JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

(Established by Andhra Pradesh Act No.30 of 2008)

Kakinada – 533 003, Andhra Pradesh (India)

Vision and Mission of the University

Vision

The University is primarily promoting quality of education in the areas of Science, Technology, Engineering, Mathematics (STEM) and also Management disciplines, as academic pillars of education, to excel in teaching, learning, research, consultancy, placements through innovative practices with a global perspective and entrepreneurship skills

Mission

The University is moving forward with a mission of promoting excellence, access, inclusion, and relevance in quality in Science, Technology, Engineering, Mathematics, and Management disciplines, viz.,

- Design an Industry relevant curriculum from time to time with a Global perspective.
- Promoting quality education by embracing ICT delivery mechanism with continuous pedagogy through e-learning mechanism.
- Spread across for industry collaborations with a focus on pre-training and placements for technology transfer to society.
- Establishing centre of excellence to promote research and innovations in multidisciplinary areas to bring in patent culture and consultancy practices.
- International Collaborations for student outreach facilitating international students to study in JNTUK to infuse cross-culture learning practices.
- Academic Excellence, Research & Innovation, People Technology & Creativity, Social & Environmental Responsibility, Human & Intellectual Knowledge.

Vision and Mission of the Institute

Vision and Mission of the Department

B. Tech Program Course Structure & Syllabus

B. Tech

Program Educational Objectives (PEOs) – Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve

BoS needs to include PEOs (Three to Five)

Mapping of PEOs with Mission statements

	PEO1	PEO2	PEO3	PEO4
M1				
M2				
M3				
M4				

Program Outcomes (POs)

POs are statements that describe what students are expected to know and be able to do upon completion of the program. These relate to the skills, knowledge, attitude and analytical ability and behavior that students acquire through the program.

(As defined by NBA)

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for

i) independent and life-long learning
ii) adaptability to new and emerging technologies and
iii) critical thinking in the broadest context of technological change.

BoS needs to include up to THREE Program Specific Outcomes (PSOs)

Categories of Courses:

BSC : Basic Science Courses
HSM : Humanities, Social Sciences including Management
ESC : Engineering Science Courses
PCC : Professional Core Courses
PEC : Professional Elective Courses (including Skill Enhancement)
OEC : Open Elective Courses (including Free 1 credit courses)
MNC : Mandatory Non-Credit Courses

S. No	Category	AICTE	%	JNTUK	%
1	Humanities and Social Sciences including Management Courses	6	3-4%	7.5	4-5%
2	Basic Science Courses	24	14-15%	21	12-13%
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/ computer / AI Applications, Design Thinking etc	20	12-13%	22.5	13-14%
4	Professional core courses	58	35-36%	60	36-37%
5	Professional Elective specialization/branch courses relevant to chosen including Skill enhanced	26	15-16%	25	15-16%
6	Indian Knowledge System	2	1-2%	---	---
7	Multidisciplinary Open Electives Courses	12	7-8%	12	7-8%
8	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	16	9-10%	14	9-10%
9	Non-credit Mandatory Courses – Universal Human Values, Environmental Science, Constitution of India, Indian Knowledge System, Research Methodology & Intellectual Property Rights, Sports & Yoga, Indian Knowledge System	0	0	0	0
		164		164	

B. Tech. – I Year I Semester

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	BSC		Linear Algebra and Calculus	3	0	0	3
2	BSC		Applied Chemistry for Emerging Technologies	3	0	0	3
3	ESC		C and Data Structures	4	0	0	4
4	ESC		AI Tools and Applications	0	1	3	2.5
5	ESC		Design Thinking and Innovation	0	1	3	2.5
6	BSC		Applied Chemistry for Emerging Technologies Lab	0	0	3	1.5
7	ESC		C and Data Structures Lab	0	0	3	1.5
8	ESC		IT and Electronics Workshop	0	0	3	1.5
9	MNC		Universal Human Values-II	2	0	0	0
							19.5

