PE-BTEELE-405	Elective	Program Elective				4
VA-BTEELE-406	DASH250101	Sports and Yoga	0	0	4	2
VA-BTEELE-407	DASH250105	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	3	0	0	3

Semester 5						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-501	DOEE250076	Electromagnetics and Field Theory	3	1	0	4
PC-BTEELE-502	DOEE250130	Linear Integrated Circuits	2	1	2	4
PC-BTEELE-503	DOEE250044	Computer Organization and Architecture	3	0	2	4
PC-BTEELE-504	DOEE250065	Digital Signal Processing	3	0	2	4
EE-BTEELE-505	EE	Industrial Internship				4
AE-BTEELE-506	DASH250026	Design Thinking	1	0	2	2

Semester 6						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-601	DOEE250011	Analog Communication	2	1	2	4
VA-BTEELE-602	DASH250021	Computational Ecosystem	2	0	0	2
PE-BTEELE-603	Elective	Program Elective				4
AE-BTEELE-604	DASH250049	Entrepreneurial Development and Innovation	1	1	0	2
PE-BTEELE-605	Elective	Program Elective				4
AE-BTEELE-606	DASH250104	Technical Presentation and Report Writing	0	0	4	2
PC-BTEELE-607	DOEE250199	VLSI Design	2	1	2	4

Semester 7						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
PC-BTEELE-701	DOEE250057	Digital Communication Systems	3	0	2	4
PC-BTEELE-702	DOEE250189	Testing of VLSI Circuits	3	0	2	4
PC-BTEELE-703	DOEE250082	Electronic Product Design using EDA Tools	2	1	2	4
EE-BTEELE-704	EE	Dissertation Phase I				3
PE-BTEELE-705	Elective	Program Elective				4
PC-BTEELE-706	DOEE250095	Embedded Systems and Internet of Things	2	1	2	4

Semester 8						
Semester Code	**Course Code**	**Course Title**	**L**	**T**	**P**	**Cr**
EE-BTEELE-801	EE	Dissertation Phase II				12

Elective Courses

Elective Courses for PE Category						
Course Code	**Course Title**	**L**	**T**	**P**	**Cr**	**For Sem./Code**
DOAI260001	AI (Industry)-Applied Ethics for AI	3	0	2	4	
DOAI260002	AI (Industry)-Introduction to Artificial Intelligence	3	0	2	4	
DOAI260003	AI (Industry)-Introduction to Generative AI	3	0	2	4	
DOAI260004	AI (Industry)-Introduction to Machine Learning	3	0	2	4	
DCSA250057	Object Oriented Programming using C++	3	0	2	4	204
DCSE250113	Programming in Python	2	0	4	4	204
DCSE250056	Data Structures and Algorithms	3	0	2	4	405
DCSE250060	Database Management Systems	2	0	4	4	405
DCSE250037	Computer Networks and Security	3	0	2	4	603
DOEE250159	Power Electronics	3	0	2	4	603
DOEE250157	PCB Designing	3	0	2	4	605
DOEE250190	Transmission Lines and PCB Technology	2	0	4	4	605
DOAI250005	Artificial Intelligence and Machine Learning	2	0	4	4	705
DOAI250043	Pattern Recognition	3	0	2	4	705
DOAI260041	Natural Language Processing	2	0	4	4	705

Elective Courses for OE Category
Students may opt courses under MOOC, NPTEL, SWAYAM, NSQF/NCVET aligned courses or other relevant technical subjects not included in their core curriculum. The exercise of option shall be subject to the Course Schedule of the respective Constituent Unit, the credit requirements and availability of seats. Guidelines for choosing MOOC/Online courses are given separately and shall have to be adhered to.

Elective Courses for AU (Audit) Category					
Course Code	**Course Title**	**L**	**T**	**P**	**Cr**
DASH240027	Disaster Management	2	0	0	0
DASH240047	English for Research Paper Writing	2	0	0	0
DASH240052	Environmental Science	3	0	0	0
DASH240085	Pedagogy Studies	2	0	0	0
DASH240086	Personality Development through Life Enlightenment Skills	2	0	0	0
DASH240097	Sanskrit for Technical Knowledge	2	0	0	0
DASH240103	Stress Management by Yoga	2	0	0	0
DASH240104	Technical Presentation and Report Writing	0	0	2	0
DASH240106	Value Education	2	0	0	0
DASH240124	Constitution of India - AU	2	0	0	0
DASH250023	Constitution of India	2	1	0	0
DASH250027	Disaster Management	3	0	0	0
DASH250034	Energy and Environmental Engineering	3	0	0	0

DASH250047	English for Research Paper Writing	2	0	0	0
DASH250054	Essence of Indian Knowledge and Tradition	2	0	0	0
DASH250085	Pedagogy Studies	2	0	0	0
DASH250086	Personality Development	2	0	0	0
DASH250097	Sanskrit for Technical Knowledge	3	0	0	0
DASH250103	Stress Management by Yoga	3	0	0	0
DASH250106	Value Education	2	0	0	0
DASH250117	Innovative Thinking and Entrepreneurship Skills	1	0	0	0
DASH250118	Intellectual Property Rights	2	0	0	0
DCSA240080	Training on Computer Networking	0	0	2	0
DCSA240304	Lab Based on Statistical Package	0	0	2	0
Any other Scheduled Course as per the Course Schedule of the respective Constituent Unit can also be chosen, subject to availability of seats. However, there shall be no assessment and grading for the course chosen as Audit Course.					

The choice of all type of Electives available shall be as per the Course Schedule of the respective Constituent Unit.

Guidelines for Massive Open Online Courses (MOOC) / approved Online Courses

1. Relevant Swayam, MOOC, NPTEL, NIELIT NSQF and any other online courses approved by UGC/AICTE shall also be allowed as Open Electives(OE).

2. One credit of MOOC course should be minimum of 30 hours.

3. A student can choose any approved online course as Open Elective, subject to minimum credit requirements.

4. The students willing to opt OE under MOOC in their next semester, will submit their request to the MOOC Coordinator at their respective campus.

5. Once approved, the campus shall display the list of accepted courses.

6. The student has to submit certificate issued by the institution offering the MOOCs course, along with the number of credits and grades, to get credits transferred into his/her marks certificate issued by NDU.

7. The transfer of credits shall be as adopted by NDU.

Detailed Syllabus

Course Code	Course Name	L	T	P	Cr
DASH250038	Engineering Mathematics I	3	1	0	4

Course Outcomes:

CO1 : Apply matrix operations to solve systems of linear equations, find eigenvalues/eigenvectors, and use the Cayley-Hamilton theorem.
CO2 : Analyze functions of a single variable for limit, continuity and differentiability, Mean value theorems, definite integrals in engineering applications such as areas and volumes.
CO3 : Solve first and second-order ordinary differential equations, including linear, exact, and simultaneous forms, and interpret their geometric and analytical solutions.
CO4 : Differentiate multivariable functions, use Euler's theorem, Jacobians, and Taylor series, and solve problems involving maxima and minima of functions of two variables.
CO5 : Evaluate double and triple integrals in different coordinate systems and apply them to compute areas and volumes, including changing the order of integration when required.

Module 1:

Matrices (9 hrs)
Rank of a matrix, Consistency of a system of linear equations, Characteristic equation of a matrix, Eigen values and Eigen vectors, Cayley-Hamilton theorem (excluding proof), Verification, Application (Finding Inverse of a matrix), Diagonalization of a matrix by orthogonal transformation.

Module 2:

Differential Calculus and Applications (9 hrs)
Limit, Continuity and differentiability of a function of single variable, Rolle's theorem, Lagrange's theorem, and Cauchy's mean value theorem (Statements and simple applications), Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves in Cartesian coordinates.

Module 3:

Differential Equations (7 hrs)
Ordinary Differential Equations (ODE): First order differential equations, Exact differential equations and integrating factor, Linear differential equations of first and second order, Simultaneous linear differential equations by elimination method.

Module 4:

Multivariable Calculus (Partial Differentiation and Applications) (11 hrs)
Partial differentiation, Partial derivatives of first, second and third order, Partial differentiation of implicit functions, Euler's theorem, Total derivative, Jacobian and its Properties, Applications: Maxima and minima of functions of two variables.

Module 5:

Multivariate Calculus (Multiple Integrals) (9 hrs)
Double integral (Cartesian, polar form), Application of double integral: Area by double integration, Change of Order of Integration. Triple Integral in Cartesian coordinate only, Application of triple integral: Volume by triple integration.

Labs / Practicals:

N/A

References:

1. Grewal, B. S. Higher Engineering Mathematics (43rd ed.). Khanna Publishers.
2. Bali, N. P., & Goyal, M. A Text Book of Engineering Mathematics. Laxmi Publications (P) Ltd.
3. Kreyszig, E. Advanced Engineering Mathematics (9th ed.). John Wiley & Sons.
4. Ramana, B. V. Higher Engineering Mathematics. Tata McGraw-Hill.
5. Jeffery, A. Advanced Engineering Mathematics. Academic Press.

Course Code	Course Name	L	T	P	Cr
DASH250042	Engineering Physics	3	0	2	4

Course Outcomes:

CO1: Understand the phenomenon of interference in thin films and diffraction by slits
CO2: Understand the principle behind the working of LASERS and Optical Fibers
CO3: Understand concept of quantum mechanics and one-dimensional motion of particle
CO4: Understand various properties of semiconductor, superconductor and nanomaterial
CO5: Understand electric and magnetic field behavior and drive Maxwell equations

Module 1:

Wave Optics:
Concept of interference, Interference in thin films (reflected light)-Newton's Rings and Michelson's Interferometer, Application as wavelength measurement. Concept of Diffraction, Single slit Fraunhofer Diffraction, Diffraction Grating and Spectrum, Determination of Wavelength, Application of Grating as wavelength splitter.

Module 2:

Lasers & Optical Fibers:
Laser: Einstein's Theory of laser action, Einstein's coefficients, population inversion and lasing action, Properties of Laser beam, Construction and working of He-Ne and semiconductor lasers, Applications of Lasers in Science and engineering. Optical Fiber: Structure, Types, Features, Light guiding mechanism, Acceptance angle and Numerical Aperture.

Module 3:

Quantum Mechanics:
Concepts and Experiments that led to the discovery of Quantum Nature. Heisenberg uncertainty principle, Wave function and basic postulate of wave mechanics, Schrodinger time independent and time dependent wave equations, Physical interpretation of wave function and properties. The free particle problem - Particle in 1-dimensional and 3-dimensional boxes, Concept of Quantum mechanical tunneling.

Module 4:

Physics of Advanced Materials:
Types of semiconductors, Conductivity in semiconductors,
Energy Band Gap, Hall Effect: Theory and applications, Superconductors: Properties, Meissner effect, Type I & II superconductors, Applications of superconductors, Nanomaterials: Significance of nanoscale, Properties of nanomaterials, Basics of Synthesis of nanomaterials: top-down and bottom-up approach, Applications of nanomaterials, X-ray Diffraction.

Module 5:

Introduction to Electromagnetism:
Gradient, divergence and curl and their physical significance, Divergence and Curl of electrostatic and static Magnetic Fields, Faraday's law, equation of continuity, Displacement current, Maxwell's equations, Electromagnetic wave propagation in free space Flow of energy and Poynting vector.

Labs / Practicals:

1. To study the formation of Newton's rings and determine the wavelength of light (Sodium lamp/LASER).
2. To determine the wavelength of light (Sodium lamp/LASER) with the help of Michelson interferometer.
3. To determine the wavelength of prominent lines of light (mercury) by using plane transmission diffraction grating.
4. To determine specific rotation of sugar using half shade/ biquartz polarimeter.
5. To determine the dispersive power of material of a prism with the help of spectrometer.
6. To determine the height of given object with the help of sextant.

7 To determination of band gap of semiconductor using a P-N junction diode.
8. To study the Hall Effect and determination of hall coefficient and charge carrier concentration.
9. To measure the numerical aperture of an optical fiber.
10. To determine the coherence length and coherence time of laser using He -Ne laser.
11. To study the charge and discharge of a condenser and hence determine the time constant.
12. To determination of resonating frequency and bandwidth by LCR circuit.
13. To study the B-H/I-H curve and hysteresis losses in a given magnetic material.

References:

1. Halliday, Resnic and Walker, "Fundamentals of Physics", Publisher: John Wiley.
2 Beiser A, "Concepts of Modern Physics", Publisher: McGraw Hill International.
3 Ajoy Ghatak, "Optics", Publisher: Tata McGraw Hill.
4 S. O. Pillai, "Solid State Physics", Publisher: New Age Publishers.
5 A. Ghatak, K. Thyagarajan, "Introduction To Fiber Optics", Publisher: Cambridge University Press.
6 W.T Silfvast, "Laser Fundamentals", Publisher: Cambridge University Press.
7 R. Shankar, "Fundamentals of Physics", Publisher: Yale University Press, New Haven and London.
8 R. Shankar, Fundamentals of Physics II", Publisher: Yale University Press, New Haven and London.
9 David J. Griffiths, "Introduction to Electrodynamics", Publisher: Cambridge University Press.
10 K. K. Chattopadhyay and A. N. Banerjee, "Introduction to Nanoscience and Nanotechnology", Publisher: PHI Learning Pvt. Limited.
11 T. Pradeep, "NANO: The Essentials, understanding Nano science and Nanotechnology", Publisher: Tata McGraw-Hill Publishing Company Limited.

Course Code	Course Name	L	T	P	Cr
DASH250016	Communication Skills	1	0	2	2

Course Outcomes:

CO1 : Understand the need and importance of English language.
CO2 : Develop proficiency in the language.
CO3 : Able to use technology to enrich communication skills.
CO4 : Gain self-confidence with improved command over English.
CO5 : Apply English communication skills effectively in academic, professional, and social environments.

Module 1:

Communication Fundamentals
Communication ;Meaning, Process and importance of Communication, Types and Channels of communications , Scope and Significance of Listening ,Speaking, Reading, Writing Skills.

Module 2:

Writing Skills
Basics of Grammar: Parts of Speech, Uses of Tenses, Active Passive, Narration.

Module 3:

Vocabulary Building
Word Formation, Synonyms , Antonyms, Words often Confused, One Word Substitutes, Idioms and Phrasal verbs, Abbreviations of Scientific and Technical Words.

Module 4:

Speaking Skills
Introduction to Phonetic Sounds & Articulation, Word Accent, Rhythm and Intonation, Interpersonal Communication, Oral Presentation, Body Language and Voice Modulation (Para linguistics and Non Verbal), Negotiation and Persuasion, Group Discussion, Interview Techniques (Telephonic and Video conferencing).

Module 5:

Technical Writing
Job application, CV writing, Business Letters, Notices, Report Writing, Minutes, E-mail Etiquette, Blog Writing.

Labs / Practicals:

1. Introducing Oneself, Exercise on Parts of Speech & Exercise on Tense.
2. Exercise on Agreement, Narration, Active Passive Voice & Dialogue Conversation.
3. Exercise on Writing Skills and Listening Comprehension.
4. Practice of Phonemes, Word Accent, Intonation, JAM Session.
5. Individual Presentation, Extempore and Picture Interpretation.
6. Vocabulary Building Exercises (One Word Substitute, Synonyms, Antonyms, Words Often Confused etc.) & Group Discussion.

References:

1. "The Essence of Effective Communication", Ludlow R. and Panton F., Pubs: Prentice Hall.
2. “Effective Communication Skills”, Kulbhushan Kumar, Khanna Publishing House.
3. “A University Grammar of English”, Quirk R. and Sidney G., Pubs: Pearson Education.
4. “High School English Grammar”, Wren and Martin, Pubs: S. Chand & Company Ltd.
5. “Essentials of Business Communication”, Guffrey M.E., Pubs: South-Western College Publishing.
6. “Technical Communication: Principles and Practice”, Raman M. and Sharma S., Pubs: Oxford University Press.
7. “Effective Business Communication”, Rodrigues M.V., Pubs: Concept Publishing Company, Delhi.

8. “English Vocabulary in Use”, McCarthy M. and Felicity O’ Dell.

Course Code	Course Name	L	T	P	Cr
DCSE250039	Programming Fundamentals	2	0	4	4

Course Outcomes:

CO1: Remember the syntax and basic operators in C language and its descendants.

CO2: Understand how to represent algorithms using flowcharts and pseudo-codes.

CO3: Apply well-known fundamental programming techniques for problem solving.

CO4: Analyze programming bugs through testing, stack traces, and core dumps.

CO5: Evaluate the outcomes of programs manually with dry runs and trace tables.

CO6: Create bug-free and efficient programming solutions for real-world problems.

Module 1:

Fundamentals of programming, program vs algorithm, implementing algorithms.
Language-independent algorithm representation using flowcharts and pseudo-codes.
Functionality vs implementation, usage of right abstractions, code documentation.
Runtime error vs logical bug, black box vs white box testing, debugging techniques.

Module 2:

Components of a program: constants, identifiers, operators, keywords, comments.
Editor vs compiler, compilation vs interpretation, basic I/O using printf and scanf.
Variable declaration vs definition, initialization, assignment, type promotion rules.
Arithmetic, relational, logical, bitwise operators, arity, precedence and associativity.

Module 3:

Sequential control flow, expression, statement, block, identifier scope, object lifetime.
Conditional operator, selection statements: if, else, switch; nested conditions.
Iteration blocks: for, while, do-while; loop invariants, nested loops, Duff's device.
Labels, jump statements: break, continue, goto; structured programming.

Module 4:

Function declaration vs definition, parameter vs argument, call by value, void type.
Local vs external variables, static variables, recursion, tail call, inline definition.
Arrays, random access, string, array vs pointer, array of array, variable-length array.
Enums, structures, bit-fields, padding, unions, compound literals, incomplete types.

Module 5:

Stack and heap layout, dynamic memory allocation, dangling pointer, memory leak.
Headers, preprocessing directives, multiple source files, internal vs external linkage.
Command-line arguments, C standard library, file I/O, buffering, signal handling.
Portability issues, undefined behavior, buffer overflow and other vulnerabilities.

Labs / Practicals:

All programming solutions should conform to ISO C99 standard (or later revisions).

01. Test the precedence and associativity of arithmetic operators in C: *, /, %, +, -.

02. Test the outcomes of relational and equality operators in C.

03. Test the short-circuit evaluation of && and || using function calls as operands.

04. Test the bitwise operators in C with unsigned and signed types: left shift, right shift, &, ^, |.

05. Convert from metric prefix (KB/MB/GB/TB) to binary prefix (KiB/MiB/GiB/TiB).

06. Use if-else-if ladder to print the grade as per the score obtained in a subject.

07. Find the mean, median, mode, variance, and standard deviation for a list of scores.

08. Print values using additive/subtractive rules of roman numerals: I, V, X, L, C, D, M.

09. Use nested loops to generate asymmetric and symmetric patterns of arbitrary size.

10. Check whether a given string is a palindrome (or not) without reversing the string.

11. Write a function to check whether an array of integers is already sorted (or not).

12. Write a function for primality testing, and use it to find first n pairs of twin primes.

13. Write a function to generate the Collatz sequence (up to 1) for a positive integer.

14. Generate the terms of Fibonacci sequence using iterative and recursive approaches.

15. Print optimal sequence of moves for a given instance of “Towers of Hanoi” puzzle.

16. Find all combinations to make a given payment from a limited set of coin types.

17. Find vowel count in a string using a lookup table for case-insensitive vowel check.

18. Write a function to check whether a string is a valid email ID (or not).

19. Use case-insensitive and dot-insensitive matching to check if two email IDs are same.

20. Display a countdown timer in HH:MM:SS format using carriage return ("\r").

21. Get current time and find clockwise angles of hour hand, minute hand, second hand.

22. Find the day of week for any date in Gregorian calendar using doomsday algorithm.

23. Populate an array with student details and write the attributes in a new CSV file.

24. Sort an array of student details as per roll number using qsort from stdlib.h .

25. Use bsearch from stdlib.h to fetch student details from an array sorted by roll.

References:

1. "Computer Science I" by Chris Bourke
https://cse.unl.edu/~cbourke/ComputerScienceOne.pdf

2. "How to Think Like a Computer Scientist (C Version)" by Thomas Scheffler and Allen Benjamin Downey
https://github.com/tscheffl/ThinkC/raw/master/PDF/Think-C.pdf

3. "Foundations of Computer Science (C Edition)" by Alfred Vaino Aho and Jeffrey David Ullman
http://infolab.stanford.edu/~ullman/focs.html

4. "The C Programming Language (Second Edition)" by Brian Wilson Kernighan and Dennis MacAlistair Ritchie
https://www.oreilly.com/library/view/c-programming-language/9780133086249

5. "C Programming: A Modern Approach (Second Edition)" by Kim N. King
http://knking.com/books/c2

6. "Modern C (Third Edition)" by Jens Gustedt
https://inria.hal.science/hal-02383654v2/file/modernC.pdf

7. "The C Book (Second Edition)" by Mike Banahan, Declan Brady, and Mark Doran
https://publications.gbdirect.co.uk/c_book

8. "Beej's Guide to C Programming" by Brian Hall
https://beej.us/guide/bgc/pdf/bgc_a4_c_2.pdf

Course Code	Course Name	L	T	P	Cr
DOEE250033	Basic Electrical & Electronics Engineering	2	1	2	4

Course Outcomes:

CO1: Analyze basic DC and AC electrical circuits using Ohm's Law, Kirchhoff's Laws, and network theorems.
CO2: Understand and explain power generation methods, transmission, and distribution, and describe the components of an electrical power system.
CO3: Identify and describe the construction and working principles of transformers, DC machines, and induction motors.
CO4: Analyze semiconductor devices like diodes, BJTs, and their applications in rectifiers, clippers, and amplifiers.
CO5: Explain the structure and operation of MOSFETs and CMOS logic circuits and their use in embedded and VLSI systems.

Module 1:

Introduction to Electrical Systems and DC Circuits
Basic concepts of electric current, voltage, power, and energy. Ohm's Law, Kirchhoff's Laws (KCL and KVL). Series and parallel circuits. Mesh and nodal analysis. Star-delta transformations. Energy sources: ideal and practical voltage and current sources.
Introduction to Power Generation and Distribution: Elementary idea of generation methods (thermal, hydro, solar, nuclear), transmission and distribution of electrical power; structure of power system; role of substations and transformers.