B. Tech (I year - II Semester) – II semester

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	HSM		English for Technical Communication	3	0	0	3
2	BSC		Differential Equations and Vector Calculus	3	0	0	3
3	BSC		Physics for advanced computing	3	0	0	3
4	ESC		Computational Thinking and Problem Solving using Python	3	0	0	3
5	ESC		Digital Logic Design	3	0	0	3
6	ESC		Basic Electrical and Electronics Engineering	3	0	0	3
7	HSM		English for Technical Communications and MOODLES laboratory	0	0	3	1.5
8	ESC		Computational Thinking and Problem Solving using Python Lab	0	0	3	1.5
9	BSC		Physics for Advanced Computing Lab	0	0	3	1.5
10	MNC		NSS/NCC	0	0	2	0
		Total		**15**	**1**	**11**	**22.5**

B. Tech.– II Year I Semester (III Semester)

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	BSC		Statistical methods for Data science	3	0	0	3
2	BSC		Discrete Mathematics	3	0	0	3
3	PCC		Fundamentals of Data Science	3	0	0	3
4	PCC		Object-Oriented Programming Through JAVA	3	0	0	3
5	PCC		Data Analysis and Visualization (Pandas/NumPy)	3	0	0	3
6	PEC		A minimum of 6 to 8-Week NPTEL /SWAYAM / course on Mobile App Development (Student can choose any one of the following) • Flutter • Android • Reactive native • Hybrid app development using technologies like HTML5, CSS3 and Java Script. **(or)** • Mobile App Development using flutter (off line offered by the Department) 1. **(*If the course is not available in the online, then offer the same course through off line)**	0	0	3	1.5
7	PCC		Data Science Lab	0	0	3	1.5
8	PCC		Object-Oriented Programming Through JAVA	0	0	3	1.5
9	PCC		Data Analysis and Visualization (Pandas/NumPy) Lab	0	0	3	1.5
10	MNC		Environmental Science for Engineers	2	0	0	0
Total				**17**	**0**	**12**	**21**

B. Tech. II Year II Semester (IV Semester)

S. No	**Course category**	Course Code	Title	L	T	P	Credits
1	PCC		Computer Organization	3	0	0	3
2	PCC		Data Engineering	3	0	0	3
3	PCC		Database Management Systems	3	0	0	3
4	PCC		Operating Systems	3	0	0	3
5	HSM		Engineering Economics and Financial Analysis	3	0	0	3
6	PEC		**Professional Elective Course-1** 1. Data Wrangling in Data Science 2. Recommender Systems 3. Social Media Analytics 4. Software Project Management 5. Any of the 6-Week SWAYAM /NPTEL Course suggested by the BoS	0	0	3	1.5
7	PCC		Data Engineering Lab	0	0	3	1.5
8	PCC		Database Management Systems Lab	0	0	3	1.5
9	PCC		Operating Systems Lab	0	0	3	1.5
10	MNC		Indian Constitution	2	0	0	0
Total				**17**	**0**	**12**	**21**
	Mandatory Industry Internship / CSP / Mini Project of 06 weeks duration during summer vacation						

III B. Tech I Semester (V Semester)

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	PCC		Computer Networks	3	0	0	3
2	PCC		Software Engineering	3	0	0	3
3	PCC		Full Stack Technologies	3	0	0	3
4	PEC		**Professional Elective Course-2** 1. Cryptography & Network Security 2. Information Retrieval Systems 3. AI Chat bots 4. Data and Application Security 5. Wiser course - 1	3	0	0	3
5	PEC		**Professional Elective Course-3** 1. Distributed Systems 2. Real-Time & Streaming Analytics 3. Drone & Autonomous Vehicle Data Analytics 4. Foundations of Cyber Security 5. IBM courses - 1 6. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
6	PCC		Computer Networks Lab	0	0	3	1.5
7	PCC		Full Stack Technologies Lab	0	0	3	1.5
8	OEC		Open Elective-1	1	0	0	1
9	IPW		Evaluation of industry Internship/ CSP / Mini Project*	0	0	0	2
10	MNC		Research Methodology				
			Total	**16**	**0**	**6**	**21**

* performed during IV to V Semester break

III B. Tech II Semester (VI Semester)

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	PCC		Cloud Computing	3	0	0	3
2	PCC		Machine Learning	3	0	0	3
3	PCC		Natural Language Processing	3	0	0	3
4	PEC		**Professional Elective-4** 1. Software Architecture & Design Pattern 2. DevOps 3. IOT Architectures & Edge Computing 4. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BOS 5. Wiser course – 2	3	0	0	3
5	PEC		**Professional Elective 5** 1. Computer Vision 2. NoSQL databases 3. Video Analytics & Object Tracking 4. Reinforcement Learning 5. IBM courses - 2 6. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
6	OEC		Open Elective-2 / SWAYAM / NPTEL 4 week MOOC	2	0	0	2
7	PCC		Machine Learning Lab	0	0	3	1.5
8	PCC		Natural Language Processing Lab	0	0	3	1.5
9	OEC		Open Elective-3	1	0	0	1
10	MNC-6		Essence of Indian Traditional Knowledge	0	0	0	0
			Total	**18**		**6**	**21**
	Industry Internship / Mini Project of 06 weeks duration during summer vacation						

IV year – I Semester

S. No.	Course Category	Course Code	Title	L	T	P	Credits
1	PCC		Deep Learning	3	0	0	3
2	PCC		Generative AI	3	0	0	3
3	PEC		**Professional Elective-6** 1. Agentic AI 2. Block chain Technology 3. Quantum Science & Technology 4. Robotic Process Automation 5. Wiser course – 3 6. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
4	PEC		**Professional Elective-7** 1. Secure Coding Techniques 2. Explainable AI 3. Digital Marketing 4. Augmented Reality and Virtual Reality 5. IBM Course-3 6. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
5	PEC		**Professional Elective-8** 1. Quantum Complexity Theory 2. Expert Systems 3. IOT Architectures & Edge Computing 4. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
6	PEC		Data Analysis and dash board creation Using power BI	0	0	2	1
7	OEC		Open Elective-4	2	0	0	2
8	OEC		Open Elective-5	0	0	2	1
9	IPW		Evaluation of Industry Internship / Mini Project	0	0	0	2
			Total	**17**		**4**	**21**

*Includes evaluation of mini project

IV B. Tech. II Semester

S.No.	Course Category	Course Code	Title	L	T	P	Credits
1	OEC		Open Elective 6 / SWAYAM/NPTEL 12 week course	3	0	0	3
2	OEC		Open Elective 7 / SWAYAM/NPTEL 8 week course	**2**	**0**	**0**	2
3	Project		Project work / Industry Internship				12
			Total				17

Courses offered under Open Elective-1 (for other department students):
1. Data structures
2. Object Oriented Programming through JAVA

Courses offered under Open Elective-2 (for other department students):
1. Operating System
2. Foundations of Data Science

Courses offered under Open Elective-3 (for other department students):
1. Principles of Database Management Systems
2. Artificial Intelligence

Courses offered under Open Elective-4 (for other department students):
1. Cloud Computing
2.IoT Based Smart Systems

Courses offered under Open Elective-5 (for other department students):
1. Machine Learning
2. Recommender System

Courses offered under Open Elective-6 (for other department students):
1. Principles of Cyber Security
2. Social Media Analytics
3. SWAYAM / NPTEL MOOC (BoS need to suggest the courses)

Courses offered under Open Elective-7 (for other department students):
1. Data Visualization
2. Generative AI
3. SWAYAM / NPTEL MOOC (BoS need to suggest the courses)

Suggested Courses for **Minor(s)** – 18 Credits
1. (II-I) (3-0-3)

2. (II-II) (3-0-0)
3. (III-I) (3-0-3)
4. (III-II) (3-0-0)
5. (IV-I) (3-0-0)

Suggested Courses for **Honor's** – 18 Credits

1. (III-I) (3-0-0)
2. (III-I) (3-0-0)
3. (III-II) (3-0-0)
4. (III-II) (3-0-0)
5. (IV-I) (3-0-0)
6. (IV-I) (3-0-0)