Module 2:

AC Circuits and Measurement
Sinusoidal voltage and current: amplitude, frequency, phase, time period. RMS and average values, form factor, peak factor. Phasor representation of sinusoidal quantities. AC analysis of pure R, L, and C components. RLC series and parallel circuits. Power in AC circuits: real, reactive, and apparent power. Power factor and its significance. Basics of three-phase systems.
Basic measuring instruments: voltmeter, ammeter, wattmeter, and energy meter.

Module 3:

Electrical Machines and Domestic Wiring
Magnetic circuits and electromagnetic induction. Transformers: principle, construction, EMF equation, efficiency, and applications. DC Machines: construction, types (motor/generator), working principle and applications. Three-phase induction motors: construction and working.
Basic concepts of domestic wiring: types of wiring, star case wiring, fuses, circuit breakers, earthing.

Module 4:

Semiconductor Devices and Applications
Semiconductors: intrinsic and extrinsic types. PN junction diode: V-I characteristics, rectifiers (half-wave and full-wave), clippers and clampers. Zener diode: breakdown and voltage regulation. BJT: construction, input-output characteristics in CE mode, application as a switch and amplifier. Basic introduction to optoelectronic devices (LED, photodiode).

Module 5:

MOSFET and CMOS Technology
MOSFET: structure, operation of nMOS and pMOS, output and transfer characteristics.

MOSFET as a switch and amplifier. CMOS logic: complementary MOS operation, CMOS inverter, static and dynamic behavior. Advantages of CMOS technology: low power, high noise margin, scalability. Applications of MOSFETs and CMOS in logic circuits, embedded systems, and VLSI design.

Labs / Practicals:

Electrical Engineering Experiments

1. Verification of Ohm's Law and Kirchhoff's Laws (KVL & KCL)
   - o Study linear resistive networks and validate current-voltage relationships.
2. Measurement of Power and Power Factor in a Single-Phase AC Circuit
   - o Calculate real, reactive, and apparent power using wattmeters and determine power factor.
3. Series and Parallel RLC Circuit Analysis
   - o Observe resonance and calculate impedance, current, and phase angle.
4. Load Test on Single-Phase Transformer
   - o Measure efficiency and voltage regulation under different loads.
5. Speed Control and Operation of a DC Motor
   - o Study working, direction control, and variation of speed with field/armature voltage.
6. Star Case Wiring and Testing of Light/Fan Circuit
   - • Perform practical wiring of a basic domestic setup using star configuration; verify connections and functionality.

Electronics Engineering Experiments

7. V-I Characteristics of PN Junction Diode
   - o Plot forward and reverse bias curves; identify cut-in and breakdown voltages.
8. Half-Wave and Full-Wave Rectifier with and without Filter
   - o Measure output DC voltage, ripple factor, and waveform using CRO.
9. Zener Diode as Voltage Regulator
   - o Test voltage regulation with varying load and input voltage.
10. Input and Output Characteristics of BJT in CE Configuration
    - o Measure current gain (β) and plot characteristics for amplification.
11. MOSFET Characteristics and CMOS Inverter Operation

References:

1. V.K. Mehta, Rohit Mehta – Principles of Electrical Engineering and Electronics, S. Chand Publishing
2. D.P. Kothari, I.J. Nagrath – Basic Electrical and Electronics Engineering, McGraw-Hill Education
3. M.S. Sukhija, T.K. Nagsarkar – Basic Electrical and Electronics Engineering, Oxford University Press

Course Code	Course Name	L	T	P	Cr
DASH250039	Engineering Mathematics II	3	1	0	4

Course Outcomes:

CO1 : Analyze the behavior of sequences and series using convergence tests and apply them in evaluating infinite processes.
CO2 : Construct Fourier series representations of periodic functions and apply them in engineering and data modeling contexts.
CO3 : Compute Laplace transforms of various functions including step and impulse functions, and use them for solving engineering problems.
CO4 : Perform inverse Laplace transforms and use them effectively to solve initial value problems in engineering models.
CO5 : Use Fourier transforms and their properties to switch between time and frequency domains, aiding AI applications such as image/signal processing and neural network optimization.

Module 1:

Sequences and Series (9 hrs)
Limit of a sequence, monotone and Cauchy sequences, properties of convergent sequences, examples. Infinite series, positive series, tests for convergence and divergence, integral test, alternating series, Leibnitz test.

Module 2:

Fourier Series (9 hrs)
Fourier Series of Periodic functions (Euler’s Formulas and Dirichlet’s conditions), Even and odd function expansions (Half range sine cosine series), Fourier series over arbitrary intervals (Change of interval techniques).

Module 3:

Laplace Transformation (7 hrs)
Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by ‘t’, Laplace transforms of derivatives (First and second derivative) of functions, Laplace Transformation of integral of functions, Evaluation of integrals by Laplace transforms.

Module 4:

Inverse Laplace Transformation and Applications (11 hrs)
Inverse Laplace transform by partial fractions and shifting theorem, convolution theorem (without proof). Applications: solving Initial value problems of first order by Laplace Transform method.

Module 5:

Fourier Transformation (9 hrs)
Introduction to Fourier Transform, Properties- Linearity, Time and frequency shifting property (1st and 2nd shifting theorem), Differentiation and integration in time domain and their transforms, Fourier Integral theorem (statement only), Fourier transform and its inverse, Convolution theorem (Statement and applications).

Labs / Practicals:

N/A

References:

1. Bali, N. P., & Goyal, M. A Text Book of Engineering Mathematics. Laxmi Publications (P) Ltd.
2. Kreyszig, E. Advanced Engineering Mathematics (9th ed.). John Wiley & Sons, New Delhi.
3. Ramana, B. V. Higher Engineering Mathematics. Tata McGraw-Hill, New Delhi.
4. Grewal, B. S. Higher Engineering Mathematics. Khanna Publishers, New Delhi.
5. H.K. Dass, Advanced Engineering Mathematics. S. Chand & Company Pvt. Ltd., New Delhi.
6. Jain, R. K., & Iyengar, S. R. K. Advanced Engineering Mathematics. Narosa Publishing House, New Delhi.
7. Dass, H. K., & Verma, R. Engineering Mathematics. S. Chand & Company Pvt. Ltd., New Delhi.
8. Pundir, R. S., & Pundir, S. Engineering Mathematics. Laxmi Publications (P) Ltd.
9. Ghosh, S. C. Engineering Mathematics. PHI Learning Pvt. Ltd.
10. Gupta, C. S., & Malik, A. Mathematical Analysis and Applications. Wiley Eastern / Narosa Publishing House

Course Code	Course Name	L	T	P	Cr
DOEE250059	Digital Electronics	3	0	2	4

Course Outcomes:

CO1: Perform conversions between number systems and design logic functions using basic and universal gates.
CO2: Simplify Boolean expressions using Karnaugh Maps and Boolean algebra for circuit minimization.
CO3: Design and analyze combinational logic circuits like adders, subtractors, multiplexers, and decoders.
CO4: Understand and implement sequential circuits such as flip-flops, counters, and shift registers.
CO5: Understand the architecture and applications of memory units and programmable logic devices.

Module 1:

Number System and Logic Gates: Representation and interconversion among binary, octal, decimal, and hexadecimal number systems, Binary arithmetic operations: addition, subtraction, multiplication, and division, Binary Coded Decimal (BCD), Excess-3, and Gray codes, Signed and unsigned binary number representation,1's and 2's complement techniques for binary subtraction, Code conversions: Binary to BCD, Excess-3, and Gray codes, and vice versa, Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Universal gates and implementation of basic logic functions using universal gates.

Module 2:

Boolean Algebra and Logic Simplification: Boolean laws and theorems, DeMorgan’s theorems, SOP and POS forms, Canonical forms, Karnaugh Map (2, 3, 4 variables) – minterms and maxterms, Quine-McCluskey method (basic idea), Logic expression simplification and gate minimization.

Module 3:

Combinational Logic Circuits: Adders: Half adder, full adder, ripple carry adder, carry look-ahead adder, Subtractors: Half and full subtractors, Comparators, Multiplexers (MUX) and De-multiplexers (DEMUX) Encoders and Decoders, BCD to 7-segment decoder, Design of combinational logic using MUX, DEMUX.

Module 4:

Sequential Logic Circuits: Latches and Flip-flops: SR, D, T, JK, Master-Slave, Characteristic tables and excitation tables, Edge and level triggering, Timing diagrams, Counters: Asynchronous (ripple) and Synchronous counters, Up/down counters, modulo-N counters, Shift registers: SISO, SIPO, PISO, PIPO, Ring counter and Johnson counter, Mealy and Moore Finite State Machines (FSMs).

Module 5:

Memory & Logic Families: Classification of memories: RAM, ROM, PROM, EPROM, EEPROM, Memory decoding and address space, Overview of programmable logic devices: PLA, PAL, CPLD, FPGA (introductory), Logic families: TTL, CMOS. Characteristics: propagation delay, power dissipation, noise margin, fan-out, fan-in.

Labs / Practicals:

1. Verification of Logic Gates: Implement and verify the truth tables of AND, OR, NOT, NAND, NOR, XOR, and XNOR gates.
2. Universal Gates Implementation: Realize basic logic functions using only NAND or NOR gates.
3. Boolean Expression Simplification: Simplify given Boolean expressions and implement the minimized circuits using logic gates.
4. Design of Half Adder and Full Adder: Construct and test circuits for half and full adders using logic gates.
5. Design of Half Subtractor and Full Subtractor: Implement and verify half and full subtractor circuits.
6. Multiplexer and Demultiplexer: Design and test 4:1 MUX and 1:4 DEMUX circuits.
7. Flip-Flop Implementations: Implement and observe SR, D, T, and JK flip-flops using basic gates or ICs.
8. Counters: Design and test asynchronous and synchronous up/down counters (e.g., mod-8, mod-10).
9. Shift Registers: Construct and analyze SIPO, SISO, PIPO, and PISO shift registers.

10. BCD to 7-Segment Display: Design a decoder to display BCD inputs on a 7-segment LED display.

References:

1. M. Morris Mano, Michael D. Ciletti – Digital Design, Pearson Education
2. R.P. Jain – Modern Digital Electronics, McGraw-Hill Education
3. Thomas L. Floyd – Digital Fundamentals, Pearson Education
4. John F. Wakerly – Digital Design: Principles and Practices, Pearson
5. Tokheim – Digital Electronics: Principles and Applications, McGraw-Hill Education

Course Code	Course Name	L	T	P	Cr
DCSA250016	Computer Aided Graphics Design	1	1	4	4

Course Outcomes:

CO1: Understand the fundamental principles of computer graphics and graphic design.
CO2: Apply transformations, projections, and rendering techniques for 2D and 3D modeling.
CO3: Develop proficiency in using CAD and vector graphic design tools for technical drawings and creative graphics.
CO4: Demonstrate the ability to perform digital editing, modeling, and visualization using software like AutoCAD, Adobe Illustrator, or Blender.
CO5: Create complete design projects from concept to digital representation, including rendering and documentation.

Module 1:

Basics of Computer Graphics: Introduction to Computer Graphics, Applications of Graphics in Design, Pixel and Resolution Concepts, Raster vs Vector Graphics, Coordinate Systems, Line and Circle Drawing Algorithms (DDA, Bresenham).

Module 2:

2D Transformations and Viewing: Basic 2D Transformations: Translation, Rotation, Scaling, Reflection, Shearing. Homogeneous Coordinates, Matrix Representation of Transformations, Composite Transformations. Windowing and Clipping Techniques: Cohen–Sutherland, Liang–Barsky.

Module 3:

3D Graphics and Modeling: 3D Coordinate Systems, 3D Transformations, Projection Techniques (Perspective and Parallel), Hidden Surface Removal, Basics of 3D Modeling and Visualization, Introduction to 3D Modeling Tools (e.g., Blender/AutoCAD).

Module 4:

Graphic Design Tools and Techniques: Introduction to Design Software: Adobe Illustrator/CorelDRAW/Inkscape. Vector Graphics Tools: Pen, Shape, Path Editing. Typography, Colors, Layers, and Effects. Designing Logos, Brochures, and Posters.

Module 5:

CAD and Real-World Applications: Introduction to AutoCAD or Equivalent CAD Tool, Drawing 2D and 3D Objects, Layers and Blocks, Dimensioning and Annotation, Rendering and Exporting Drawings. Application of CAD in Engineering Drawings, Architecture, and Product Design.

Labs / Practicals:

Module 1 & 2 – 2D Graphics and Transformations
1. Implement DDA Line Drawing Algorithm using C/C++ or Python.
2. Perform 2D Transformations (Translation, Rotation, Scaling, Reflection) on a geometric shape.
3. Implement Cohen–Sutherland Line Clipping Algorithm for windowing and clipping.

Module 3 – 3D Graphics and Modeling
4. Create and Transform 3D Objects (e.g., Cube, Sphere) using Blender.
5. Apply Perspective and Parallel Projections to a 3D model and visualize the differences.

Module 4 – Graphic Design Tools
6. Design a Logo using vector graphic tools in Adobe Illustrator or Inkscape.
7. Create a Poster or Brochure using typography, color themes, and shapes.

Module 5 – CAD Applications
8. Draw a 2D Engineering Component using AutoCAD with layers and dimensions.
9. Model a Simple 3D Object in AutoCAD and apply rendering.

10. Export and Annotate Drawings from AutoCAD for documentation or print-ready formats.

References:

1. Donald Hearn and M. Pauline Baker – Computer Graphics with OpenGL, Pearson Education.
2. D. F. Rogers and J. A. Adams – Mathematical Elements for Computer Graphics, McGraw-Hill.
3. Sham Tickoo – Learning AutoCAD: A Project-Based Tutorial, CADCIM Technologies.
4. Adobe Creative Team – Adobe Illustrator Classroom in a Book, Adobe Press.
5. Blender Foundation – Blender Basics: Classroom Tutorial Book, Blender Foundation.

Course Code	Course Name	L	T	P	Cr
DASH250030	Economics for Engineers	1	1	0	2

Course Outcomes:

CO1 : Understand basic economic concepts, including demand, supply, cost, and market structures.
CO2 : Analyze the economic feasibility of engineering projects using cost-benefit and break-even analysis.
CO3 : Evaluate different investment alternatives using engineering economic tools like NPV, IRR, and Payback Period.
CO4 : Apply knowledge of macroeconomic indicators and fiscal/monetary policies in the context of engineering.
CO5 : Develop the ability to assess the economic impact of engineering decisions in real-world scenarios.

Module 1:

Basic Economic Concepts
Introduction to Economics: Micro vs Macro, Utility, Demand and Supply Analysis, Elasticity of Demand and Supply, Equilibrium, Law of Diminishing Returns, Opportunity Cost.

Module 2:

Cost and Production Analysis
Types of Costs: Fixed, Variable, Marginal, Average, Total, Cost-Output Relationship, Break-even Analysis, Law of Variable Proportions, Returns to Scale, Cost-Volume-Profit Analysis.

Module 3:

Market Structures and Pricing
Types of Market: Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition, Pricing Strategies, Price Discrimination, Government Policies and Pricing.

Module 4:

Engineering Economics
Time Value of Money, Present Worth and Future Worth, Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, Comparison of Investment Alternatives, Depreciation and Inflation Considerations.

Module 5:

Macroeconomic Concepts
National Income, GDP, GNP, Inflation, Deflation, Unemployment, Fiscal and Monetary Policy, Role of RBI and Government in Economic Planning, Economic Indicators Relevant to Engineers.

Labs / Practicals:

N/A

References:

1. R. Panneerselvam, Engineering Economics, PHI Learning.
2. D.M. Mithani, Managerial Economics, Himalaya Publishing House.
3. M.L. Jhingan, Microeconomic Theory, Vrinda Publications, Latest Edition.
4. Chan S. Park, Contemporary Engineering Economics, Pearson Education.
5. Paul A. Samuelson and William D. Nordhaus, Economics, McGraw Hill.

Course Code	Course Name	L	T	P	Cr
DASH250040	Engineering Mathematics III	3	1	0	4

Course Outcomes:

CO1 : Apply Bisection, Regula-Falsi, Newton-Raphson, Secant, and Iterative methods to solve nonlinear equations and analyze their convergence.
CO2 : Solve systems of linear equations using direct methods (Gauss Elimination, LU Decomposition, Gauss-Jordan) and iterative methods (Gauss-Jacobi, Gauss-Seidel).
CO3 : Demonstrate understanding of probability fundamentals, including events, axioms, conditional probability, independence, and Bayes' theorem.
CO4 : Evaluate expectation, variance, and covariance of random variables and use generating functions to derive properties of distributions.
CO5 : Analyze and apply standard discrete and continuous probability distributions, use the Central Limit Theorem, and understand distribution approximations (e.g., Binomial to Normal).

Module 1:

Solution of Transcendental and Polynomial Equations (9 hrs)
Bisection method, Secant method, Regula-Falsi method, Newton-Raphson method, direct iterative method, convergence criteria and order of convergence.

Module 2:

Solution of Linear Systems (9 hrs)
Direct methods: Gauss-elimination method, LU-Decomposition methods, Gauss Jordan Method Iterative method: Gauss Jacobi method, Gauss-Siedel method.

Module 3:

Probability Theory Fundamentals (9 hrs)
Definitions, Algebra of events, Concept of probability, Axioms of probability, Conditional probability, Independent and compound events, Bayes' Rule (without proof) and applications.

Module 4:

Random variables and Probability Distributions (9 hrs)
Introduction to Random Variables and Types-Discrete and Continuous Random Variables, Independent Random Variables, Bivariate Random Variables, Expectation, Variance, and Covariance– Properties and Calculations, Probability Distribution Functions(PDF), Generating Functions– Probability Generating Function (PGF), Moment Generating Function (MGF), Characteristic Function (CF): Properties and Applications.

Module 5:

Standard Distributions (9 hrs)
Standard Discrete Distributions- Binomial Distribution, Poisson Distribution, Standard Continuous Distributions-Normal Distribution, Uniform Distribution, Exponential Distribution, Other Important Distributions-Chi-Square Distribution, t-Distribution, F-Distribution, Relationships Among Distributions– Binomial to Normal Approximation, Poisson to Normal Approximation, Central Limit Theorem (CLT)– Statement and Applications.

Labs / Practicals:

N/A

References:

1. Das, N.G., Statistical Methods (Combined Volume I & II), McGraw Hill.
2. Jain, M.K., Iyengar, S.R.K. & Jain, R.K., Numerical Methods: Problems and Solutions, New Age International.
3. Sastry, S.S., Introductory Methods of Numerical Analysis, PHI Learning.
4. Gupta, S.C. & Kapoor, V.K., Probability and Statistics, Sultan Chand & Sons.
5. Gupta, S.C. & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
6. Dutta, D. & Jana, A., Introductory Numerical Analysis, Academic Publishers.
7. Goon, A.M., Gupta, M.K. & Dasgupta, B., Fundamentals of Statistics (Volumes I & II), World Press.

Course Code	Course Name	L	T	P	Cr
DOEE250128	Linear Electrical Networks	2	2	0	4

Course Outcomes:

CO1: Understand the principles of linear circuit analysis including Ohm's Law, Kirchhoff's Laws, and network theorems.
CO2: Analyze and solve linear electrical networks consisting of resistors, capacitors, inductors, and independent sources.
CO3: Gain proficiency in analyzing AC circuits using phasor techniques, impedance, and admittance concepts.
CO4: Explore the behavior of linear networks under sinusoidal steady-state conditions and transient responses.
CO5: Develop problem-solving skills for analyzing and designing linear electrical networks for various engineering applications.

Module 1:

Basic concept of circuit theory & Network Theorems: Review of circuit analysis using Kirchoff's laws, nodal and mesh analysis, solution by classical method and
Laplace transform, concept of independent and dependent sources, analysis of special signal waveforms, and duality of networks, Brief review of Signals and Systems. Superposition and Reciprocity theorem, Thevenin's and Norton's theorem, Millman's theorem, maximum power transfer theorem, compensation, Tellegan's theorem, analysis of circuits using theorems.

Module 2:

Transient Analysis of Networks: Network elements, Transient response of R-L, R-C, R-L- C for DC and sinusoidal excitation, Initial
condition, Solution using differential equation approach and Laplace transform method. Behaviors of series and parallel resonant circuits

Module 3:

RLC circuit and Resonance: Laplace transforms and properties: Partial fraction, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace. Resonance conditions, quality factor.

Module 4:

Two Port Networks and Graph theory: Two Port Networks, Graph theoretic analysis for Large scale networks, Formulation and solution of network graph of simple networks, State space representation, Analysis using NGSPICE.

Module 5:

Passive Filter Design: Butter worth and Chebyshev approximations, Normalized specifications, Frequency transformations,
Frequency and impedancede-normalisation, Types of frequency selective filters, Linear phase filters.

Labs / Practicals:

NA

References:

"Network and systems" by D.Roy - Choudhary
"Circuit Analysis - with computer applications to problem solving" by

Someshwar C. Gupta, Jon W. Bayless, Behrouz Peikari.
Franklin F. Kuo, “Network Analysis and Synthesis ", John Wiley.
Vanvalkenburg, “Network Analysis ", Printice Hall of India Pvt. Ltd., New Delhi, 1994.
A William Hayt, “Engineering Circuit Analysis,” 8th Edition, McGraw-Hill Education.
A. Anand Kumar, “Network Analysis and Synthesis,” PHI publication, 2019.
Sudhakar, A., Shyammohan, S. P., “Circuits and Network,” Tata McGraw-Hill New Delhi, 1994.

Course Code	Course Name	L	T	P	Cr
DOEE250080	Electronic Measurements and Instrumentation	2	0	4	4

Course Outcomes:

CO1.Understand the principles and operation of electronic measuring instruments used for electrical and electronic parameters.
CO2.Learn techniques for accurate measurement, calibration, and error analysis in electronic circuits and systems.
CO3.Gain proficiency in the design and implementation of instrumentation systems for various engineering applications.
CO4.Explore advanced topics such as sensors, transducers, signal conditioning, and data acquisition systems.
CO5.Develop practical skills in laboratory experiments, data acquisition, and analysis using modern instrumentation tools and techniques.

Module 1:

Fundamentals of Electronic Measurement and Instrumentation: Necessity of electronic Measurement , Block diagram of electronic measurement system,Types of Measurements, Function of instruments and measurement systems, Applications ofmeasurement system, Elements of measurement system, Types of instruments, Theory of errors ,Accuracy and Precision, Types of errors, Statistical analysis , probability of errors, Limiting errors,Standards of measurement.

Module 2:

Electromechanical Instruments and AC, DC Bridges: Construction of Galvanometer, Suspension Galvanometer, Torque and deflection Galvanometer, PMMC mechanism, DC voltmeter; AC voltmeters; Peak, average and true RMS voltmeters; Digital Millimetres; Ammeters, Ohm-meters and their design' AC indicating instruments, Watt-hour meter; Power factor meter.
DC Bridges : Wheatstone Bridge, Kelvin Bridge. AC Bridges and their applications: Maxwell's Bridge, Hay's Bridge, Schering Bridge, Desauty's Bridge, Wein Bridge, Detectors for AC bridges.

Module 3:

Transducers and sensors: Static and dynamic characteristics of Transducer , Classification of transducers, Capacitive transducer, Inductive transducer, Resistive transducer, Displacement Transducer, LVDT, RVDT, Strain Gauge, RTD, Optical Transducers, Hall effect transducer, Piezoelectric transducers, Transducers for measurement of Pressure, Temperature, Level, Displacement, Flow.Sensors and its types. Thermoelectric Sensors: Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Electrochemical. Sensors, Acoustic Temperature Sensors, Nuclear Thermometer, Magnetic Thermometer, Semiconductor Types, Thermal Radiation, Quartz Crystal, NQR, Spectroscopic Noise Thermometry, Heat Flux Sensors. Position Encoders, Resonant Sensors, SAW Sensors, Sensors Based On Semiconductor Junctions, Sensors Based On MOSFET Transistors,Charge-Coupled And CMOS Image Sensors, Fiber-Optic Sensors, Ultrasonic-Based Sensors, Biosensors, Proximity Sensors: Typical Sensor Characteristics, Technologies For Proximity Sensing, Electro-Optical Sensors, Capacitive Sensors, Magnetic Sensors.

Module 4:

Signal generator and Signal Analyzer: CRO: Types, Dual trace, High frequency, sampling and storage oscilloscopes, Applications of CRO. Signal Generators: Introduction, Sine-wave generator, standard signal generators, Audio frequency signal generation, RF generator, Pulse generator, Function generator. Construction and operation of Signal analyzer, Wave analyzer, Harmonic Distortion analyzer, Spectrum analyzer and Logic analyzer; Signal conditioning and its necessity, process adopted.

Module 5:

Data Acquisition System: Signal conditioning,Functions of ,Signal conditioning, AC/DC Conditioning systems, Data conversion: ADC, DAC, Generalized data acquisition system: single channel and multi-channel DAS.

Labs / Practicals:

1.Displacement measurement using LVDT
2.Force/ Pressure measurement using Strain Gauge
3. Study of Data Acquisition System
4. Study of Lab VIEW software
5. Study of Lab VIEW projects, SubVIs, Block Diagram, Front Panel
6.Use of Loops, Case Structure, Sequence, Timing, Formula Node, Expression Node
7.Use of Arrays and Clusters
8. Study of Lab VIEWs Visual display
9.Exploring String and File I/O
10.Data Acquisition in Lab VIEW

References:

1. A.D. Helfrick and W.D. Cooper: "Modern Electronic Instrumentation and Measurement Techniques", PHI Publications.
2. A.K. Sawhney : "Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai & Sons Publications
3. S.S. Kalsi : "Electronics Measurements", Mc Graw Hill Publications.
4. B.H. Oliver and J.M Cage : "Electronics Measurement and Instrumentation", Mc Graw Hill Publications

Course Code	Course Name	L	T	P	Cr
DOEE250078	Electronic Devices and Circuits	3	0	2	4

Course Outcomes:

CO1: Understand the fundamentals of semiconductors, energy bands, carrier concentrations, and analyze P-N junction diode behavior including Zener diodes, LEDs, and photodiodes.
CO2: Apply diode principles to design and analyze wave-shaping circuits including RC differentiators, integrators, clippers, clampers, and voltage multipliers.
CO3: Design and evaluate rectifier circuits (half-wave, full-wave, bridge) with appropriate filters, and analyze their performance parameters such as ripple factor, efficiency, and load regulation.
CO4: Analyze the operation of Bipolar Junction Transistors (BJT), including CE, CB, and CC configurations, understand biasing techniques, equivalent circuits, and use BJTs for amplification and switching applications.
CO5: Understand and analyze Field Effect Transistors (JFET, MOSFET, FinFET), including device characteristics, non-ideal effects, CV characteristics, and their applications in analog and digital circuits.

Module 1:

Semiconductor Physics and Diode Theory: Introduction to Semiconductors: Intrinsic and Extrinsic semiconductors, Energy bands in solids, Conductors, Semiconductors and Insulators, Carrier concentration in intrinsic and extrinsic semiconductors, P-N junction diode: formation and characteristics, Current components in a diode, diode equation, Zener diode and its applications, Photodiode and LED.

Module 2:

Diode Applications-Wave shaping circuits:RC differentiating and integrating circuits. Analysis of first order RC differentiator and integrator to step input, rise time, bandwidth. Diode Clippers: Series and parallel configurations, biased clippers, Practical clippers and their transfer characteristics, Diode Clampers: Positive and negative clamping, Applications in signal shaping.

Voltage doubler, tripler, and quadrupler circuits, Zener Diode as a Voltage Regulator: Operation, load and line regulation, Series and shunt voltage regulators (brief overview).

Module 3:

Diode Applications- Rectifiers and Filters: Rectifiers and Filters: Half-Wave Rectifier: Operation, waveform analysis, ripple factor, efficiency, Full-Wave Rectifier (Center-tap and Bridge): Analysis, performance comparison, Filter circuits: Capacitor filter, inductor filter, π-filter, Load and transformer utilization factors.

Module 4:

Bipolar junction transistor: Bipolar Junction Transistors: Fundamental operation, Input and output characteristics of BJT in active region, BJT configurations: CE, CB, CC. Amplification with BJTs, generalized biasing and equivalent circuit models, non-ideal effects, switching.

Module 5:

Field Effect Transistor: Field – Effect Transistors: Transistor operations. JFET, MOSFET and their operations, device characteristics, non-ideal effects, CV characteristics, equivalent circuits. Overview of FinFET.

Labs / Practicals:

1. RC integrator and differentiator circuits: To design and implement RC integrator and differentiator circuits using a square wave input of period ‘T’, and to analyze the output waveforms for the following conditions:
- Time constant (τ) much greater than T
- Time constant much less than T
- Time constant approximately equal to T

2. Characterization of Semiconductor Materials: Perform experiments to understand the electrical properties of semiconductor materials such as silicon and germanium. Measure parameters like resistivity, mobility, and carrier concentration.
3. PN Junction Diode Characteristics: Study the I-V characteristics of a PN junction diode under forward and reverse bias conditions. Determine parameters like threshold voltage, forward and reverse bias currents, and ideality factor.
4. Diode Clipping and Clamping Circuits: To design and implement various diode-based wave shaping circuits such as series and parallel clippers (biased and unbiased) and clamping circuits, and to observe their effects on input waveforms.
5. Filter circuits: To design and construct filter circuits (capacitor filter, LC filter, and π-filter)
6. Zener Diode Characteristics: Investigate the voltage-regulating properties of Zener diodes. Measure the breakdown voltage and dynamic resistance of Zener diodes under different load conditions.
7. Zener Diode as a Voltage Regulator
8. Diode Rectifier Circuits: Construct and analyze various diode rectifier circuits such as half-wave, full-wave bridge, and center-tapped full-wave rectifiers. Measure output voltage, ripple factor, and efficiency.
9. Bipolar Junction Transistor (BJT) Characteristics: Study the DC and AC characteristics of NPN and PNP bipolar junction transistors. Measure parameters like DC current gain (β), collector current vs. collector-emitter voltage (IC- VCE) characteristics, and output characteristics.
10. BJT Amplifier Circuits: Design and analyze common-emitter and common-base amplifier circuits using bipolar junction transistors. Measure parameters like voltage gain, input/output impedance, and frequency response.
11. Field Effect Transistor (FET) Characteristics: Investigate the DC and AC characteristics of both JFET and MOSFET transistors. Measure parameters like drain current vs. drain-source voltage (ID-VDS), transconductance, and output conductance.
12. FET Amplifier Circuits: Design and analyze common-source and common-drain amplifier circuits using field-effect transist

References:

1. Electronic devices and Circuit Theory", "R. Boylestad", "Pearson Education", 9th Edition
2. "Electron devices", "S. Poornachandra, Sasikala", "Scitech", 2nd Edition
3. "Electronic Devices and Circuits", "Millman Halkias", "TMH", 2000
4. "Electronic Devices and Circuits", "DavidA.Bell", "PHI", 4thEdition

Course Code	Course Name	L	T	P	Cr
DOEE250050	Control System Engineering	3	1	0	4

Course Outcomes:

CO1. Understand the principles and concepts of control systems including feedback, stability, and performance criteria.
CO2. Analyze and design control systems using various techniques such as root locus, frequency response, and state-space methods.
CO3. Gain proficiency in modeling dynamic systems and obtaining transfer functions for control system design.
CO4. Explore the application of control systems in engineering disciplines such as robotics, aerospace, and industrial automation.
CO5. Develop practical skills in implementing control algorithms, tuning controllers, and analyzing system responses through simulations and experiments.

Module 1:

Introduction to Control Systems: Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.

Module 2:

Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to PI, PD and PID Controllers (excluding design).

Module 3:

Stability analysis: Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion, Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci.

Module 4:

Frequency domain analysis and stability: Correlation between time and frequency response, Bode Plots, Experimental determination of transfer function. Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, (Systems with transportation lag excluded) Introduction to lead, lag and lead-lag compensating networks (excluding design).

Module 5:

Introduction to Digital Control System: Introduction, Spectrum Analysis of Sampling process, Signal reconstruction, Difference equations. Introduction to State variable analysis: Introduction, Concept of State, State variables & State model, State model for Linear Continuous & Discrete time systems, Diagonalization.

Labs / Practicals:

NA

References:

Control systems, K.R. Varmah, McGraw hill
Control System Engineering, D. Roy Chowdhuri, PHI
Digital Control system, B.C. Kuo, Oxford University Press.
Control System Engineering, I. J. Nagrath& M. Gopal. New AgeInternational Publication
Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education

Course Code	Course Name	L	T	P	Cr
DOEE250147	Microprocessors and Microcontrollers	2	1	2	4

Course Outcomes:

CO1: Explain the architecture, memory organization, and modes of operation of the 8086 microprocessor.
CO2: Analyze the 8086 instruction set, interrupts, and interfacing with the 8259A controller.
CO3: Demonstrate keyboard and display interfacing using 8086 and 8279 controllers.
CO4: Compare advanced microprocessor architectures (Pentium series, RISC vs CISC).
CO5: Design microcontroller-based systems using 8051/8096 with peripheral interfacing.

Module 1:

8086 Architecture: Introduction to advanced microprocessors, 8086 internal architecture, Memory, Organization, Addressing modes, Accessing immediate & Register data, Memory accessing. 8086 minimum/maximum mode system, Real and Protected modes of operation, Address translation, Memory organization, Paging.

Module 2:

8086 Instruction Set: 8086 data transfer instructions, Arithmetic instructions, Bit manipulation instructions, String instructions, Conditional & Unconditional branch instructions, Processor control instructions, Overview of 8086 interrupts responses, 8086 interrupt types, Examples, Hardware interrupt applications, Multiple interrupts, 8259 a interrupt controller, Examples using 8259 A with 8088.

Module 3:

Keyboard & Display interfacing: Keyboard interfacing, interfacing LED displays, 8279 keyboard/ display controller, Block diagram, Pin description, Functional description, Software operation, Interface considerations, Circuit connections with 8086.

Module 4:

Advanced Microprocessors: Introduction to Pentium and Pentium pro architectures: RISC concepts, BUS operation, Super scalar architecture, Pipelining Introduction to Pentium II, Pentium III and Pentium 4 processors. RISC Architecture : Properties of RISC Systems Comparison with CISC architecture.

Module 5:

Introduction to Microcontrollers: Study of micro controller (MCS 51 family- 8051) - Architecture - Comparison of various families of 8 bit micro controllers. System design techniques interfacing of LCD, Stepper motor, Keyboard and ADC /DAC using microcontrollers. Study of micro controller 8096 - Architecture, Typical application in automotive and other industries, Introduction to super pipelined super scalar architectures of microcontrollers.

Labs / Practicals:

1.Microprocessor 8086 based development system
2.Simple arithmetic programs
3.Array manipulation programs
4.Code conversion programs
5.LED Bank interface
6.ADC ,DAC interface
7.Stepper Motor interface
8.Programming exercises in c and assembly language covering program and data memory
9.i/o port, Peripheral and external interrupt, power saving modes
10. Interfacing of devices like keys, relays, leads, seven segment, LCD Module, Matrix keyboard etc.

References:

D. Hall, “ Microprocessor and Interfacing (8086), 2nd ed, TMH
Gibson, “ Microprocessor and Interfacing”, 2nd edition, PHI
Triebel and Singh, “ The 8088 and 8086 Microprocessors : Programming, Interfacing, software, Hardware and Applications ”, PHI
Brey, “ Intel Microprocessors, 8086 to Pentium and Pentium pro processor: Architecture, Programming and interfacing”, 4th edition, PHI / Pearson
Ajay Deshmukh, “Microcontrollers (Theory and Applications) –TMH
M.A. Mazidi&J.G.Mazidi, The 8051 Microcontroller and Embedded systems 3rd Indian reprint, Pearson Education.

Course Code	Course Name	L	T	P	Cr
DOEE250183	Signals and Systems	2	1	2	4

Course Outcomes:

CO1: Explain the concepts of vector spaces, subspaces, linear dependence, bases, dimensions, and linear transformations with matrix representation.
CO2: Classify continuous-time and discrete-time signals and systems, and analyze their fundamental properties.
CO3: Apply Fourier Transform and Fourier Series for spectral analysis of signals and characterization of LTI systems.
CO4: Demonstrate sampling theorem, DTFT, DFT, and their properties for signal analysis in discrete domain.
CO5: Analyze continuous and discrete-time LTI systems using Laplace transform and Z-transform with stability considerations

Module 1:

Vector spaces: Field-definition-Finite field arithmetic. Vector Spaces – Subspaces – Linear Combinations - Linear Span – Linear Dependence - Linear Independence – Bases and Dimensions. Linear Transformations. Matrix representation of linear transformation.

Module 2:

Classification of signals and systems: Continuous time signals (CT signals)- Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals – periodic and aperiodic signals, random signals, Energy & Power signals - CT and DT systems, Classification of systems. LINEAR TIME INVARIANT SYSTEMS.

Module 3:

Spectral analysis of continuous time signals : Representation of a periodic Signals by continuous FT, FT of periodic signals, convolution and multiplication property of continuous FT, systems characterized by Linear Constant Coefficient Differential Equations. Magnitude and phase representation of FT, Magnitude and phase response of LTI systems, Time domain and Frequency domain aspects of ideal and non-ideal filters.
Fourier Series representation of periodic signals.

Module 4:

Sampling: Sampling theorem. Effect of under sampling. DTFT and Spectral analysis of sampled signal. DFT. Properties of DTFT and DFT, convolution property, multiplication property, Duality, Systems characterized by Linear Constant Coefficient Difference Equations.

Module 5:

Characterization of continuous time and discreate time LTI Systems: Definition-ROC-Properties-Inverse Laplace transforms-the S-plane and BIBO stability-Transfer functions- System Response to standard signals-Solution of differential equations with initial conditions. Application in continuous time signal and system analysis.

Z-transform, Region of convergence and its properties, Inverse Z transform, properties of ZT, Analysis and characterization of LTI systems using ZT, LTI Systems, System function algebra and block diagram representations. Application in discreate time system analysis.

Labs / Practicals:

Module 1: Signal Basics and LTI Systems

1. Generation and Visualization of Standard Signals
Objective: Generate and plot continuous-time and discrete-time signals: step, ramp, exponential, sinusoidal, and impulse.
Tools: MATLAB/Scilab/Python
2. Operations on Signals
Objective: Perform and plot operations like scaling, shifting, folding, and addition on signals.
3. Verification of Linearity and Time Invariance of Systems
Objective: Test whether a given discrete-time system is linear and time-invariant using example inputs and outputs.
Module 2 & 3: Fourier Series and Fourier Transform
4. Fourier Series Representation of Periodic Signals
Objective: Compute and plot the Fourier series coefficients of a square/triangular waveform and reconstruct the waveform using limited harmonics.
5. Computation and plotting of Fourier Transform
Objective: Find the Fourier Transform of a given time-domain signal (e.g., rectangular pulse) and plot its magnitude and phase spectrum.
Module 4: Laplace Transform
6. System Response using Laplace Transform
Objective: Use Laplace transform to find system response to standard inputs (step, impulse) and compare time-domain and Laplace-domain results.
Module 5: DTFT and DFT, Z transform
7. Sampling and Reconstruction of Signals
Objective: Demonstrate the effect of sampling and reconstruction using sinc interpolation. Analyze aliasing with under-sampling.
8. Compute and Plot DTFT and DFT of Discrete-Time Signals
Objective: Use MATLAB/Python to compute DTFT and DFT, and visualize the spectral content of a discrete-time signal.
9. Computation and Plotting of Z-Transform and Inverse Z-Transform
Objective: Determine and plot the Z-transform of basic sequences. Find inverse Z-transform using partial fractions.
Integrated Application
10. Analysis of LTI System using Convolution and Z-Transform
Objective: Implement an LTI system described by a difference equation. Use convolution and Z-transform to compute and verify the system's response.

References:

Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems Prentice Hall India, 2nd Edition, 2009.
John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, 4th Edition, PHI, 2007.
B.P. Lathi, —Signals, Systems & Communications‖, 2009,BS Publications.
Simon Hykin , " Signals and Systems", John Wiley
Robert A. Gable, Richard A. Roberts, Signals & Linear Systems, 3rd Edition, John Wiley, 1995.
Harish Parthasarathy,"Signals and Systems" JK International Second Edition.
HWEI P.HSU Schaum's, " Signals and Systems" TMH
M.J.Roberts,"Signals and Systems" TMH Ed 2003

Course Code	Course Name	L	T	P	Cr
DOEE250012	Analog Electronics	2	1	2	4

Course Outcomes:

CO1: Explain the characteristics, operating regions, and biasing techniques of BJTs and design stable biasing circuits.
CO2: Analyze small-signal models of BJTs and evaluate amplifier performance (gain, impedance, frequency response, bandwidth).
CO3: Illustrate the concepts of feedback in amplifiers and design sinusoidal oscillators using RC and LC circuits.
CO4: Demonstrate MOSFET characteristics, biasing methods, and analyze their amplifier configurations and digital applications.
CO5: Classify power amplifiers and voltage regulators, analyze their operation, efficiency, and design protection mechanisms.

Module 1:

BJT Characteristics and Biasing Techniques: Overview of BJT operation: active, cut-off, and saturation regions, Input and output characteristics of CE, CB, and CC configurations, DC load line, operating point, Biasing techniques: Fixed bias, Collector-to-base bias, Voltage divider bias, Stability factors and thermal runaway, Design of BJT biasing circuits.

Module 2:

BJT Small Signal Models and Amplifiers: Small signal equivalent models (hybrid-π and r_e models), CE, CB, CC amplifier analysis: voltage gain, input/output impedance, Multistage amplifier concepts: cascade and cascode configurations, Frequency response of BJT amplifiers: low and high-frequency analysis, Miller effect and bandwidth estimation.

Module 3:

Feedback Amplifiers and Oscillators: Concept of negative and positive feedback in amplifiers, Voltage series, voltage shunt, current series and current shunt feedback configurations, Oscillators: Barkhausen criterion, RC phase shift oscillator, Wien bridge oscillator, LC oscillators: Colpitts and Hartley.

Module 4:

MOSFET Characteristics and Amplifier Configurations:Overview of MOSFET types (Enhancement and Depletion), MOSFET characteristics: output and transfer characteristics, Biasing techniques for MOSFETs, Small signal analysis of common source, common drain, and common gate configurations. MOSFET as an amplifier and switch, Frequency response of MOSFET amplifiers, Comparison with BJT amplifier performance. Introduction to CMOS inverter and digital logic applications.
Analog applications: active loads, current sources, analog switches

Module 5:

Power Amplifiers and Linear Regulators: Classification of power amplifiers: Class A, B, AB, and C, Class A power amplifier with resistive and transformer load, Class B push-pull amplifier and crossover distortion, Class AB operation and efficiency.
Linear Voltage Regulators: Types of voltage regulators-series and shut. Working and design. Load and line regulation. Short circuit protection and fold back protection.

Labs / Practicals:

Design and Implementation of Voltage Divider Biasing Circuit
To design a voltage divider bias circuit for a BJT and determine its operating point (Q-point).

Single Stage CE Amplifier – Gain and Impedance Measurement
To design and implement a CE amplifier and measure voltage gain, input/output impedance.

Two-Stage RC Coupled Amplifier
To design and analyze a two-stage RC coupled amplifier and determine overall gain and bandwidth.

Frequency Response of CE Amplifier
To study low-frequency and high-frequency response and determine bandwidth and cutoff frequencies.

RC Phase Shift Oscillator using BJT
To design and implement a phase shift oscillator and verify frequency of oscillation using Barkhausen criterion.

Wien Bridge Oscillator using Op-Amp or BJT
To construct a Wien bridge oscillator and analyze output waveform and frequency.

Colpitts Oscillator using BJT
To design and implement a Colpitts oscillator circuit and verify its frequency of oscillation.

MOSFET Output and Transfer Characteristics
To obtain the output and transfer characteristics of an enhancement-type MOSFET and extract threshold voltage.

Common Source MOSFET Amplifier
To implement and analyze a common source amplifier and measure voltage gain and frequency response.

MOSFET as a Switch
To demonstrate the switching behavior of a MOSFET for digital signal interfacing.

Class A Power Amplifier with Transformer Coupling
To design and analyze a Class A power amplifier and determine efficiency.

Design and Testing of Linear Voltage Regulator Circuit
To design and implement a series-type voltage regulator and measure line/load regulation and short-circuit protection.

References:

1 Sedra, Adel S. and Smith, Kenneth C.
Microelectronic Circuits
Oxford University Press, India
2 Millman, Jacob and Halkias, Christos C.
Electronic Devices and Circuits
McGraw-Hill Education (India)
3 Boylestad, Robert L. and Nashelsky, Louis
Electronic Devices and Circuit Theory
Pearson Education, India
4 Mottershead, Allen
Electronic Devices and Circuits: An Introduction
Pearson Education, India
5 Salivahanan, S. and Kumar, N. Suresh
Electronic Devices and Circuits
McGraw-Hill Education (India)

Course Code	Course Name	L	T	P	Cr
DASH250101	Sports and Yoga	0	0	4	2

Course Outcomes:

CO1: Understand the principles of physical education, fitness, wellness, and positive lifestyle habits essential for maintaining overall health.

CO2: Demonstrate knowledge of basic anatomy, physiology, and posture correction, and apply this understanding to enhance body mechanics and prevent injuries.

CO3: Practice fundamental yoga postures, breathing techniques, and relaxation methods to improve flexibility, concentration, and mental well-being.

CO4: Apply yoga and fitness practices to manage lifestyle-related health conditions and promote physical and psychological balance.

CO5: Participate actively in sports and fitness activities, demonstrating teamwork, discipline, and awareness of safety, nutrition, and lifelong fitness practices.

Module 1:

Foundations of Physical Education and Fitness
Meaning & definition of Physical Education, Aims & Objectives of Physical Education, Changing trends in Physical Education, Meaning & importance of Physical Fitness and Wellness, Components of physical fitness and health-related fitness, Components of wellness, Concept of positive lifestyle, Preventing health threats through lifestyle changes.

Module 2:

Anatomy, Physiology and Posture
Introduction to Anatomy and Physiology, Importance of Anatomy and Physiology in Physical Education, Effects of exercise on circulatory, respiratory, and neuromuscular systems, Meaning & concept of posture, Causes and correction of bad postures, Postural deformities: Knock knee, Flat foot, Lordosis, Kyphosis, etc., Weight training: pros and cons.

Module 3:

Yoga-Theory and Practice
Meaning & importance of Yoga, Elements of Yoga: Asanas, Pranayama, Meditation, Kriyas, Yoga for concentration and related Asanas (Sukhasana, Tadasana, Padmasana, Shashankasana), Relaxation techniques (Yog-Nidra).

Module 4:

Yoga for Lifestyle and Health Conditions
Preventive role of Asanas, Yoga for hypertension, obesity, back pain, diabetes, asthma, Benefits, procedures & contraindications for relevant Asanas (e.g., Bhujangasana, Pavan Muktasana, Tadasana, Chakrasana, etc.).

Module 5:

Games and Sports Fundamentals
Select any one sport: Athletics, Basketball, Kabaddi, etc., History and development of the sport, General rules and regulations, Specifications of playfields and equipment, Major tournaments, venues, and personalities, Importance of proper sports gear.

Labs / Practicals:

1. Practice of Sukhasana, Padmasana, and Tadasana for improving concentration and posture.

2. Shashankasana and Bhujangasana for relaxation and spinal flexibility.
3. Introduction to and practice of basic Pranayama techniques (Anulom-Vilom, Bhramari).
4. Practice of Yog Nidra (deep relaxation technique).
5. Asanas for lifestyle diseases: practice of Pavan Muktasana, Chakrasana, and Tadasana for obesity and diabetes control.
6. Demonstration and correction of bad postures (knock knee, flat foot, lordosis, kyphosis).
7. Light warm-up and stretching routines before yoga or sports activities.
8. Basic fitness tests: measurement of flexibility, endurance, strength, and body composition.
9. Participation in any one selected sport: demonstration of rules, gear, warm-up drills.
10. Practice of the chosen sport (e.g., Athletics, Basketball, Kabaddi) including basic skills and gameplay
11. Group activity: Demonstration of importance of proper sports gear and warm-up before sports.
12. Poster or presentation on a Yoga-based lifestyle for common health issues.
13. Introduction to circuit training and its benefits for physical fitness.
14. Meditation sessions and reflective journaling on mental well-being.
15. Nutritional awareness activity: discussion on diet for fitness and yoga lifestyle.

References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga by B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11TH and 12th Classes).
4. Back to health through YOGA by Ramesh Bijlani.

Course Code	Course Name	L	T	P	Cr
DASH250105	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	3	0	0	3

Course Outcomes:

CO1: Understand human aspirations and distinguish between needs of the self and the body.
CO2: Analyze the concept of harmony in self, family, society, and nature.
CO3: Apply ethical principles to real-life situations and emerging challenges in science and technology.
CO4: Evaluate responsible behavior in professional and personal domains with sustainability and justice in mind.
CO5: Develop a holistic perspective for ethical human conduct in the context of AI, data use, and digital society.

Module 1:

Introduction to Value Education and Human Aspirations
Purpose of education, the role of values in personal and professional life; Understanding happiness and prosperity; Distinction between needs of the Self ('I') and Body; right understanding and right feelings; AI ethics and human well-being.

Module 2:

Harmony in the Human Being – Understanding the Self
Self-exploration as the process for value education; Understanding the activities of the Self and harmony in them; Program to ensure harmony; Applying this to deal with digital distractions, identity crisis, and mental well-being.

Module 3:

Harmony in Family and Society
Values in human relationships – trust and respect; Nine universal feelings in relationships; harmony in society through justice, mutual fulfillment, and participation; Ethical dilemmas in teamwork, AI product development, and organizational conduct.

Module 4:

Harmony with Nature and Sustainable Living
Interconnectedness of human and natural systems; Four orders of nature; Co-existence and Eco-balance; Sustainable production, consumption, and innovation in AI/ML; Responsible use of computing resources and data centers.

Module 5:

Ethical Human Conduct and Universal Order
Universal human order (Sarvabhauma Vyavastha); Ethical competence; vision for a humane society; Professional ethics for technologists – data privacy, bias in AI, ethical design of systems; role of engineers in promoting equity, well-being, and digital justice.

Labs / Practicals:

N/A

References:

Textbooks & Guides:
1. R.R. Gaur, R. Sangal, G.P. Bagaria – A Foundation Course in Human Values and Professional Ethics, Excel Books (AICTE
Recommended)
2. Ritu Sinha – Understanding Human Values, Laxmi Publications
3. B. L. Bajpai – Indian Ethos and Modern Management, New Royal Book Co.
4. R. Subramanian – Professional Ethics, Oxford University Press India
5. K. Mohan & M. Banerjee – Developing Soft Skills and Personality, McGraw Hill India

Course Code	Course Name	L	T	P	Cr
DOEE250076	Electromagnetics and Field Theory	3	1	0	4

Course Outcomes:

CO1: Apply vector calculus operators (gradient, divergence, curl, Laplacian) to analyze physical field problems.
CO2: Analyze electrostatic fields, potentials, capacitance, and solve boundary value problems using Gauss's Law, Poisson's and Laplace's equations.
CO3: Apply magnetostatics, Ampere's law, and Maxwell's equations to evaluate magnetic fields, inductance, and electromagnetic energy.
CO4: Analyze EM wave propagation in free space, dielectrics, and conductors; evaluate reflection, refraction, polarization, and power flow using Poynting theorem.
CO5: Evaluate transmission line characteristics using analytical tools (e.g., Smith chart) and analyze antenna types, radiation parameters, and array behavior.

Module 1:

Vector calculus: Orthogonal Coordinate System, Transformations of coordinate systems; Del operator; Gradient, Divergence, Curl - their physical interpretations; Laplacian operator.

Module 2:

Electrostatics: Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Electric dipole, Energy Density, Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.

Module 3:

Magneto statics & Maxwell's Equations: Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields,Magnetic torque and moment, Magnetic dipole, Inductances and Magnetic Energy, Illustrative Problems.
Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Boundary Conditions of Electromagnetic fields: Dielectric-Dielectric and Dielectric-Conductor Interfaces, Illustrative Problems.

Module 4:

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization,Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Pointing Vector, and Pointing Theorem – Applications, Power Loss in a Plane Conductor, Illustrative Problems

Module 5:

Transmission Lines & Antennas: Transmission Lines: Types, Transmission line parameters (Primary and Secondary), Transmission line equations, Input impedance, Standing wave ratio & power, Smith chart & its applications, Applications of transmission lines of various lengths, Micro- strip transmission lines – input impedance, Illustrative Problems.
Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Loop antenna, parabolic reflector anteena Horn antenna, Yagi-Uda array, Array Antennas: End fire and Broadside array

Labs / Practicals:

NA

References:

Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education
Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K
Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India
Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery& T. Van Duzer, John Wiley
Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
Electromagnetics, 2ed Edition – J. A. Edminister, Tata-McGraw-Hill.
Engineering Electromagnetics, 7th Edition-W.H.Hayt& J. A. Buck, Tata-McGraw-Hill

Course Code	Course Name	L	T	P	Cr
DOEE250130	Linear Integrated Circuits	2	1	2	4

Course Outcomes:

CO1: Analyze differential amplifier circuits, current mirrors, and operational amplifier characteristics.
CO2: Explain negative feedback in op-amp circuits and evaluate performance parameters of closed-loop amplifiers.
CO3: Apply op-amps in linear, non-linear, oscillator, and multivibrator circuits for practical applications.
CO4: Design and analyze active filters and voltage regulator circuits with IC implementations.
CO5: Examine PLLs, timers, VCOs, and data converters for signal processing and communication applications.

Module 1:

Differential Amplifiers: Differential Amplifiers: Differential amplifier configurations using BJT, DC analysis – transfer characteristics; AC analysis – differential and common mode gains, CMRR, input and output resistance, voltage gain, constant current bias, constant current source.

Concept of Current Mirror: Two-transistor current mirror, Wilson and Widlar current mirrors.

Operational Amplifiers (Op Amps): The 741 Op Amp, block diagram, ideal Op Amp parameters, typical parameter values for 741, equivalent circuit, open loop configurations, voltage transfer curve, frequency response curve.

Module 2:

Op-Amp with Negative Feedback: Op Amp with Negative Feedback: General concept of Voltage Series, Voltage Shunt, Current Series and Current Shunt negative feedback.

Amp circuits with Voltage Series and Voltage Shunt feedback, virtual ground concept.

Analysis of inverting and non-inverting amplifier for closed loop gain, input resistance and output resistance.

Module 3:

Op-Amp Applications: Op Amp Applications: Summer, Voltage Follower, Differential and Instrumentation Amplifiers, Voltage to Current and Current to Voltage converters, Integrator, Differentiator, Precision Rectifiers, Comparators, Schmitt Triggers, Log and Antilog amplifiers.

Oscillators and Multivibrators: Phase Shift and Wien-bridge Oscillators, Triangular and Sawtooth waveform generators, Astable and Monostable multivibrators.

Module 4:

Active Filters and Voltage Regulators: Active Filters: Comparison with passive filters, First and Second order Low pass, High pass, Band pass and Band Reject active filters, State Variable filters.

Voltage Regulators: Fixed and Adjustable voltage regulators, IC 723 – Low voltage and High voltage configurations, current boosting, current limiting, short circuit and fold-back protection.

Module 5:

PLLs and Data Converters: Timer and VCO: Timer IC 555 – functional diagram, astable and monostable operations. Basic concepts of Voltage Controlled Oscillator and application of VCO IC LM566.

Phase Locked Loop: Basic building block, operation, closed loop analysis, lock and capture range, applications of PLL, PLL IC 565.

Data Converters: Digital to Analog converters – specifications, weighted resistor type and R-2R ladder type. Analog to Digital Converters – specifications, flash type and successive approximation type.

Labs / Practicals:

Familiarization of Operational Amplifiers – Inverting and Non-inverting amplifiers, Integrator, Differentiator – Frequency response, Adder, Comparators

Measurement of Op-Amp Parameters

Difference Amplifier and Instrumentation Amplifier

Schmitt Trigger Circuit

Waveform Generators using Op-Amps – Triangular and Sawtooth

Wien Bridge Oscillator – Without & With Amplitude Stabilization

RC Phase Shift Oscillator

Precision Rectifiers

DC Power Supply using IC 723 – Low Voltage and High Voltage Configurations, Short Circuit and Fold-back Protection

Analog to Digital Converters – Counter Ramp and Flash Type

Digital to Analog Converters – R-2R Ladder Circuit

Study of PLL IC – Free Running, Frequency Lock Range and Capture Range

References:

1. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson Education.
2. D. Roy Choudhury and Shail B. Jain, Linear Integrated Circuits, New Age International Publishers.
3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, McGraw-Hill.
4. Robert F. Coughlin and Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, Pearson.
5. James M. Fiore, Operational Amplifiers and Linear Integrated Circuits: Theory and Application, Delmar Cengage Learning.

Course Code	Course Name	L	T	P	Cr
DOEE250044	Computer Organization and Architecture	3	0	2	4

Course Outcomes:

CO1: Explain processor fundamentals, instruction representation, and hardware operations including arithmetic and logical functions.
CO2: Analyze instruction set architectures, addressing modes, and computer arithmetic with parallelism and SIMD extensions.
CO3: Design basic datapath and pipelined architectures, and evaluate instruction-level parallelism and hazards in modern processors.
CO4: Demonstrate memory mapping techniques, cache design, memory hierarchy, and virtual memory mechanisms.
CO5: Evaluate memory management strategies including RAID levels, disk storage, multithreading, and multiprocessor systems.

Module 1:

Introduction of Processor:Introduction, Technologies for building Processors and Memory, Performance, The Power Wall, Operations of the Computer Hardware, Operands Signed and Unsigned numbers, Representing Instructions, Logical Operations, Instructions for Making Decisions

Module 2:

Instructions Set:MIPS Addressing for 32-Bit Immediate and Addresses, Parallelism and Instructions: Synchronization, Translating and Starting a Program, Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Sub word Parallelism, Streaming SIMD Extensions and Advanced Vector Extensions in x86.

Module 3:

Architecture Building Block: Logic Design Conventions, building a Datapath, A Simple Implementation Scheme, overview of Pipelining, Pipelined Datapath, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions, The ARM Cortex – A8 and Intel Core i7 Pipelines, Instruction –Level Parallelism and Matrix Multiply Hardware Design language.

Module 4:

Memory Mapping: Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance, dependable memory hierarchy, Virtual Machines, Virtual Memory, Using FSM to Control a Simple Cache, Parallelism and Memory Hierarchy: Redundant Arrays of Inexpensive Disks, Advanced Material: Implementing Cache Controllers.

Module 5:

Memory Management: Disk Storage and Dependability, RAID levels, performance of storage systems, Introduction to multi- threading clusters, message passing multiprocessors.

Labs / Practicals:

Module 1 & 2: Processor Basics and Instruction Set
1. Simulation of Basic Arithmetic Operations in MIPS Assembly
o Objective: Write MIPS assembly code to perform addition, subtraction, multiplication, and division of two integers.
o Tool: MIPS Simulator (e.g., QtSpim, MARS)
2. Binary and Hexadecimal Conversion & Representation
o Objective: Implement a program (in C or Assembly) to convert between binary, hexadecimal, and decimal formats; demonstrate signed and unsigned number representations.

3. Instruction Encoding and Decoding
o Objective: Manually encode and decode sample MIPS instructions and verify using a simulator.

Module 3: Datapath and Pipelining
4. Design a Basic Arithmetic Logic Unit (ALU) Using VHDL/Verilog
o Objective: Implement an ALU capable of performing AND, OR, ADD, SUB, and SLT operations.
o Tool: Xilinx Vivado / ModelSim / Logisim
5. Simulate Single-Cycle and Multi-Cycle Datapaths
o Objective: Model a simplified processor datapath (single-cycle and pipelined) and compare performance.
o Tool: Digital Simulator / Logisim / Ripes (RISC-V simulator)
6. Pipeline Hazard Detection and Resolution
o Objective: Simulate and analyze data and control hazards in a pipelined processor; demonstrate stalling and forwarding.

Module 4 & 5: Memory Mapping and Management
7. Cache Memory Simulation
o Objective: Simulate direct-mapped, fully-associative, and set-associative caches; compute hit/miss ratio.
o Tool: Custom Python/C program or existing cache simulator tools.
8. Implementation of Virtual Memory using Paging
o Objective: Simulate address translation using page tables; demonstrate page faults and TLBs.
o Tool: Python or Java-based simulation
9. Disk Scheduling Algorithm Simulation
o Objective: Implement and compare performance of FCFS, SSTF, SCAN, and LOOK disk scheduling algorithms.
10. RAID Level Simulation and Performance Comparison
• Objective: Simulate different RAID levels (RAID 0, 1, 5) and evaluate redundancy, speed, and fault tolerance.

References:

1. David A. Patterson and John L. Hennessey, “Computer organization and design, The Hardware/Software interface”, Morgan Kauffman / Elsevier, Fifth edition, 2014
2. V. Carl Hamacher, Zvonko G. Varanesic, and Safat G. Zaky, “Computer Organization “, 6 th edition, McGraw-Hill Inc, 2012.
3. William Stallings, “Computer Organization and Architecture”, 8th Edition, Pearson Education, 2010

Course Code	Course Name	L	T	P	Cr
DOEE250065	Digital Signal Processing	3	0	2	4

Course Outcomes:

CO1: Apply the concepts of Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) algorithms for digital signal analysis and filtering.
CO2: Implement and analyze discrete-time FIR and IIR systems using different realization structures and evaluate round-off effects.
CO3: Design and evaluate FIR filters (low-pass, high-pass, band-pass, band-reject) using linear phase, optimal, and minimum phase design techniques.
CO4: Design IIR filters using approximation of derivatives, impulse invariant, and bilinear transformation techniques, and analyze the effect of finite word length.
CO5: Apply spectral estimation methods (parametric and non-parametric) to analyze signals in terms of autocorrelation, power spectrum, and energy density spectrum.

Module 1:

Discrete Fourier Transform and FFT Algorithms: Discrete Fourier Transform, Linear filtering methods based on the DFT, Filtering of long sequences. Direct computation of the DFT, Divide and Conquer approach, Radix -2 decimation in Time and Frequency FFT algorithms, quantization effect in computation of the DFT and FFT.

Module 2:

Implementation of the Discrete time systems: Structure for the realization of discrete time FIR and IIR systems, Direct Form, cascade form, Frequency sampling structure, lattice structure. State space system analysis and structures. Round-off effects in digital filter.

Module 3:

Design of FIR Digital Filters: Magnitude and phase response of digital filter, frequency response of Linear phase FIR filters, Design Techniques for FIR (Low pass, high pass, band pass and band reject) filters. Design of Optimal Linear phase FIR Filters, Design of Minimum phase FIR Filters.

Module 4:

Design of IIR Digital Filters: IIR filter design by approximation of derivatives, impulse invariant approach and bilinear transformation. Butterworth filters, Chebyshev filters, Inverse Chebychev filter and elliptic filters, Design of Low pass, high pass, band pass and band reject IIR filters. Spectral transformation of IIR filters, Effects of Finite word length in digital filters.

Module 5:

Spectral Estimation methods: Spectral estimation, Energy Density Spectrum, Estimation of autocorrelation and power spectrum, DFT in spectral estimation, Parameteric and nonparametric method for power spectrum estimation.

Labs / Practicals:

Compute linear convolution, circular convolution, and cross-correlation of two sequences.

Verify different properties of the Discrete Fourier Transform (DFT).

Implement different Fast Fourier Transform (FFT) algorithms.

Design and implementation of low-pass, high-pass, band-pass, and band-reject FIR filters.

Design and implementation of low-pass, high-pass, band-pass, and band-reject IIR filters of different types.

Computation of power spectral density, correlation function, and correlation matrix of stochastic systems.

Implementation of basic digital signal processing algorithms for different applications like denoising, edge detection, etc., using computer programming.

Implementation of basic digital signal processing algorithms for different applications like denoising, edge detection, etc., using digital signal processors (e.g., TMS DSP kits).

References:

Discrete Time Signal Processing – Oppenheim & Schafer, PHI Ltd, Third Edition

Digital Signal Processing: Principles, Algorithms and Applications – John G. Proakis and Dimitris G. Manolakis

Digital Signal Processing: A Computer-Based Approach – Sanjit K. Mitra, McGraw Hill Education

Course Code	Course Name	L	T	P	Cr
DASH250026	Design Thinking	1	0	2	2

Course Outcomes:

CO1 : Understand the core principles and process of design thinking including empathy, ideation, and prototyping.
CO2 : Apply user-centric research methods to identify and frame real-world problems.
CO3 : Generate and evaluate innovative ideas through brainstorming and collaborative design activities.
CO4 : Build and test low-fidelity prototypes to explore solution possibilities.
CO5 : Present and communicate design solutions effectively using appropriate tools and storytelling techniques.

Module 1:

Introduction to Design Thinking
Definition and Importance of Design Thinking, Comparison with Traditional Problem Solving, Mindsets for Innovation, Stanford d.school Design Process, Applications in Engineering, Business, and Social Sectors.

Module 2:

Empathize – Understanding Users
Importance of Empathy, Observation and Interview Techniques, User Persona Creation, Empathy Mapping, Journey Maps, Capturing Insights from Field Research.

Module 3:

Define and Ideate
Problem Definition and Framing: Point of View (POV) Statements, Ideation Techniques (Brainstorming, SCAMPER, Mind Mapping), Idea Evaluation and Selection Criteria.

Module 4:

Prototype and Test
Prototyping Tools and Techniques, Rapid Prototyping, Paper Prototypes, Role-Playing, Usability Testing, Feedback Integration and Iteration.

Module 5:

Communication and Implementation
Storyboarding, Pitching Ideas, Design Thinking for Entrepreneurship, Real-life Case Studies, Ethical and Sustainable Design Considerations.

Labs / Practicals:

1. Conduct user interviews and observations to develop empathy maps.
2. Create user personas and problem statements.
3. Brainstorm solutions for a chosen problem and organize ideas using mind maps.
4. Develop low-fidelity prototypes for the selected ideas.
5. Test prototypes with users and gather feedback for refinement.
6. Present project using storyboards and pitch decks.
7. Group project: Apply the design thinking process to a real-world challenge and document the journey.
8. Use tools like Canva, Miro, or Figma for visualizing and presenting ideas.
9. Role-play-based usability tests.
10. Peer review and reflection journal on the design process.

References:

1. Tim Brown, Change by Design, Harper Business.
2. Rolf Faste, Design Thinking Methodology, Stanford University Materials.
3. Jeanne Liedtka & Tim Ogilvie, Designing for Growth: A Design Thinking Toolkit for Managers, Columbia

Business School Publishing.
4. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers.
5. Plattner, Meinel, Leifer, Design Thinking: Understand – Improve – Apply, Springer.

Course Code	Course Name	L	T	P	Cr
DOEE250011	Analog Communication	2	1	2	4

Course Outcomes:

CO1: Explain the fundamentals of amplitude modulation, its types (AM, DSB-SC, SSB, VSB, QAM) and demodulation techniques with applications.
CO2: Analyze angle modulation techniques (FM, PM), their bandwidth requirements, generation and demodulation schemes.
CO3: Evaluate the effect of noise in analog communication systems and compare system performance (SNR, noise figure) under different modulation schemes.
CO4: Apply the principles of analog pulse modulation (PAM, PWM, PPM) and demodulation with spectral analysis.
CO5: Illustrate the working of radio receivers (AM, FM, superheterodyne) and associated circuits (PLL, Costas loop, FDM) with performance metrics like sensitivity and selectivity.ls.

Module 1:

Basics of Amplitude Modulation: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications. Amplitude Modulation & Demodulation: Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Quadrature amplitude modulation (QAM), Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Illustrative Problems.

Module 2:

Angle Modulation &Demodulation: Concept of instantaneous frequency, Generalized concept of angle modulation, Bandwidth of angle modulated waves – Narrow band frequency modulation (NBFM); and Wide band FM (WBFM), Phase modulation, Verification of Frequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves – Indirect method, Direct generation; Demodulation of FM, Band pass limiter, Practical frequency demodulators, Small error analysis,

Module 3:

Noise in Communication Systems: Types of noise, Time domain representation of narrowband noise, Filtered white noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSB-SC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems.

Module 4:

Analog pulse modulation schemes: Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and
demodulation schemes, PPM spectral analysis, Illustrative

Module 5:

Radio Receivers : Pre-emphasis, & De-emphasis filters, FM receiver, FM Capture Effect,. Carrier Acquisition-phased locked loop (PLL), Costas loop, Frequency division multiplexing (FDM), and Super-heterodyne AM receiver, Sensitivity and selectivity , selection of IF ,Illustrative Problems.

Labs / Practicals:

Amplitude Modulation and Demodulation

Frequency Modulation and Demodulation

Characteristics of Mixer

Pre-emphasis and De-emphasis

Pulse Amplitude Modulation and Demodulation

Pulse Width Modulation and Demodulation

Pulse Position Modulation and Demodulation

Radio Receiver Measurements – Sensitivity, Selectivity, and Fidelity

Sampling Theorem – Verification

Time Division Multiplexing

References:

B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006
Sham Shanmugam, "Digital and Analog Communication Systems", WileyIndia edition, 2006.
A. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition, 5th Edition, 2010.
Simon Haykin, "Communication Systems", Wiley-India edition, 3 rd edition, 2010.
Herbert Taub& Donald L Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 3rd Edition, 2009.
George Kennedy and Bernard Davis, "Electronics & Communication System", TMH, 2004.

Course Code	Course Name	L	T	P	Cr
DASH250021	Computational Ecosystem	2	0	0	2

Course Outcomes:

CO1 : Understand the architecture and components of a computational ecosystem including hardware, software, and network layers.
CO2 : Identify and describe various computing paradigms such as client-server, cloud, edge, and grid computing.
CO3 : Analyze the role of data, storage, virtualization, and operating systems in supporting computing environments.
CO4 : Recognize the significance of computational efficiency, scalability, and interoperability in ecosystem design.
CO5 : Comprehend the ethical, environmental, and sustainability aspects of computational infrastructure.

Module 1:

Fundamentals of Computational Ecosystems Definition and Scope, Components of Computational Ecosystem, Hardware and Software Stack, Role of Operating Systems, Ecosystem Architecture Models.

Module 2:

Computing Paradigms
Centralized, Decentralized, Distributed Systems, Cloud Computing, Edge Computing, Grid Computing, Serverless Architecture: Use Cases and Comparison.

Module 3:

Networking and Communication
Internet Infrastructure, TCP/IP, DNS, Firewalls, Network Topologies, Communication Protocols, Data Transmission in Computational Systems.

Module 4:

Data Management and Storage
File Systems, Databases, Big Data Storage, Virtualization, Containerization (e.g., Docker), Backup and Recovery, Scalability in Data Storage.

Module 5:

Sustainability and Trends
Energy Efficiency in Data Centers, Green Computing, Digital Inclusion, Ethical Issues in Computing Ecosystems, Future Trends (Quantum Computing, AI-as-a-Service, IoT Ecosystems).

Labs / Practicals:

N/A

References:

1. Tanenbaum, A. S., & Van Steen, M., Distributed Systems: Principles and Paradigms, Pearson.
2. Rajkumar Buyya et al., Cloud Computing: Principles and Paradigms, Wiley.
3. William Stallings, Computer Organization and Architecture, Pearson.
4. Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall.
5. Arvind Kumar Bansal, Introduction to Computational Thinking, CRC Press.

Course Code	Course Name	L	T	P	Cr
DASH250049	Entrepreneurial Development and Innovation	1	1	0	2

Course Outcomes:

CO1: Describe fundamental concepts and the ecosystem of entrepreneurship and innovation in the Indian context.
CO2: Analyze market opportunities and prepare a basic business model canvas.
CO3: Apply innovation frameworks and ideation techniques for product or service development.
CO4: Explain government schemes, startup support systems, and funding mechanisms.
CO5: Demonstrate teamwork, presentation, and proposal writing skills through entrepreneurial assignments.

Module 1:

Introduction to Entrepreneurship:
Definition, characteristics and types of entrepreneurs, entrepreneurial mindset, role of entrepreneurship in economic development, examples of Indian entrepreneurs in electronics, IT, and embedded domains, relevance for Diploma and B.Tech engineers.

Module 2:

Innovation and Design Thinking:
Definition of innovation, types (product, process, business model), TRIZ basics, Design Thinking framework, Ideation techniques, Creative problem solving, Case studies from Indian startups using electronics/ICT innovations.

Module 3:

Business Model and Opportunity Analysis:
Idea screening, opportunity identification, Value proposition design, Business model canvas, Basics of marketing, pricing and distribution, competitors and SWOT analysis, Application to electronics/service/product ideas.

Module 4:

Startup Ecosystem and Support in India:
Startup India initiative, Digital India, Make in India, Atmanirbhar Bharat, MeitY TIDE scheme, role of MSME, DST, AIM, incubation centers, accelerators, Funding sources – angel, VC, Bank loans, grants, Basics of intellectual property (IPR).

Module 5:

Proposal Writing, Teamwork and Entrepreneurial Communication:
Writing simple project proposals (idea, team, cost, timeline), team formation and role distribution, pitching and elevator pitch, communication and leadership skills for entrepreneurs, tools like Canva, PPT, video pitch.

Labs / Practicals:

N/A

References:

1. Vasant Desai - Dynamics of Entrepreneurial Development and Management, Himalaya Publishing.
2. C.B. Gupta & N.P. Srinivasan - Entrepreneurship Development, Sultan Chand & Sons.
3. S.S. Khanka - Entrepreneurial Development, S. Chand.

Course Code	Course Name	L	T	P	Cr
DASH250104	Technical Presentation and Report Writing	0	0	4	2

Course Outcomes:

CO1 : Understand the principles and formats of technical communication including different types of reports and presentations.
CO2 : Prepare clear, concise, and well-structured technical documents for academic and professional purposes.
CO3 : Design and deliver effective oral presentations using appropriate tools and visual aids.
CO4 : Demonstrate proficiency in grammar, technical vocabulary, and formal style required in technical writing.
CO5 : Collaborate in teams to produce technical content and receive peer feedback constructively.

Module 1:

Introduction to Technical Communication
Principles and characteristics of technical communication, Purpose and types of technical documents, Features of a good technical report, Audience analysis.

Module 2:

Writing Skills for Technical Documents
Structure of reports: Title Page, Abstract, Table of contents, Introduction, Body, Conclusion, and References. Writing instructions, lab reports, Project Reports, and Proposals. Use of charts, graphs, and tables.

Module 3:

Grammar and Language in Technical Writing
Use of formal tone and objective language, sentence construction, common errors, punctuation, and vocabulary building for technical writing. Editing and proofreading techniques.

Module 4:

Preparing Technical Presentations
Planning a presentation, structuring content, use of slides, visual aids, and multimedia tools (e.g., PowerPoint, Prezi). Non-verbal communication and handling audience questions.

Module 5:

Practice and Evaluation
Student individual and group presentations on technical topics, peer reviews, instructor feedback. Writing mini technical reports based on lab/project work or case studies.

Labs / Practicals:

1. Analyzing Samples of Technical Documents
Objective: Identify the structure and features of different technical documents (e.g., lab report, project report, instruction manual).
2. Writing a Lab Report Based on Practical Work
Objective: Write a complete lab report including abstract, objectives, procedure, observations, and conclusion.
3. Creating a Project Proposal Document
Objective: Prepare a short technical proposal on a selected topic including problem statement, objectives, methodology, and timeline.
4. Designing Visual Elements (Graphs, Charts, Tables)
Objective: Use data to create visual aids using Excel/PowerPoint and integrate them into a technical report.
5. Grammar and Proofreading Workshop
Objective: Identify and correct errors in sample texts focusing on sentence construction, punctuation, and vocabulary.
6. Preparing and Delivering an Individual Presentation
Objective: Create and present a 5-minute talk on a technical topic using PowerPoint or Prezi.

7. Group Presentation on a Technical Case Study
Objective: Collaboratively research and present findings on a real-world technical issue or innovation.
8. Peer Review and Feedback Session
Objective: Evaluate and provide constructive feedback on peers' written reports and oral presentations.
9. Editing and Improving a Poorly Written Report
Objective: Revise and rewrite a given flawed report to meet academic/professional standards.
10. Writing a Mini Technical Report on a Chosen Topic
Objective: Submit a short report (3–5 pages) on a lab experiment, research article, or emerging technology.

References:

1. Meenakshi Raman and Sangeeta Sharma – Technical Communication: Principles and Practice, Oxford University Press.
2. M. Ashraf Rizvi – Effective Technical Communication, Tata McGraw-Hill.
3. Sharma, R.C. and Krishna Mohan – Business Correspondence and Report Writing, Tata McGraw-Hill.
4. Lesikar, Raymond V. et al. – Basic Business Communication, Tata McGraw-Hill.
5. David F. Beer and David McMurrey – A Guide to Writing as an Engineer, Wiley India.

Course Code	Course Name	L	T	P	Cr
DOEE250199	VLSI Design	2	1	2	4

Course Outcomes:

CO1: Explain the basics of VLSI design flow, CMOS logic, layouts, and fabrication process.
CO2: Analyze MOS and CMOS device models, inverter characteristics, and logic design constraints.
CO3: Evaluate delay, power dissipation, and interconnect effects in VLSI circuits.
CO4: Design and compare various CMOS circuit families, latches, and flip-flops.
CO5: Develop subsystem designs and FPGA-based implementations using VHDL and CAD tools.

Module 1:

Introduction To VLSI: Basics of VLSI design CMOS Logic: Combinational and sequential circuits, CMOS fabrication and layouts, Layout representations, Stick diagrams, Design partitioning, Logic design, Circuit design, Physical design, Design verification, fabrication, packaging and testing, Design Flow

Module 2:

MOS and CMOS: Modelling of MOS transistor, Capacitance voltage characteristics, non-ideal effects DC transfer characteristics, MOS Inverter, MOS Transistor Switches, CMOS Logic design, Circuit and System Representations, Design Equations, Static Load MOS Inverters, Transistor Sizing, Static and Switching Characteristics; Body Effect, Noise Margin.

Module 3:

Delay Power: Transient Response, RC Delay Model, Effective Resistance, Gate and Diffusion Capacitance, Equivalent RC Circuits, Transient Response, Elmore Delay, Layout Dependence of Capacitance, Determining Effective Resistance, Linear Delay Model Logical Effort, Parasitic Delay, Delay in a Logic Gate, Drive, Extracting Logical Effort from Datasheets, Limitations to the Linear Delay Model, Logical Effort of Paths, Delay in Multistage Logic Networks, Choosing the Best Number of Stages, Sources of power dissipation, dynamic power , static power, Wire Geometry, Example of Metal Stacks, Interconnect Modelling, Resistance, Capacitance Inductance, Skin Effect, Temperature Dependence, Interconnect Impact, Delay, Energy, Crosstalk, Inductive Effects

Module 4:

Circuit Design: Circuit Families, Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass-Transistor Circuits, Sequencing Static Circuits, Sequencing Methods, Max Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew, Circuit Design of Latches and Flip-Flops, Conventional CMOS Latches, Conventional CMOS Flip-Flops, Pulsed Latches, Resettable Latches and Flip-Flops, Enabled Latches and Flip-Flops, Incorporating Logic into Latches

Module 5:

Subsystem Design FPGA: Adders, zero one detectors, comparators, counters, Memory subsystems SRAM, Read and write operation, DRAM, sense amplifiers Field Programmable gate arrays- Logic blocks, routing architecture, design flow technology mapping for FPGAs, Case studies Sitar x XC4000 & ALTERA's FLEX 8000/10000 FPGAs: AT &T ORCA's (Optimized Reconfigurable Cell Array): ACTEL's ACT-1,2,3 and their speed performance

Labs / Practicals:

1. Based on VHDL (Xilinx) platform and implementation on FPGA boards:

Logic expression s, modulo synchronous and asynchronous up down counters. Multiplexers/ decoders, arithmetic logic unit, priority encoder,62 models based on Moore's law, mealy model etc.

2. CADENCE CAD tool-based experiments:

Design of MOS transistor circuits, DC characteristics, AC small signal analysis and extraction of parameters, design of sample and hold circuits, measurement of switching times, design of PLL and measurement of all characteristics parameters, design of 3-8 decoder using MOS technology.

References:

1. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley,1979.
2. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, 2002
3. J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, Digital Integrated Circuits : A Design Perspective, Second Edition, PHI /Pearson, 2003.
4. J. P. Uyemura, CMOS Logic Circuit Design, Springer; 2001,.
5. J. P. Uyemura, Introduction to VLSI Circuits and System, Wiley, 2002.
6. R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design, Layout and Simulation, PH, 1997

Course Code	Course Name	L	T	P	Cr
DOEE250057	Digital Communication Systems	3	0	2	4

Course Outcomes:

CO1: Explain the concepts of random variables, random processes, and their statistical properties in communication systems.
CO2: Analyze the fundamentals of digital communication, line coding, pulse shaping, and performance measures.
CO3: Compare and evaluate digital modulation techniques such as ASK, FSK, PSK, DPSK, and QPSK.
CO4: Apply equalization and detection techniques for digital communication over band-limited and noisy channels.
CO5: Demonstrate understanding of information theory, entropy, mutual information, coding techniques, and channel capacity.

Module 1:

Random Variables and Random Process: Deterministic and Random Signal: Types of random variables, cumulative distribution function and probability density functions, Standard distributions: Gaussian, exponential, Rayleigh, uniform, Bernoulli, binominal, Poisson, discrete uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.
Random Processes: Random processes, stationary processes, mean and covariance functions, periodicity, linear filtering of random processes, power spectral density, examples of random processes: white noise process and white noise sequence, Gaussian process, Poisson process, Markov process.

Module 2:

Digital communication and modulation basics: Band pass and Low pass signal, Introduction to Digital communication systems, Pulse code modulation
, differential pulse code modulation, delta modulation, adaptive delta modulation, PSD of Line Coding schemes, Pulse shaping, Scrambling, Eye diagram, Gram-Schmidt orthogonalization scheme.

Module 3:

Digital Modulation Techniques: Modulation and Demodulation of Digital modulation schemes-ASK, FSK, PSK, DPSK, QPSK and Constellation diagram. Introduction to M-ary communication.

Module 4:

Digital Communication Through Band Limited Channels and Digital Receiver: Characteristic and signal Design of band Limited Channels. Optimum Receiver for Channel with ISI and AWGN. Linear Equalization, Decision Equalization, Adaptive Equalization. Introduction of Multichannel and Multicarrier System. Optimum threshold detection, Concept of Matched Filters, BER analysis of BASK, BFSK, BPSK, Model of Spread Spectrum Digital Communication. Direct Sequence Spread Spectrum Signal (DS-SS), Frequency Hopped Spread Spectrum Signal (FH-SS).

Module 5:

Information theory and Coding: Discrete Source models – Memoryless and Stationary, Mutual Information, Self-Information, Conditional Information, Average Mutual Information, Entropy, Entropy of the block, Conditional Entropy, Information Measures for Analog Sources. Review of probability theory Entropy Mutual information Data compression Huffman coding Asymptotic equipartition property Universal source coding Channel capacity Differential entropy Block codes and Convolutional codes.

Labs / Practicals:

1 Design and Generation of random binary signals

2 Study of impairments of signals generated in experiment 1 on passing through a simulated channel by observing Eye Pattern.
3 Generation Unipolar NRZ, Polar NRZ, Unipolar RZ and Polar RZ line codes.
4 Generation Manchester and AMI line codes
5 Conversion of analogue signal into PCM format and its study
6 Design and implementation of Delta Modulator for analogue signals
7 Design, implementation and study of BASK Modulator and demodulator
8 .Design, implementation and study of BPSK Modulator and demodulator
9 Design, implementation and study of BFSK Modulator and demodulator
10 Design, implementation and study of multiplexer and de-multiplexer of digital signals using TDM.
11 study of spread spectrum signal

References:

1 John G. Proakis & Masoud Salehi, “Digital Communications”, 5th Edition, McGraw Hill
2 B.P. Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press
3 H. Taub, D L Schilling, Gautam Saha, “Principles of Communication”, 4th Edition, McGraw Hill
4 Singh & Sapre, Analog & Digital Communication Systems, 3th Edition, McGraw Hill
5 John G. Proakis,"Communication Systems Engineering 2nd Edition, Pearson Education, 2015
6 (Schaum's Outline Series) H P HSU & D Mitra, “Analog and Digital Communications”, McGraw Hill 3rd Edition
7 Bernard Sklar, Digital Communications, Pearson Education
8 Simon Haykin, “Communication Systems”, 5th Edition, Wiley India

Course Code	Course Name	L	T	P	Cr
DOEE250189	Testing of VLSI Circuits	3	0	2	4

Course Outcomes:

CO1: Explain the fundamentals of VLSI testing, fault models, controllability, and observability in nanoscale circuits.
CO2: Apply fault simulation techniques and generate test patterns for combinational circuits using ATPG algorithms.
CO3: Analyze and test sequential circuits using scan design techniques and test compression methods.
CO4: Implement Design for Testability (DFT) strategies including BIST for memory and logic testing.
CO5: Evaluate advanced testing methods such as delay, analog/mixed-signal testing, and assess test economics with EDA tools.

Module 1:

Fundamentals of VLSI Testing : • Introduction to VLSI testing – Need for testing, testing challenges in nanoscale circuits.

- Defects, errors, and faults: Permanent, transient, intermittent faults.
- Fault models: Stuck-at fault, bridging fault, open fault, delay fault.
- Controllability and observability.

Module 2:

Fault Simulation and Test Pattern Generation

- Fault simulation techniques: Serial, parallel, deductive, concurrent fault simulation.
- Automatic Test Pattern Generation (ATPG) for combinational circuits – D-algorithm, PODEM, FAN.
- ATPG complexity and fault coverage metrics.

Module 3:

Testing of Sequential Circuits

- ATPG for sequential circuits – Time-frame expansion, iterative logic array.
- State justification and learning-based techniques.
- Scan Design Techniques: Full scan, partial scan, boundary scan (IEEE 1149.1 standard).
- Introduction to test compression.

Module 4:

Design for Testability (DFT)

- Ad-hoc and structured DFT techniques.
- Built-In Self-Test (BIST): BIST architecture, Test pattern generators – LFSR.
- Response analyzers – Signature analysis.
- Memory BIST and Logic BIST.

Module 5:

Advanced Testing and Practical Aspects

- Delay testing: Transition fault model, path delay fault model.
- Analog and mixed-signal testing – Basics and challenges.
- Test economics and yield considerations.
- Introduction to EDA tools for test synthesis and simulation (TetraMAX, DFT Compiler, etc.)

Labs / Practicals:

1. Study and simulation of stuck-at faults in combinational circuits using fault simulation tools.
2. Implementation of D-algorithm for test pattern generation on basic logic circuits.
3. Generation of test patterns using the PODEM algorithm in digital circuits.
4. Insertion and verification of scan chains in sequential circuits.
5. Design and implementation of Built-In Self-Test (BIST) using LFSR and signature analyzer.
6. Simulation of boundary scan architecture and IEEE 1149.1 standard compliance.
7. Testing and diagnosis of memory faults using March test algorithms.
8. Simulation of delay faults and path delay analysis in combinational logic.
9. Analysis of test coverage and fault grading using ATPG tools.
10. Design for Testability (DFT) implementation and validation using industry-standard EDA tools.

References:

1. M. Abramovici, M.A. Breuer, and A.D. Friedman, Digital Systems Testing and Testable Design, IEEE Press, 1994.
2. Miron Abramovici, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2001.
3. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures, Morgan Kaufmann, 2006.
4. Bushnell and Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2000.
5. N. Jha and S. Gupta, Testing of Digital Systems, Cambridge University Press, 2003.

Course Code	Course Name	L	T	P	Cr
DOEE250082	Electronic Product Design using EDA Tools	2	1	2	4

Course Outcomes:

CO1: Understand and apply EDA tools for schematic capture, simulation, synthesis, and layout design.
CO2: Perform schematic design, simulation, and signal integrity verification using industry-standard methodologies.
CO3: Apply logic synthesis, optimization, and timing analysis for efficient digital circuit design.
CO4: Develop layout design with placement, routing, and physical verification ensuring manufacturability.
CO5: Integrate advanced EDA techniques in a complete design flow and demonstrate through project work.

Module 1:

Introduction to Electronic Design Automation (EDA) Tools: Overview of EDA tools for electronic product design, Introduction to popular EDA software suites (e.g., Cadence, Synopsys, Mentor Graphics), Basic concepts of schematic capture, simulation, synthesis, and layout design.

Module 2:

Schematic Design and Simulation: Schematic capture techniques using EDA tools, Component selection, placement, and connectivity considerations, Introduction to simulation methodologies (e.g., transient, DC, AC, and transient analysis), Verifying circuit functionality, performance, and signal integrity through simulation.

Module 3:

Synthesis and Optimization: Principles of logic synthesis and optimization, Utilizing EDA tools for RTL (Register Transfer Level) synthesis, Optimization techniques for area, power, and timing constraints, Timing analysis and constraints setup for synchronous digital designs.

Module 4:

Layout Design and Physical Verification: Introduction to layout design principles and methodologies, Floor planning, placement, and routing techniques using EDA tools, Understanding Design Rule Checks (DRC) and Layout vs. Schematic (LVS) verification, Physical verification techniques to ensure design manufacturability and reliability.

Module 5:

Advanced Topics and Project Work: Advanced concepts such as analog/mixed-signal design, power analysis, and formal verification, Integration of EDA tools into a complete electronic product design flow, Hands-on project work involving the design, simulation, synthesis, layout, and verification of a complex electronic product using EDA tools, Presentation and documentation of project outcomes.

Labs / Practicals:

1. Schematic Design Exercise:
• Create a schematic diagram for a simple digital circuit using EDA software, ensuring proper component selection and connectivity.
2. Simulation Analysis:
• Conduct transient analysis on the designed circuit to verify its functionality and transient response using EDA simulation tools.
3. Logic Synthesis and Optimization Task:
• Perform RTL synthesis and optimization for a given digital design, optimizing for area, power, and timing constraints.
4. Timing Constraints Setup:
• Set up timing constraints and perform timing analysis for synchronous digital designs to ensure proper operation within specified timing requirements.

5. Layout Design Challenge:
• Design the layout for the synthesized digital circuit, considering floor planning, placement, and routing techniques to optimize layout area and signal integrity.
6. Design Rule Checks (DRC) Evaluation:
• Conduct DRC checks on the layout design to identify and rectify violations, ensuring compliance with manufacturing rules and constraints.
7. Layout vs. Schematic (LVS) Verification Task:
• Perform LVS verification to ensure consistency and accuracy between the schematic and layout designs, resolving any mismatches or discrepancies.
8. Physical Verification Assignment:
• Perform physical verification tasks including DRC, LVS, and other checks to ensure design manufacturability and reliability.
9. Advanced Design Exploration Project:
• Explore advanced design concepts such as analog/mixed-signal design or power analysis, implementing a small-scale project using EDA tools.
10. Comprehensive Project Presentation:
11. Present and document a comprehensive project involving the entire electronic product design flow, demonstrating proficiency in using EDA tools for design, simulation, synthesis, layout, and verification.

References:

1. "EDA for IC Implementation, Circuit Design, and Process Technology" by Luciano Lavagno, Igor L. Markov, and Louis K. Scheffer
2. "Digital Integrated Circuits: A Design Perspective" by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolić
3. "Introduction to VLSI Circuits and Systems" by John P. Uyemura
4. "SystemVerilog for Design" by Stuart Sutherland, Simon Davidmann, and Peter Flake
5. "ASIC Design in the Silicon Sandbox: A Complete Guide to Building Mixed-Signal Integrated Circuits" by Keith Barr

Course Code	Course Name	L	T	P	Cr
DOEE250095	Embedded Systems and Internet of Things	2	1	2	4

Course Outcomes:

CO1: Explain Intel and ARM Cortex-M processor architectures, microarchitectural techniques, and peripheral programming.
CO2: Apply ARM Cortex-M instruction sets and Thumb instruction sets in robotics applications using MSP432 kits.
CO3: Analyze communication networks, protocols, and challenges in IoT, including 5G and LPWAN technologies.
CO4: Implement IoT-specific low-power protocols (Zigbee, BLE, 6LoWPAN) and design application-oriented IoT solutions.
CO5: Evaluate modern networking concepts, IoT data analytics, cloud/fog computing, and lightweight cryptographic security solutions.

Module 1:

Introduction to Processor Architecture: Architecture of Intel processors from 80286 to Pentium-Microarchitectural techniques of advanced processors –pipelining-superscalar concept –Out of order execution –Speculative execution – branch prediction –register renaming -Multicore processors- Processors beyond Pentium-Architecture of ARM Cortex-M – NVIC – WIC--Sleep modes – peripheral programming of a Cortex-M processor.

Module 2:

Robotics Design And Application Instruction Set And Thumb Instruction Set: Robotics – Designing robotics applications using ARM cortex-M in MSP 432 Robotics kit GPU Processing.
Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions
Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions.

Module 3:

Communication and Networking in IoT: Review of Communication Networks, Challenges in Networking of IoT Nodes, range, bandwidth Machine-to-Machine (M2M) and IoT Technology Fundamentals, Medium Access Control (MAC) Protocols for M2M Communications Standards for the IoT Basics of 5G Cellular Networks and 5G IoT Communications, Low-Power Wide Area networks (LPWAN)Wireless communication for IoT: channel models, power budgets, data rates.Networking and communication aspects: IPv6, 6LoWPAN, COAP, MQTT, Operating Systems need and requirements for IoT..

Module 4:

IoT Protocols: Low power, low range protocols –Zigbee –BLE – 6LoWPAN. Applications for IoT-Smart home, city, agriculture etc, - IoT services Project work on Design and development of an IoT product.

Module 5:

Modern Networking: Cloud computing: Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud, Hypervisors, Comparison of Cloud providers, Cloud and Fog Ecosystem for IoT Review of architecture IoT Data analytics and Security: OLAP and OLTP, NoSQL databases, Row and column Oriented databases, Introduction to Columnar DBMS CStore , Run :Length and Bit vector Encoding, IoT Data Analytics. Cryptographic algorithms, Analysis of Light weight Cryptographic solutions IoT security, Key exchange using Elliptical Curve Cryptography, Comparative analysis of Cryptographic Library for IoT

Labs / Practicals:

Module 1: ARM Cortex-M Processor Basics
1. LED Blinking using ARM Cortex-M (MSP432)
o Objective: Blink an onboard LED using GPIO with a delay.
o Concepts: GPIO, delay loops, register-level programming or driverlib.
2. UART, I2C, and SPI Communication on MSP432
o Objective: Demonstrate UART, I2C, and SPI by sending/receiving data between MSP432 and peripheral/sensor (e.g., EEPROM, temperature sensor).
o Concepts: Serial communication protocols, data transfer, bus configuration.

Module 2: Thumb Instruction Set & Robotics
3. Basic Arithmetic Using ARM Thumb Assembly
o Objective: Perform addition, subtraction, and multiplication using Thumb instruction set in Keil IDE.
o Concepts: ARM registers, instruction format, branching.
4. PWM Motor Speed Control for Line Following Robot
o Objective: Control speed of DC motors using PWM to simulate a basic line following robot behavior.
Module 3: IoT Communication & Networking
5. Wi-Fi-based Sensor Data Transmission Using ESP32
o Objective: Interface DHT11/LM35 with ESP32 and send data over Wi-Fi to serial monitor.
o Concepts: Sensor interfacing, Wi-Fi configuration.
6. MQTT-based IoT Communication Using ESP32
o Objective: Publish temperature data to MQTT broker and subscribe from another node.
Module 4: IoT Protocols and Communication
7. BLE-based Smart Home Simulation
o Objective: Control an LED or fan using BLE from a smartphone app.
o Tools: ESP32 or nRF52 board, BLE scanner app.
8. Aries VAGA Processor-Based I2C/SPI Communication
o Objective: Demonstrate communication between Aries board (VAGA processor) and an I2C/SPI device like BMP180 or EEPROM.
o Concepts: Embedded communication, device addressing.

Module 5: Cloud Computing and Security
9. Sending Sensor Data to ThingSpeak Cloud
o Objective: Interface ESP32 with DHT11 and log temperature/humidity to ThingSpeak.
o Concepts: HTTP, REST APIs, IoT cloud platforms.
10. Client-Server Communication Using Socket Programming (Simulation)
• Objective: Write a basic client-server program using Python/C to simulate IoT node-to-server communication.
• Concepts: TCP/IP basics, socket programming.

References:

The x86 Microprocessors: 8086 to Pentium, Multicores, Atom, and the 8051 Microcontroller – Architecture, Programming and Interfacing
— Lyla B. Das, Second Edition, Pearson Education, India, 2014

Architecture, Programming, and Interfacing of Low-power Processors – ARM7, Cortex-M
— Lyla B. Das, Cengage, 2017

From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence
— Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, 1st Edition, Academic Press, 2014

Internet of Things: A Hands-On Approach
— Arshdeep Bahga, Vijay Madisetti, 2015

Understanding the Linux Kernel
— Daniel P. Bovet, Marco Cesati, 3rd Edition, O'Reilly, 2005

Course Code	Course Name	L	T	P	Cr
DOAI260001	AI (Industry)-Applied Ethics for AI	3	0	2	4

Course Outcomes:

CO1. Understand and be able to define and explain the terms 'AI for good' and 'responsible AI'. Describe the significance of responsible AI and recognize the potential benefits of AI in society.
CO2. Discuss and examine the impact of ethics on AI decision-making processes. Identify common ethical pitfalls in AI development and deployment. Explore methods for ethical AI practices.
CO3. Understand to apply an ethics-first approach to AI project planning and development. Compare different approaches to ethical AI design which include design of rules based on ethics and virtues. Identify factors influencing ethical decisions in AI development.
CO4. Apply Utilitarian and Kantian ethical principles to AI case studies, scenarios, and dilemmas. Explain the purpose and benefits of AI ethics codes. Develop a code of ethics for AI within an organization.
CO5. Identify the importance of interpretability in AI models. Evaluate the strengths and weaknesses of three different explainable AI tools: SHAP, LIME, and Tree Interpreter.
CO6. Conduct impact assessments for AI solutions. Apply ethical considerations in designing an AI system or solution. Implement measures to mitigate ethical risks and challenges post deployment.

Module 1:

Introduction to AI Ethics – meaning and importance, Role of Ethics in Responsible AI – defining 'AI for good' and 'responsible AI', significance of responsible AI in society, Common Ethical Pitfalls in AI – bias, fairness, accountability, transparency issues in AI development and deployment, Principles of Ethical AI – core principles guiding ethical AI, methods for ethical AI practices in development and deployment.

Module 2:

Ethics-First Approach in the AI Project Cycle – applying ethics at every stage of AI project planning and development, Approaches for Designing Ethical AI – rules-based ethics, values-based design, Introduction to Ethical Frameworks – overview of major ethical frameworks applied to AI, Virtue-Based Ethics – virtue ethics principles and the 4-box method for analysing ethical dilemmas, Applying Bio-Ethics Framework in AI – bioethical principles applied to AI in healthcare and biotechnology.

Module 3:

Utilitarianism for Ethical AI – utilitarian principles applied to AI case studies and dilemmas, Kantianism for Ethical AI – Kantian ethical principles applied to AI scenarios, Code of AI Ethics for Organizations – purpose, benefits and development of an organizational AI code of ethics, Data Protection and AI – risks of data breaches, privacy violations, responsible data handling.

Module 4:

Explainable AI – importance of interpretability in AI models, Intel XAI Toolkit, impact of explainability on decision-making and trust, Explainable AI in Practice – SHAP, LIME and Tree Interpreter tools: strengths, weaknesses and methods for applying them to analyze and interpret AI applications.

Module 5:

Impact Assessment of AI Solutions – conducting impact assessments for AI systems, Mitigating Ethical Issues Post Deployment – strategies to identify and resolve ethical risks after deployment, Project Creation – creating an AI startup with data card, model card, code of ethics, explainability report, impact self-assessment and transparency report.

Labs / Practicals:

1. Develop comprehensive Data Cards for datasets, as outlined in the Data Cards Playbook by Google, to ensure transparency and accountability in AI training data.
2. Design Responsible AI Best Practices.

3. Apply Human-Centered AI Canvas to design AI systems that address user needs and ethical considerations.
4. Learn to use The Box to embed AI principles into organizational workflows and operations.
5. Apply bio-ethics principles to AI case studies, scenarios, and dilemmas; evaluate the impact of virtue-based ethics on AI systems.
6. Develop AI ethics cards for given AI scenarios. Analyse a variety of ethical dilemmas by following the 4-box method from Virtue Ethics.
7. Analyse a variety of ethical dilemmas by walking through the ethical frameworks: Virtue Ethics, Bioethics, Utilitarian, Kantian, and Moral System Agnostic.
8. Develop an AI Code of Ethics for a fictitious company.
9. Use the UXAI Toolkit to brainstorm and plan different explainable interfaces for AI applications. Use the explainable AI library SHAP to create an explainability report for income prediction on the standard adult census income dataset.
10. Conduct impact assessments for AI solutions; create your own AI startup, develop business documents, write documentation (data card, model card, code of ethics, explainability report, impact self-assessment) and create and analyze transparency report.

References:

1. Intel AI for Future Workforce – Applied Ethics for AI Course Content, Intel Digital Readiness Program.
2. Virginia Eubanks – Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor, St. Martin's Press.
3. Cathy O'Neil – Weapons of Math Destruction, Crown Publishers.
4. Kate Crawford – Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence, Yale University Press.
5. Google Data Cards Playbook – https://pair-code.github.io/datacardsplaybook/

Course Code	Course Name	L	T	P	Cr
DOAI260002	AI (Industry)-Introduction to Artificial Intelligence	3	0	2	4

Course Outcomes:

CO1. Describe what AI is and what it is not. Appreciate the history of AI and its evolution over time.
CO2. Identify and analyze current trends in AI by correlating them with other technologies like IoT, Big Data and 5G.
CO3. Identify 3 common domains of AI – Natural Language Processing, Computer Vision and Statistical Data – based on the type of underlying data.
CO4. Examine and appreciate typical steps involved in an AI Project through the AI Project Cycle.
CO5. Examine the immediate impacts of AI practices on society and appreciate the ethical concerns of AI applications.
CO6. Classify Supervised Learning, Unsupervised Learning and Reinforcement Learning with the help of examples. Discuss the roles played by different key stakeholders in a typical AI team.

Module 1:

Demystification of AI – what AI is and what it is not, History and Evolution of AI, Current trends in AI, AI and Technology convergence, Industry 4.0 and Digitalization, Role of IoT, Big Data and 5G in AI, Domains of AI – Natural Language Processing, Computer Vision and Statistical Data.

Module 2:

AI Project Cycle-I – Problem Scoping and Data Acquisition, AI Project Cycle-II – Modelling and Evaluation, Societal Impact of AI – ethical concerns and responsible practices, Elements of ML – Supervised Learning, Unsupervised Learning and Reinforcement Learning with examples.

Module 3:

Elements of AI – types and characteristics, Data as Fuel for AI – structured and unstructured data, methods of data mining and data storage, AI/Data Science Team – roles and responsibilities of key stakeholders.

Module 4:

Tools to implement AI – No-Code tools (Teachable Machine, Orange, Roboflow, Chatfuel) and Code-based tools, Introduction to Neural Networks – working of simple Neural Networks, difference between common Deep Learning models with examples and applications.

Module 5:

AI Project-I – Natural Language Processing use case using no-code tool Chatfuel, AI Project-II – Statistical Data use case using no-code tool Orange Data Mining, AI Project-III – Computer Vision use case using no-code tool Roboflow, Future Possibilities of AI – emerging software and hardware technology trends and their direct impact on development of AI.

Labs / Practicals:

1. Familiarize with AI tools and techniques, including statistical data analysis using raw graphs, computer vision applications like Vision API, and generative AI tools such as DALL·E, Stable Diffusion, Gemini, and ChatGPT.
2. Apply the AI Project Cycle to real-world scenarios by identifying problems, collecting data, developing models, and evaluating their effectiveness to propose impactful AI-based solutions.
3. Deconstruct the working behind simple Neural Networks and outline the difference between some common DL models with the help of examples and applications.
4. Explore and utilize no-code tools, such as Teachable Machine, to build AI projects.
5. Project Building using No-code tool – Orange Data Mining for Statistical Data Use cases.
6. Project Building using No-code tool – Roboflow for Computer Vision Use cases.
7. Project Building using No-code tool – Chatfuel for Natural Language Processing Use cases.
8. Classify the type of data into structured and unstructured and evaluate data quality using real datasets.

9. Explore various AI domains by running Vision API experiments and comparing outcomes from NLP, CV, and Statistical Data use cases.
10. Demonstrate the AI Project Cycle on a chosen real-world problem from an industrial or social impact perspective and present findings.

References:

1. Intel AI for Future Workforce – Introduction to AI Course Content, Intel Digital Readiness Program.
2. Stuart Russell and Peter Norvig – Artificial Intelligence: A Modern Approach, Pearson Education.
3. Andreas Mueller and Sarah Guido – Introduction to Machine Learning with Python, O'Reilly Media.
4. Ian Goodfellow, Yoshua Bengio, and Aaron Courville – Deep Learning, MIT Press.
5. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media.

Course Code	Course Name	L	T	P	Cr
DOAI260003	AI (Industry)-Introduction to Generative AI	3	0	2	4

Course Outcomes:

CO1. Define Gen AI and distinguish its role in the broader context of AI. Describe how the basic model of Gen AI works. Discuss the wider societal impact of Gen AI.
CO2. Understand how NLP has evolved over time and the shift from Traditional AI to Gen AI. Understand Prompt Engineering and its impact on the output of NLP tasks.
CO3. Learn the limitations of current AI generation tools for video and audio. Recognize the challenges in ethical considerations and responsibilities when using generative AI tools.
CO4. Describe the stages of a generative AI project and learn to select and use appropriate AI tools for development.
CO5. Understand the basic structure of neural networks, architecture of transformer models, workings of diffusion models, and the pre-training process for generative AI models.
CO6. Learn to fine-tune generative AI models, understand RLHF, prototype Gen AI applications, and apply principles of responsible and ethical use of LLMs.

Module 1:

Introduction to Gen AI – definition and scope, role of Gen AI in the broader context of AI, how the basic model of Gen AI works, societal impact of Gen AI, Demystifying Gen AI Models – types of generative models (GANs, VAEs, Diffusion Models, LLMs), evolution of NLP to Gen AI, shift from Traditional AI to Gen AI.

Module 2:

Prompt Engineering-I – introduction to prompt engineering, basic applications and impact on NLP task outputs, text generation and conversation initiation, Prompt Engineering-II – advanced prompt engineering techniques for diverse NLP applications, real-world examples such as Mint Mobile Commercial, Basics of Video and Audio for Generation using Gen AI for Productivity-I – introduction to video generation tools (Runway ML, Genmo), text-to-video and image-to-video generation, limitations of current AI generation tools for video and audio.

Module 3:

Basics of Video and Audio for Generation using Gen AI for Productivity-II – audio and music generation using AIVA, code generation using Codeium, text generation using ChatGPT, Gemini and Perplexity, Generative AI-Ethics – ethical considerations, responsibilities and challenges when using generative AI tools, Generative AI Project Lifecycle – stages of a Gen AI project, selection of appropriate AI tools, Gen AI Tools for Development – open-source tools such as Stable Diffusion XL, proprietary tools such as Bing Image Creator powered by DALLE3.

Module 4:

Neural Network Fundamentals – basic structure and functioning of neural networks, how neural networks process data to make predictions, Transformers and the Evaluation of LLMs – architecture of transformer models, methods to evaluate large language models for performance and reliability, walkthrough of OpenAI Playground and parameter exploration, Diffusion Models and the Evaluation of Text to Image Generation – workings of diffusion models, evaluation of quality of text-to-image generation, Pre-Training Gen AI Models-I – pre-training process for generative AI models, importance of pre-training in building effective AI systems, modifying classification labels of Cohere datasets and its impact on fine-tuning and model confidence.

Module 5:

Fine-Tuning Gen AI Models – techniques for fine-tuning generative AI models to adapt them for specific tasks and applications, RLHF – Evaluating and Optimizing Gen AI Models: reinforcement learning with human feedback, evaluation and improvement of performance of generative AI models, Prototyping Gen AI Applications – skills to design, develop and test prototypes of generative AI applications, LangChain components – LLM, Agents, Prompts, Chains, Document loaders and utils with code-based implementation, LLM Application and Responsible use of AI – practical applications of large language models, ethical and responsible use of LLMs, building an AI

Tutor using open-source models such as Dolly 3B and Intel Neural Chat 7B.

Labs / Practicals:

1. Apply prompt engineering skills in basic NLP tasks, such as text generation, conversation initiation, and simple problem-solving.
2. Develop advanced prompt engineering skills for diverse NLP applications. Examine real-world prompt engineering examples, such as the Mint Mobile Commercial, to discern its role in marketing.
3. Explore cutting-edge Gen AI tools, their features, and capabilities for content generation including video and audio.
4. Explore open-source models such as Stable Diffusion XL and proprietary tools such as Bing Image Creator (powered by DALLE3) for image generation.
5. Text-to-video generation and image-to-video generation using tools like Runway ML and Genmo. Generate audio and music files using the tool AIVA.
6. Generate code by prompts using the tool Codeium. Generate text using tools like ChatGPT, Gemini, and Perplexity.
7. Walkthrough of OpenAI Playground. Explore how changing parameters can affect responses generated by different models.
8. Explore how modifying classification labels of Cohere datasets impacts fine-tuning and model confidence.
9. Explore basic components of LangChain like LLM, Agents, Prompts, Chains, and Document loaders and utils, along with a code-based implementation.
10. Utilize open-source text generation models such as Dolly 3B and Intel Neural Chat 7B for building an AI Tutor application.

References:

1. Intel AI for Future Workforce – Introduction to Generative AI Course Content, Intel Digital Readiness Program.
2. Antony Hagiwara – Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media.
3. Ashish Vaswani et al. – Attention is All You Need, Advances in Neural Information Processing Systems.
4. OpenAI – GPT-4 Technical Report, OpenAI.
5. Harrison Chase – LangChain Documentation – https://docs.langchain.com/

Course Code	Course Name	L	T	P	Cr
DOAI260004	AI (Industry)-Introduction to Machine Learning	3	0	2	4

Course Outcomes:

CO1. Describe Machine Learning and how Deep Learning is a subset of the wider field of Machine Learning.
CO2. Understand the importance of dashboards and discuss various applications of dashboards across different industries.
CO3. Explain the mathematical working behind different ML models. Implement different classification and regression ML models using Python.
CO4. Outline the difference between supervised, unsupervised and reinforcement learning algorithms. Examine the working of different reinforcement learning models.
CO5. Describe the working of Neural Networks and contrast it with biological Neurons. Describe various applications of neural networks. Outline different methods to overcome variance and bias in DL models.
CO6. Discuss and interpret the future of ML based on current and upcoming trends. Develop Python-based AI Projects incorporating Supervised Learning, Unsupervised Learning and Deep Neural Networks.

Module 1:

Introduction to Machine Learning – definition, types and applications, Relationship between AI, ML and Deep Learning, Tools to Implement AI (Python & Mathematics) – I: Python basics for ML, NumPy, Pandas, data manipulation.

Module 2:

Tools to Implement AI (Python & Mathematics) – II: mathematical foundations – linear algebra, statistics and probability, No-Code tool for Data Exploration – Tableau dashboard creation, data visualization techniques, statistical concepts implementation using no-code visualization tools.

Module 3:

AI (Modeling) Supervised Learning-I – Linear Regression, Logistic Regression, mathematical working behind models, classification and regression using Python, AI (Modeling) Supervised Learning-II – SVM, Decision Tree, industrial applications of ML models, AI (Modeling) Unsupervised Learning-I – K-Means Clustering, mathematics of clustering algorithms, AI (Modeling) Unsupervised Learning-II – Recommendation Systems, mathematics behind recommendation system, applications of recommendation systems.

Module 4:

Reinforcement Learning – definition, difference from supervised and unsupervised learning, working of reinforcement learning models with applications, Neural Network and Deep Learning-I – biological vs artificial Neurons, working of Neural Networks, applications of neural networks, Deep Learning-II – Convolutional Neural Networks, Recurrent Neural Networks, methods to overcome variance and bias in DL models, implementation using Python and deep learning frameworks, exploring OpenAI's Gym for reinforcement learning.

Module 5:

ML Project – Supervised Learning AI models: end-to-end Python project using classification/regression, ML Project – Unsupervised Learning AI models: end-to-end Python project using clustering, ML Project – Deep Neural Networks: building and training DNN in Python, Future of Machine Learning and Deep Learning – current and upcoming trends in ML and DL.

Labs / Practicals:

1. Interpret and understand the basic tools required for building ML Projects through a selected list of topics from Mathematics and Python Programming.
2. Develop and create a simple dashboard for visualizing data through Tableau.
3. Implement statistical concepts using the no-code visualization tool and create your own dashboard with the help of a no-code visualization tool.

4. Implement supervised machine learning algorithms, such as SVM and Decision Tree, using Python to develop a deeper understanding of their practical applications.
5. Implement unsupervised machine learning algorithms, such as K-Means, using Python to develop a deeper understanding of their practical applications.
6. Implement neural networks and create simple generative AI models using Python and deep learning frameworks, including exploring OpenAI's Gym for hands-on experience with AI and reinforcement learning.
7. Develop Python-based use cases and AI Projects incorporating Supervised Learning methods.
8. Develop Python-based use cases and AI Projects incorporating Unsupervised Learning methods.
9. Develop Python-based use cases and AI Projects incorporating Deep Neural Networks.
10. Implement a recommendation system using Python and evaluate its performance on a real-world dataset.

References:

1. Intel AI for Future Workforce – Introduction to Machine Learning Course Content, Intel Digital Readiness Program.
2. Andreas Mueller and Sarah Guido – Introduction to Machine Learning with Python, O'Reilly Media.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville – Deep Learning, MIT Press.
4. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media.
5. Christopher Bishop – Pattern Recognition and Machine Learning, Springer.

Course Code	Course Name	L	T	P	Cr
DCSA250057	Object Oriented Programming using C++	3	0	2	4

Course Outcomes:

CO1. Describe the different features of Object Oriented Programming.
CO2. Write programs to Implement the concepts of classes and objects.
CO3. Create new classes using the concepts of inheritance.
CO4. Apply knowledge of Polymorphism to solve real life problems.
CO5. Implement exception handling mechanism.

Module 1:

Introduction to Object Oriented Programming: Object Oriented Paradigm Objects and Classes, Features Object oriented Programming, Structured Vs Object Oriented Development, Features of Object Oriented Languages, Applications ofObjectOriented Programming, Merits and Limitations of Object Oriented Programming.Basic Data types, Basic Type modifiers, Derived Data types, Variables, Storage class specifiers, Initializing variables, Operators, Unformatted Console and stream I/O Functions, Formatted Console I/O Functions

Module 2:

Classes and Objects: Classes ,Class Members and Creating Objects, Member functions, Member Access Specifiers (public, private, protected), Static class member, Inline Functions, Arrays within a Class and Array of Objects, Passing Objects as function arguments and returning object from a function,Constructors, Overloaded Constructors, Null Contradictor, Copy Constructor, Destructors Constraints on Constructors and Destructors

Module 3:

Inheritance: Base and Derived classes, Accessing Base class members and Access Control, Overriding member functions, Multi Level, Multiple, Hierarchical& Hybrid Inheritance, Virtual Base Class.

Module 4:

Polymorphism: Fundamental of Polymorphism, Overloading Functions, Overloading Operators (Unary, binary, string manipulation using operator), Pointer to object and derived class, 'This' pointer, Virtual Functions, Early and Late Binding, Rules of Virtual Functions, Pure Virtual Function, Friend Functions.

Module 5:

File Handling, Exception Handling & Templates: Basic File Operations, File Handling, Classes for file stream operation, Opening and Closing Files, File modes File, Introduction to Exception Handling, Catching Class Types, Multiple Catch Handlers, Exception Specification, Generic Functions/Function Templates, Template Arguments.

Labs / Practicals:

1. Write a C++ program to demonstrate class and object creation.
2. Implement constructors and destructors in a C++ class.
3. Demonstrate function overloading and operator overloading in C++.
4. Create a program to implement single and multilevel inheritance.
5. Use virtual functions to implement runtime polymorphism.
6. Design a template class for stack or queue operations.
7. Demonstrate file handling using file streams in C++.
8. Implement a program using exception handling with multiple catch blocks.

References:

1. Object Oriented Programming With C++, E Balagurusamy
2. Object oriented programming in C++ , Robert Laffore
3. Introduction To Programming With C++, Diane Zak
4. Object oriented programming with C++ Reema Thareja

Course Code	Course Name	L	T	P	Cr
DCSE250113	Programming in Python	2	0	4	4

Course Outcomes:

CO1: Remember syntax rules, basic operators, and built-in features of Python 3.

CO2: Understand guiding principles and coding conventions from Zen of Python.

CO3: Apply object-oriented programming paradigms in design and practice.

CO4: Analyze the runtime efficiency and resource utilization of Python programs.

CO5: Evaluate the outcomes of programs manually with dry runs and trace tables.

CO6: Create modular and maintainable programs following Pythonic practices.

Module 1:

Constants, types, identifiers, keywords, comments, print, input, help functions.
Operator precedence and associativity, arithmetic operators (**, *, /, //, %, +, -).
Binary number system, bin function, bitwise operators (shift, &, ^, |), bit masking.
Relational and equality operators (== vs "is"), not, short-circuit evaluation (and, or).

Module 2:

Selection: if, elif, else, mutual exclusion, indent (space vs tab), nesting, pass.
Iteration: while loop, range of integers, in operator, for loop, break vs continue.
Function: parameters, arguments, return value, global, recursion, lambda, closure.
Modules: from, import, as, __name__, top-level module, avoiding circular imports.

Module 3:

ASCII and UTF-8, ord and chr functions, escape sequence, strings, docstring, regex.
Mutability, id function, object vs reference, is vs ==, interning, datetime module.
Ordered: list, tuple, negative indexing, slicing, sort with key, pack and unpack.
Unordered: set, dictionary (keys, values, items), subscript vs get method, None.

Module 4:

Class definition, self parameter in methods, constructor, attributes, instantiation.
Dot notation, type function, __str__ vs __repr__, methods for built-in operators.
Static attributes, annotations, private name mangling, getter and setter methods.
Inheritance, object, super, C3 linearization, ambiguous MRO, abstract base class.

Module 5:

Syntax errors vs runtime exceptions, traceback, try, except, else, finally, raise.
Matching except clause, except with multiple exceptions, finally with return.
Built-in exceptions, user-defined exception classes, exceptions with arguments, as.
Command-line arguments, file opening modes (read/write/append), with statement.

Labs / Practicals:

01. Test the precedence and associativity of arithmetic operators.

02. Test the bitwise operators and verify the results with bin function.

03. Test the relational operators (with and without chaining).

04. Test the short-circuit evaluation of and, or operators using function calls as operands.

05. Convert from metric prefix (KB/MB/GB/TB) to binary prefix (KiB/MiB/GiB/TiB).

06. Use if-elif-else ladder to print the grade as per the score obtained in a subject.

07. Find the mean, median, mode, variance, and standard deviation for a list of scores.

08. Print values using additive/subtractive rules of roman numerals: I, V, X, L, C, D, M.

09. Use string repetition with multiplication to generate patterns without nested loops.

10. Use nested loops to generate asymmetric and symmetric patterns of arbitrary size.

11. Check whether a given string is a palindrome (or not) without reversing the string.

12. Test positional arguments, default arguments, and keyword arguments for functions.

13. Write a function to check whether an indexed collection of numbers is already sorted.

14. Write a function for primality testing, and use it to find first n pairs of twin primes.

15. Write a function to generate the Collatz sequence (up to 1) for a positive integer.

16. Generate the terms of Fibonacci sequence using iterative and recursive approaches.

17. Print optimal sequence of moves for a given instance of “Towers of Hanoi” puzzle.

18. Find all combinations to make a given payment from a limited set of coin types.

19. Check if a letter is a vowel using two approaches: if-elif-else and in operator.

20. Find vowel count in a string using a lookup table for case-insensitive vowel check.

21. Write a regular expression to check whether a string is a valid email ID (or not).

22. Use case-insensitive and dot-insensitive matching to check if two email IDs are same.

23. Display a countdown timer in HH:MM:SS format using carriage return ("\r").

24. Get current time and find clockwise angles of hour hand, minute hand, second hand.

25. Find the day of week for any date in Gregorian calendar using doomsday algorithm.

26. Define Matrix class and implement these operators: unary +, unary -, +, -, *, ==.

27. Define Person class in a module and extend it with Student class in another module.

28. Incrementally generate roll numbers in Student constructor using a static counter.

29. Populate a list with Student instances and write their attributes in a new CSV file.

References:

1. "Python Tutorial" by Guido van Rossum and the Python development team
https://bugs.python.org/file47781/Tutorial_EDIT.pdf

2. "Think Python: How to Think Like a Computer Scientist (Second Edition)" by Allen Benjamin Downey
https://greenteapress.com/thinkpython2/thinkpython2.pdf

3. "Python for Everybody: Exploring Data in Python 3" by Charles Russell Severance
https://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf

4. "Beej's Guide to Python Programming" by Brian Hall
https://beej.us/guide/bgpython/pdf/bgpython_a4_c_2.pdf

5. "Learning Python: Powerful Object-Oriented Programming (Sixth Edition)" by Mark Lutz
https://learning-python.com

6. "Fluent Python: Clear, Concise, and Effective Programming (Second Edition)" by Luciano Ramalho
https://www.fluentpython.com

Course Code	Course Name	L	T	P	Cr
DCSE250056	Data Structures and Algorithms	3	0	2	4

Course Outcomes:

1)Classify Data structures
2)Describe Linear Data Structures
3)Explain Non-Linear Data Structures
4)Explain basic algorithmic concepts and recursion
5)Apply different Sorting and Searching Algorithms

Module 1:

Introduction to Data Structures:Basic Terminology, Classification of Data Structures, Operations on Data Structures

Module 2:

Linear Data Structures: Arrays: Introduction to Arrays, Representation in Memory, Operations on an Array, Two Dimensional Arrays
Linked Lists: Singly Linked List, Representation in Memory, Operations on a Single Linked List, Circular Linked Lists, Doubly Linked Lists.
Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on a Stack, Linked List Representation and Operations of Stack, Applications of Stacks-Infix-to-Postfix Transformation, evaluating Postfix Expressions.
Queues: Introduction to Queues, Array Representation of Queues, Operations on a Queue,
Linked List Representation and Operations of Queue, Types of Queues-DeQueue, Circular Queue, Applications of Queues-Round Robin Algorithm

Module 3:

Non Linear Data Structures:
Trees: Basic Terminologies, Definition and Concepts of Binary Trees, Representations of a Binary Tree using Arrays and Linked Lists, Operations on a Binary Tree-Insertion, Deletion, Traversals, Types of Binary Trees.
Graphs: Graph Terminologies, Representation of Graphs- Set, List, Matrix, Graph Traversals

Module 4:

Introduction to Algorithms:
Algorithms and flow charts, Time & Space complexity (definition only)
Recursion: Basic concepts and examples of recursion e.g. factorial problem, Fibonacci sequence.

Module 5:

Sorting & Searching Algorithms: Sorting Algorithms: Algorithms and their analysis (time and space) — Bubble sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap sort and Radix Sort
Searching Algorithms: Linear search — Binary search –Concept of Hashing.

Labs / Practicals:

1.Write a program to implement array
2.Write a program to add two matrices using two dimensional arrays
3.Write a program using recursive and non-recursive functions to perform search operation in a given list of integers using linear search technique
4.Write a program to implement search operation in a given list of integers using binary search technique

5.Write a program to implement insertion sorting for a given random data
6.Write a program to implement bubble sorting for a given random data
7.Write a program to implement quick sorting for a given random data
8.Write a program to implement selection sorting for a given random data.

References:

1)Data Structures, R.S. Salaria, Khanna Book Publishing, New Delhi
2)Data Structures Using C, Reema Thareja, Oxford University Press India.
3)Classic Data Structures, SamantaDebasis, Prentice Hall of India.
4)Fundamentals of Data Structure in C, Horowitz, Ellis, Sahni, Sartaj, AndersonFreed, Susan, University Press, India.
5)Data Structures: A Pseudo code approach with C, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India.
6)Data Structures and Algorithms: Concepts, Techniques and Applications, G. A. V. Pai, McGraw- Hill Education, India.
7)Introduction to Algorithms, T.H. Cormen, C.E. Leiserson, R. L. Rivest, C. Stein, MIT Press

Course Code	Course Name	L	T	P	Cr
DCSE250060	Database Management Systems	2	0	4	4

Course Outcomes:

CO1. Understand the basic database concepts, data models, schemas and instances.
CO2. Learn database design using Entity Relationship model and learn the use of constraints and relational algebra operations.
CO3. Gain proficiency in SQL and construct queries using SQL.
CO4. Understand the importance of normalization in database design.
CO5. Understand transaction processing, concurrency control and recovery

Module 1:

Introduction to Databases, File systems vs. Database systems, Characteristics of DBMS, Applications of DBMS, Advantages of using a DBMS, Database users and administrators, Three-level architecture of DBMS (ANSI/SPARC architecture), Data independence, Database schema, Instance, Generalization, Specialization, Structure of a DBMS, Overview of DBMS software (e.g., MySQL, SQL Server, Oracle, PostgreSQL)

Module 2:

Introduction to Data models: Hierarchical, Network, Relational, Object-oriented, Data Modeling using Entity Relationship (ER) model: entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples.
Relational data model: Concepts, schema, instances, keys, constraints, Relational algebra: Select, project, union, set difference, Cartesian product, joins, ER to Relational mapping, Relational algebra and relational calculus, Tuple Relational Calculus, Domain Relational Calculus

Module 3:

Structured Query Language (SQL): Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – 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 – Commit, Rollback, Save point, Cursors, Indexes, stored procedures, Triggers

Module 4:

Normalization – Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms – dependency preservation, Boyce/Codd normal form.
Higher Normal Forms - Introduction, Multi-valued dependencies and Fourth normal form, Join dependencies and Fifth normal form.

Module 5:

Transaction management and Concurrency control: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, and serializability concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, and database recovery management. Error recovery and logging, undo, redo, undo-redo logging and recovery methods, Introduction to database security concepts.

Labs / Practicals:

1. Create a database, define tables using DDL, apply constraints (Primary, Foreign, Not Null, Unique).
2. Insert, update, delete, and retrieve records using SQL DML commands.
3. Write SQL queries using WHERE, ORDER BY, GROUP BY, HAVING, LIKE, etc.
4. Write SQL queries to demonstrate the use of INNER JOIN, LEFT OUTER JOIN, RIGHT OUTER JOIN, and SELF JOIN using appropriate sample tables.
5. Write nested subqueries with IN, EXISTS, and ANY/ALL.

6. Draw ER diagram for a sample application (e.g., Library or Hospital), map it to relational schema.
7. Normalize sample unstructured data up to 3NF or BCNF. Implement before-and-after schemas in SQL.
8. Create and execute stored procedures/functions for common operations.

References:

1. Silberschatz, Korth, Sudarshan – Database System Concepts, McGraw Hill Year: 2020 (7th edition).
2. Elmasri and Navathe – Fundamentals of Database Systems, Pearson Edition 2016
3. Raghu Ramakrishnan, Johannes Gehrke – Database Management Systems, McGraw Hill
4. Database Systems Concepts Author H.f.Korth and Silberschatz Publisher McGraw Hill
5. Database System Author Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom Publisher Pearson Edition 2nd Edition
6. C.J. Date – An Introduction to Database Systems, Pearson

Course Code	Course Name	L	T	P	Cr
DCSE250037	Computer Networks and Security	3	0	2	4

Course Outcomes:

CO1: Understand the fundamentals of computer networks, including protocols, architectures, and networking technologies.
CO2: Analyze and design network architectures for efficient data transmission, routing, and switching.
CO3: Gain proficiency in network security concepts, including cryptography, authentication, and access control.
CO4: Explore advanced topics such as wireless networks, network management, and cloud computing.
CO5: Develop practical skills in configuring and securing network devices, conducting vulnerability assessments, and implementing security measures to protect against cyber threats.

Module 1:

Introduction:Data Communications, Networks, The Internet, Protocols and Standards, Network Models, Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite, Addressing, Physical Layer and Media, Data and Signals, Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission impairment, Data Rate Limits, Performance, Network topologies.

Module 2:

Physical and Data Link Layer:Bandwidth utilization: Multiplexing and Spreading, Multiplexing, Spread Spectrum, Transmission Media, Guided Media, Unguided Media: Wireless, Switching, Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Structure of a Switch, Introduction, Block Coding, Liner Block Codes, Cyclic Codes, Checksum, Data Link Control, Framing, Flow and Error Control, Protocols, Noiseless Channels, HDLC, Point-to-Point Protocol, Multiple Access, Random Access, Aloha, Controlled Access, Channelization, IEEE Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Bluetooth, Connecting LANs, Backbone Networks, and Virtual LANs, Connecting Devices, Backbone Networks, Virtual LANs, Sonet Networks, Virtual Tributaries, Virtual- Circuit Networks: Frame Relay and ATM, Frame Relay, ATM, ATM LANs.

Module 3:

Network Layer and Transport layer:Logical Addressing, IPv4 Addresses, IPv6 Addresses, Network Layer: Internet Protocol, Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Network Layer: Address Mapping, Error Reporting and Multicasting, Address Mapping, ICMP, IGMP, ICMPv6, Network Layer: Delivery, Forwarding and Routing, Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols. Process-Process Delivery: UDP, TCP and SCTP, Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, SCTP, Congestion Control and Quality of Service, Data Traffic, Congestion, Congestion Control, Two Examples, Quality Service, Techniques to improve QoS, Integrated Services, Differentiated Services, QoS in Switched Networks.

Module 4:

Application Layer : Domain Name System, Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Resolution, DNS Messages, Types of Records, Registrars, Dynamic Domain Name System (DDNS), Encapsulation, Remote Logging, Electronic Mail and File Transfer, Remote Logging, Telnet, Electronic Mail, File Transfer, WWW and HTTP: Architecture, Web Documents, HTTP, Network Management: SNMP, Network Management System, Simple Network Management Protocol (SNMP), Multimedia, Digitizing Audio and Video, Audio and Video Compression, Streaming Stored Audio/Video, Streaming Live Audio/Video, Real-Time Interactive Audio/Video, RTP, RTCP, Voice over IP.

Module 5:

Network Security:Security concepts and terminology TCP/IP and OSI network security access control issues (packet filters, firewalls) communication security (OSI layer security protocols) security tools cryptography- Public Key Cryptography And Its Application, Cyber Security and its application

Labs / Practicals:

1. Simulate and analyze different network topologies (bus, ring, star, mesh) using simulation tools like Cisco Packet Tracer or NS2.
2. Configure static and dynamic IP addressing in a LAN setup using network simulation software.
3. Implement error detection techniques such as parity check, checksum, and cyclic redundancy check (CRC) in C/C++.
4. Simulate flow and error control protocols such as Stop-and-Wait, Go-Back-N, and Selective Repeat ARQ.
5. Configure and test Ethernet and Wi-Fi connectivity using physical lab setup or simulator.
6. Demonstrate the working of switching (circuit, packet, and message switching) using practical scenarios or simulators.
7. Configure and test routing protocols like RIP, OSPF, and EIGRP using network simulation tools.
8. Demonstrate TCP and UDP socket programming using simple client-server communication in Python or C.
9. Implement encryption and decryption using Caesar Cipher, RSA, or AES algorithms in a high-level programming language.
10. Simulate firewall and packet filtering rules using open-source tools like Wireshark and IPtables.

References:

1. Data Communications and Networking, Fourth Edition by Behrouza A. Forouzan, TMH.
2. Computer Networks, A.S. Tanenbaum,4th edition, Pearson education.
3. Introduction to Data communications and Networking, W. Tomasi, Pearson education.
4. Data and Computer Communications, G.S. Hura and M. Singhal, CRC Press, Taylor and Francis Group.
5. An Engineering Approach to Computer Networks-S. Keshav,2nd Edition, Pearson Education
6. Understanding communications and Networks,3rd Edition, W. A. Shay, Cengage Learning.
7. "Modern Cryptography, Theory & Practice", Pearson Education. Wenbo Mao
8. "Computer Security", Pearson Education. Matt Bishop

Course Code	Course Name	L	T	P	Cr
DOEE250159	Power Electronics	3	0	2	4

Course Outcomes:

CO1: Analyze the characteristics, switching behavior, and protection of power semiconductor devices like SCR, IGBT, and MOSFET.
CO2: Design and evaluate rectifiers, choppers, and inverters for different power conversion applications.
CO3: Understand the structure and protective components of power systems, including smart grid and renewable integration.
CO4: Apply power management techniques in embedded systems, battery-operated devices, and low-power applications.
CO5: Evaluate and explain the role of power electronics in motor drives, EVs, and renewable energy conversion systems.

Module 1:

Power Semiconductor Devices and Switching Fundamentals: Power semiconductor devices: characteristics and operation of power diodes, SCR, TRIAC, DIAC, BJT, MOSFET, and IGBT. Switching characteristics, gate triggering methods, turn-on and turn-off processes, and thermal management. Commutation techniques and protection circuits including snubbers and freewheeling diodes. Comparison and selection of devices based on application requirements.

Module 2:

Power Converters – Rectifiers, Choppers, and Inverters: AC-DC converters: uncontrolled and controlled rectifiers (single-phase and three-phase), half and full converters, output characteristics, and power factor control. DC-DC converters: step-down (buck), step-up (boost), buck-boost and Cuk converters, operation in continuous and discontinuous modes. DC-AC inverters: single-phase and three-phase, PWM techniques (sine PWM, SVPWM), harmonic reduction and inverter applications.

Module 3:

Power System Design and Protection: Structure of electrical power systems: generation, transmission, and distribution. Components of power systems: generators, transformers, cables, circuit breakers, and substations. Basics of load estimation, transformer selection, and cable sizing. Earthing and lightning protection. Protective devices: relays, fuses, MCBs, and surge protectors. Introduction to smart grid systems and renewable energy integration.

Module 4:

Power Management in Electronic Systems: Power supply design: linear voltage regulators (LDOs) and switching mode power supplies (SMPS). Battery management systems: battery types, charging techniques, protection circuits, and SoC estimation. Low-power design strategies in embedded systems: dynamic voltage and frequency scaling (DVFS), sleep modes, and power gating. Energy harvesting techniques using solar, vibration, and RF energy sources for low-power devices.

Module 5:

Applications of Power Electronics in Modern Systems: Applications of power electronics in motor drives: DC motors, induction motors, BLDC and stepper motors. Overview of variable frequency drives (VFDs). Role of power electronics in renewable energy systems such as solar and wind energy converters. Introduction to electric vehicle power electronics: traction inverters, DC-DC converters, and onboard chargers. Design insights into UPS, SMPS, and real-world power management ICs.

Labs / Practicals:

1. V-I Characteristics of SCR, TRIAC, and DIAC

- o Observe and plot the static characteristics under different gate triggering conditions.

2. Gate Triggering Circuits for SCR
- o Design and test gate triggering using R, RC, and UJT-based methods.

3. Single-Phase Controlled Rectifier
- o Implement half-wave and full-wave controlled rectifiers using SCRs and analyze the output waveforms.

4. DC-DC Buck and Boost Converter
- o Design and simulate buck and boost converters and evaluate efficiency and voltage regulation.

5. Single-Phase PWM Inverter
- o Implement a PWM-based inverter using MOSFETs or IGBTs and analyze output waveform and harmonics.

6. Design of a Switching Mode Power Supply (SMPS)
- o Construct a simple SMPS circuit and evaluate performance parameters such as ripple and efficiency.

7. Battery Charging Circuit with Protection
- o Design a Li-ion battery charger with overcurrent and overvoltage protection.

8. Simulation of Three-Phase Inverter using MATLAB/Simulink
- o Generate PWM signals and study the output waveform and THD.

9. Speed Control of DC Motor using Chopper
- o Implement chopper-based speed control and observe the relationship between duty cycle and motor speed.

10. Energy Harvesting Circuit (Solar or Piezo)
    Build a small-scale solar energy harvesting setup to power a low-voltage load (e.g., LED or sensor node).

References:

1 P.C. Sen , “ Power Electronics ”, Tata McGraw Hill
2 M.H. Rashid , “ Power Electronics ” , John Wiley & Sons
3 General Electric, “ SCR manual ”
4 G. K. Dubey, S. R Doradle, “ Thyristorised Power Controller ”
5 J. M. Jalnekar and N. B. Pasalkar, “ Power Electronics ” Technical Publication
6 Ned Mohan, T.M. Undeland and W.P. Robbins, “ Power Electronics: Converters, Applications and Design”, John Wiley, Singapore, 1994
7 M D Singh and K. B Khanchandani, “ Power Electronics ”, Tata McGraw Hill
8 B.K.Bose, “Power Electronics & A.C. Drives”, Prentice Hall, 1986.

Course Code	Course Name	L	T	P	Cr
DOEE250157	PCB Designing	3	0	2	4

Course Outcomes:

CO1: Explain PCB evolution, classifications, materials, standards, and applications across industries.
CO2: Apply PCB design flow, rules, constraints, and CAD tools for schematic-to-layout development.
CO3: Analyze PCB layout, routing, high-speed design, EMI/DFM/DFT considerations for reliable circuits.
CO4: Describe PCB fabrication processes, multilayer techniques, finishes, and quality inspection methods.
CO5: Evaluate PCB assembly, soldering, testing, reliability, and thermal management practices.

Module 1:

Introduction to PCB Technology: History and evolution of PCB technology, Classification: single-sided, double-sided, multi-layer, flexible PCBs, PCB materials: substrate types (FR4, CEM, polyimide, Rogers), PCB design standards: IPC specifications, Applications in consumer, automotive, industrial, and high-frequency electronics.

Module 2:

PCB Design Fundamentals: Design flow: schematic capture to layout, Component libraries and footprints, Design rules and constraints: trace width, spacing, via sizes, Netlist and design rule checking (DRC), CAD tools overview (Altium Designer, KiCAD, OrCAD).

Module 3:

PCB Layout and High-Speed Design: Component placement strategies for signal integrity and manufacturability, Routing techniques: single-ended and differential pairs, Power and ground planes: decoupling and EMI considerations, High-speed design practices: impedance control, crosstalk mitigation, Design for manufacturability (DFM) and design for testability (DFT).

Module 4:

PCB Fabrication Processes: Photolithography and pattern transfer, Etching, drilling, and plating techniques, Multilayer PCB lamination and via formation (PTH, blind, buried vias), Solder mask, silkscreen, and surface finishes (HASL, ENIG, OSP), Quality control and inspection: AOI, flying probe, X-ray inspection.

Module 5:

PCB Assembly, Testing, and Relatability: Assembly methods: through-hole and surface mount technology (SMT), Soldering techniques: reflow, wave soldering, Rework and repair techniques, PCB testing methods: in-circuit testing (ICT), functional testing, boundary scan, Failure analysis, reliability and thermal management.

Labs / Practicals:

1. Schematic capture and netlist generation.
2. Creating footprints and libraries.
3. PCB layout design using EDA tools.
4. Design rule check (DRC) and electrical rule check (ERC).
5. Generating Gerber files for fabrication.
6. PCB assembly practice and soldering techniques.
7. Basic testing and troubleshooting of fabricated PCBs.
8. Thermal analysis and heat dissipation techniques in PCB design

Objective: Analyze heat flow and incorporate thermal management features in PCB layouts.

9. Design for manufacturability (DFM) and design for testability (DFT) evaluation of PCB layouts

Objective: Evaluate and modify PCB designs to meet DFM and DFT standards.

10. Silkscreen and solder mask layer design and verification

Objective: Add and validate silkscreen markings and solder mask layers in the PCB design for assembly readiness.

References:

1 Printed Circuit Boards: Design and Technology, Walter C Bosshart ,Tata McGraw- hill publication
2 Printed Circuit Boards: Design, Fabrication, Assembly & Testing, R S Khandpur, Tata McGraw-hill publication
3 Printed Circuit Boards, Coombs Clyde F., Tata McGraw-hill publication
4 The Design & Drafting of Analog Printed Circuit boards, Darryl Lindsey, Bishop Graphics Inc
5 Printed Circuit Boards: Design Techniques For EMC Compliance, Montrose Mark I, IEEE Press Series of Electronics Technology

Course Code	Course Name	L	T	P	Cr
DOEE250190	Transmission Lines and PCB Technology	2	0	4	4

Course Outcomes:

CO1: Explain the fundamentals of transmission lines, wave propagation, reflection, VSWR, losses, and Smith chart applications.
CO2: Apply impedance matching techniques and analyze signal integrity issues in time and frequency domains.
CO3: Describe PCB materials, fabrication techniques, and industry standards for reliable design.
CO4: Design PCB layouts considering component placement, trace routing, grounding, DFM, and DFT guidelines.
CO5: Evaluate PCB assembly, inspection, testing methods, and troubleshoot common PCB issues.

Module 1:

Fundamentals of Transmission Lines: Transmission line theory: distributed parameters, wave propagation, Types: coaxial, microstrip, stripline, twin-lead, waveguides, Reflection coefficient, standing waves, VSWR, Losses in transmission lines, Smith Chart: basic applications.

Module 2:

Impedance Matching and Signal Integrity: Impedance transformation., Quarter-wave transformers, Single and double stub matching, Signal integrity: crosstalk, ringing, reflections, Time domain and frequency domain analysis.

Module 3:

PCB Materials and Fabrication Techniques : Types of PCB materials: FR4, polyimide, Rogers substrates, PCB layers: single, double, multi-layer, PCB manufacturing steps: patterning, etching, drilling, plating, solder masking, silkscreen. Design rules and standards (IPC standards).

Module 4:

PCB Design and Layout Guidelines: Schematic capture and component placement, Trace routing: controlled impedance traces, Grounding and power planes, High-speed PCB design considerations, Design for manufacturability (DFM) and design for testability (DFT)

Module 5:

PCB Assembly, Testing, and Troubleshooting: PCB assembly techniques: through-hole and surface-mount, Soldering methods: reflow, wave soldering, PCB inspection methods: AOI, X-ray, ICT, Testing signal integrity and transmission line effects on PCB, Troubleshooting common PCB issues.

Labs / Practicals:

1. Simulation of transmission lines using CAD tools.
2. Smith Chart exercises and impedance matching design.
3. Hands-on schematic and PCB layout using EDA software (e.g., Altium, KiCAD, OrCAD).
4. PCB fabrication: etching and drilling a simple circuit.
5. PCB assembly and soldering practice.
6. Signal testing on transmission line PCB prototypes using oscilloscope and network analyzer.
7. Crosstalk and signal integrity analysis in PCB layouts.
8. Design and implementation of a quarter-wave transformer for impedance matching.
9. Thermal analysis and power plane design in multilayer PCBs.
10. Visual inspection and fault diagnosis of assembled PCB.

References:

1 Printed Circuit Boards: Design and Technology, Walter C Bosshart ,Tata McGraw- hill publication
2 Printed Circuit Boards: Design, Fabrication, Assembly & Testing, R S Khandpur, Tata McGraw-hill publication
3 Printed Circuit Boards, Coombs Clyde F., Tata McGraw-hill publication
4 The Design & Drafting of Analog Printed Circuit boards, Darryl Lindsey, Bishop Graphics Inc
5 Printed Circuit Boards: Design Techniques For EMC Compliance, Montrose Mark I, IEEE Press Series of Electronics Technology

Course Code	Course Name	L	T	P	Cr
DOAI250005	Artificial Intelligence and Machine Learning	2	0	4	4

Course Outcomes:

CO1: Understand AI problem-solving techniques, heuristic search algorithms, and reinforcement learning.
CO2: Apply knowledge representation, logic-based reasoning, and probabilistic models in AI systems.
CO3: Develop and evaluate machine learning models using supervised and unsupervised learning techniques.
CO4: Design and implement deep learning architectures for vision, language, and sequential data applications.
CO5: Analyze advanced AI methods, ethical challenges, and emerging trends in artificial intelligence.

Module 1:

AI Techniques and Search Strategies
History of AI, problem-solving using search, uninformed vs. informed search, heuristic search techniques (Hill Climbing, Simulated Annealing, A* Algorithm), adversarial search (Minimax Algorithm, Alpha-Beta Pruning), AI-driven game strategies (Chess, Chinese Checkers), Reinforcement Learning fundamentals (Markov Decision Processes, Q-learning), heuristic optimization techniques (Genetic Algorithms, Particle Swarm Optimization).

Module 2:

Knowledge Representation, Reasoning, and Probabilistic Models
Propositional logic, inference mechanisms, forward and backward chaining, probabilistic reasoning techniques (Bayesian Networks, Markov Models, Probabilistic Graphical Models), logic-based AI vs. machine learning-driven reasoning, Natural Language Processing (NLP) fundamentals (tokenization, embeddings, language models), AI-driven text processing, machine translation.

Module 3:

Machine Learning Fundamentals and Neural Networks
Supervised and unsupervised learning paradigms, classification and regression techniques (decision trees, support vector machines, ensemble learning methods: Random Forest, XGBoost), artificial neural networks (activation functions, loss functions, back propagation, multilayer perceptions), overfitting, bias-variance tradeoff, hyperparameter tuning, performance evaluation metrics (precision-recall, ROC curves, F1-score).

Module 4:

Deep Learning and Advanced Neural Architectures
Convolutional Neural Networks (CNNs) for image classification and object detection (convolution layers, pooling, fully connected layers), Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks for sequential data processing, Transformer models (BERT, GPT) for NLP applications, optimization techniques (batch normalization, dropout regularization, transfer learning), deep learning applications (medical imaging, self-driving vehicles, generative AI).

Module 5:

Unsupervised Learning, Generative Models, and Ethical AI
Clustering techniques (K-Means, Hierarchical Clustering), Autoencoders, Generative Adversarial Networks (GANs), self-supervised learning, foundation models in AI, AI applications in healthcare, finance, and autonomous systems, AI ethics (fairness, bias mitigation, adversarial attacks, explainable AI), advancements in AI (quantum computing, federated learning, AI governance frameworks).

Labs / Practicals:

1. Implement a basic uninformed search algorithm (e.g., Breadth-First Search, Depth-First Search).
2. Implement informed search algorithms using heuristics (e.g., A* Algorithm for pathfinding).
3. Implement the Hill Climbing algorithm for local search problems.
4. Develop a solution using Simulated Annealing for optimization problems.
5. Implement the Minimax algorithm to solve a simple game (e.g., Tic-Tac-Toe).
6. Implement Alpha-Beta Pruning for optimizing the Minimax algorithm.
7. Build a Reinforcement Learning agent using Q-learning to solve a basic maze problem.
8. Implement Genetic Algorithms to solve optimization problems (e.g., travelling salesman).
9. Build a Particle Swarm Optimization model for function optimization.
10. Implement propositional logic and inference mechanisms (e.g., forward and backward chaining).
11. Develop a basic Bayesian Network for probabilistic reasoning.

References:

1.Tom M. Mitchell: Machine Learning. McGraw Hill
2.Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig
3.Pattern Recognition and Machine Learning by Christopher M. Bishop
4.Machine Learning: A Probabilistic Perspective by Kevin P. Murphy
5.Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto
6.Natural Language Processing with Python by Steven Bird, Ewan Klein, and Edward Loper
7.The Elements of Statistical Learning" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
8.Michael Nielsen: Neural Networks and Deep Learning (free online book)
9.Stuart Russel & Peter Norvig: Artificial Intelligence– A Modern Approach. Pearson, 4th edition, 2023
10.Deep Learning (Adaptive Computation and Machine Learning series) Illustrated Edition, by Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, London

Course Code	Course Name	L	T	P	Cr
DOAI250043	Pattern Recognition	3	0	2	4

Course Outcomes:

CO1: Understand the fundamentals of pattern recognition, probability, discriminant functions, and supervised learning methods.
CO2: Apply clustering techniques for unsupervised learning and validate cluster quality.
CO3: Perform feature extraction and selection using statistical, transform-based, and dimensionality reduction methods.
CO4: Implement classification techniques using HMMs, SVMs, and feature selection methods.
CO5: Apply fuzzy logic and genetic algorithms for pattern classification in real-world case studies.

Module 1:

Overview of Pattern recognition – Basics of Probability and Statistics, Linear Algebra, Linear Transformations, Components of Pattern Recognition System, Learning and adaptation Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

Module 2:

Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.

Module 3:

Feature Extraction and Feature Selection: Feature extraction – discrete cosine and sine transform, Discrete Fourier transform, Principal Component analysis, Kernel Principal Component Analysis. Feature selection – class separability measures, Feature Selection Algorithms - Branch and bound algorithm, sequential forward / backward selection algorithms. Principle component analysis, Independent component analysis, Linear discriminant analysis, Feature selection through functional approximation – Elements of formal grammars.

Module 4:

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

Module 5:

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception

Labs / Practicals:

1. Implementation of Minimum Distance Classifier
   - o Classify patterns using Euclidean distance-based decision rules.
2. Supervised Learning using Bayesian Classifier with Gaussian Assumptions
   - o Implement Bayesian classification with maximum likelihood parameter estimation.
3. Unsupervised Learning using C-Means Clustering Algorithm
   - o Perform clustering on multivariate data using the C-Means algorithm.
4. Hierarchical Clustering and Dendrogram Visualization
   - o Apply hierarchical clustering and plot dendrograms for visual analysis.
5. Feature Extraction using PCA and Kernel PCA
   - o Extract features and reduce dimensionality using PCA and Kernel PCA.
6. Sequential Forward Feature Selection Algorithm
   - o Implement and evaluate sequential forward feature selection technique.
7. Design and Training of Hidden Markov Model (HMM)
   - o Train an HMM and use it for classification of sequential data.

8. Support Vector Machine Classification using scikit-learn
o Train an SVM with linear and nonlinear kernels for binary/multi-class classification.
9. Pattern Classification using Fuzzy Inference Systems
o Implement a fuzzy rule-based classifier using membership functions.
10. Feature Selection using Genetic Algorithms
• Apply genetic algorithm for optimal feature subset selection in classification problems.

References:

1. Andrew Webb, “Statistical Pattern Recognition”, Arnold publishers, London,1999.
2. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
3. M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.
4. Menahem Friedman, Abraham Kandel, “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific publishing Co. Ltd, 2000.
5. Robe

Course Code	Course Name	L	T	P	Cr
DOAI260041	Natural Language Processing	2	0	4	4

Course Outcomes:

CO1. Develop the ability to collect, preprocess, and analyze textual data using NLP techniques and Python libraries
CO2. Apply text representation techniques and machine learning algorithms to build, train, and evaluate NLP classification models using appropriate performance metrics.
CO3. Develop and apply advanced NLP techniques for information extraction, text summarization, question answering, sentiment analysis, and topic modelling in real-world applications.
CO4. Design, develop, and deploy intelligent chatbot systems using rule-based and neural network-based NLP techniques following the AI project development cycle.
CO5. Evaluate and apply modern NLP concepts including Large Language Models, prompt engineering, ethical AI practices, and model interpretability techniques for responsible deployment of NLP solutions

Module 1:

Introduction to NLP, Data Collection and Processing for NLP – definition and current applications of Natural Language Processing, exploration of text data, text preprocessing pipeline – sentence segmentation, tokenization, stop word removal, stemming, lemmatization, part-of-speech tagging, handling and cleaning raw text data in Python.

Module 2:

Classification for NLP – Bag of Words (BoW) representation of text data, TF-IDF (Term Frequency-Inverse Document Frequency) format, Introduction to word embeddings. Model building for text classification – Naive Bayes classifier, Logistic Regression classifier, training and evaluating the classification model, performance metrics – precision, recall, F1-score, confusion matrix. Roadmap from MLP to LSTM and LSTM to Transformers. Attention Mechanism, Transformer architecture (BERT and GPT). Transformer-based text representation using BERT.

Module 3:

Advanced NLP Tasks and Applications - Named Entity Recognition (NER) and Relation Extraction, Text Summarization: Extractive and Abstractive Approaches, Advanced Question Answering Systems (Open-Domain, Generative QA), Sentiment Analysis and Opinion Mining, Topic Modelling. Applications of BERT in NER, sentiment analysis, and question answering, Coreference resolution, Information extraction.

Module 4:

Chatbot architecture, cosine similarity for rule-based chatbots, neural network-based intent recognition, chatbot training, and building/testing chatbots in Python. Application of the AI Project Cycle for chatbot development, including problem scoping, Data Preprocessing, Classification Model Development, and Evaluation.

Module 5:

Current Topics, Ethics, and Deployment, Large Language Models (LLMs), Capabilities and Prompt Engineering, Bias, Fairness, and Ethical Considerations in NLP Models, Model Debugging, NLP Interpretability and Explainability.

Labs / Practicals:

Explore text data that has been downloaded and processed from a given corpus.
2. Process textual data by sentence segmentation, tokenization, and stop word removal using NLTK/spaCy in Python.
3. Express data in a bag of words format and use the TFIDF format to represent text features.
4. Construct a separate dataset for model training, including train-test split and cross-validation.
5. Construct and train a text classification model using Naive Bayes or Logistic Regression in Python.

6. Evaluate the classification model using precision, recall, F1-score, and confusion matrix.
7. Implement Named Entity Recognition and relation extraction for identifying entities and relationships in text.
8. Perform text summarization using extractive and abstractive techniques, and compare the generated summaries.
9. Develop NLP applications for sentiment analysis, topic modelling, and question answering using sample datasets.
10. Use cosine similarity to build and train a simple rule-based Chatbot.
11. Use a neural network to train a more advanced Chatbot capable of intent recognition.
12. Apply the AI Project Cycle for the Hotel Chatbot problem: data collection, pre-processing, model training, and deployment.
13. Apply AI Project Cycle to develop a complete AI solution for an NLP project of choice, documenting all stages from data collection to evaluation.
14. Explore LLM capabilities using prompt engineering for NLP tasks and analyze ethical issues such as bias and fairness.
15. Apply SHAP and LIME for NLP model interpretability, debugging, and ethical analysis.

References:

Intel AI for Future Workforce – Natural Language Processing Course Content, Intel Digital Readiness Program.
2. Steven Bird, Ewan Klein, and Edward Loper – Natural Language Processing with Python, O'Reilly Media.
3. Delip Rao and Brian McMahan – Natural Language Processing with PyTorch, O'Reilly Media.
4. Yoav Goldberg – Neural Network Methods for Natural Language Processing, Morgan and Claypool Publishers.
5. Jacob Devlin et al. – BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding, Google AI.
6. Practical Natural Language Processing, Sowmya Vajjala et al. O’Reilly
7. “Attention Is All You Need”, 31st Conference on Neural Information Processing Systems (NIPS 2017), Long Beach, CA, USA.