COURSE CODE	LINEAR ALGEBRA AND CALCULUS	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisite: Mathematics of 10+2 / Intermediate level (algebra, matrices and basic calculus)

Course Objectives:

- The main objective of this course is to provide the learner with variety of linear algebra techniques to solve linear systems, orthogonal representation of the quadratic surfaces and apply its knowledge in optimization problems.
- It aims further to calculate areas, surfaces and volumes in various coordinate systems.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Apply matrix algebra and numerical techniques to determine the rank, inverse, eigenvalues and eigenvectors of matrices, solve homogeneous and non-homogeneous systems of linear equations using direct and iterative methods, and analyze their applications in engineering and scientific problems (K2, K3, K5).

CO2: Analyze and solve engineering problems by applying matrix diagonalization, Singular Value Decomposition (SVD), the Cayley-Hamilton Theorem for matrix inverses and powers, and orthogonal transformations to classify and reduce quadratic forms to canonical forms (K2, K3, K5).

CO3: Find the mean value of a given function and use it to estimate the bounds of a given function (K2, K3, K5).

CO4: Compute change in the dependent variable with respect to many independent variables and Jacobians. Apply the knowledge in optimizing functions of several variables (K2, K3, K5).

CO5: Compute double and triple integrals of functions of several variables and must be able to change the coordinate systems from Cartesian to polar, spherical and cylindrical coordinates (K2, K3, K5).

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M											
CO2	H	H	M											
CO3	H	H	M											
Co4	H	H	M											
CO5	H	H	M											

UNIT-I

Matrices, Eigenvalues, Eigenvectors: Rank of a matrix by echelon form, normal form. Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations, Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods**.** Eigenvalues, Eigenvectors and their properties.

UNIT-II

Diagonalization of a Matrix: Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation. Singular valued Decomposition.

UNIT-III

Calculus: Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems. Taylor's and Maclaurin series.

UNIT-IV

Partial Differentiation and Applications (Multi Variable Calculus): Functions of several variables: Continuity and Differentiability, Partial derivatives, Total derivatives, Chain rule, Euler's Theorem, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, Maxima and Minima of functions of two variables without constraints and with Constraints-Method of Lagrange multipliers.

UNIT-V

Multiple Integrals: Double integrals, Change of order of integration, Triple integrals, Change of variables from Cartesian to polar, Cylindrical and Spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Learning Resources:

Text Books:

1. Grewal, B.S. (2024). Higher Engineering Mathematics, 45th Edition. Khanna Publishers.
2. Kreyszig, E. (2025). Advanced Engineering Mathematics, 11th Edition. John Wiley & Sons.

Reference Books:

1. Ramana, B.V. (2017). Higher Engineering Mathematics. McGraw Hill Education.
2. James, G. (2018). Advanced Modern Engineering Mathematics. 5th Edition Pearson publishers.
3. Dass, H.K. (2022). Advanced Engineering Mathematics, 22nd Edition. S. Chand Publications.

Web Resources:

- https://en.wikipedia.org/wiki/System_of_linear_equations
- https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
- https://www.math.hmc.edu/calculus/tutorials/eigenstuff/
- https://en.wikipedia.org/wiki/Quadratic_form
- https://en.wikipedia.org/wiki/Calculus
- https://en.wikipedia.org/wiki/Partial_derivative
- https://www.whitman.edu/mathematics/calculus_online/section14.03.html
- https://en.wikipedia.org/wiki/Multiple_integral
- http://tutorial.math.lamar.edu/Classes/CalcIII/MultipleIntegralsIntro.aspx

COURSE CODE	Physics for Advanced Computing (For CSE and Allied Branches of Engineering)	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisites: NIL

Course Objectives:

1. To equip students the concepts of interference, diffraction and polarization and their applications in optics and communication systems.
2. To understand the basic concepts of Laser light sources and working principle of optical fibers and identify the engineering applications of lasers and optical fibers in communication.
3. To explain various electron theories and interpret the effect of temperature on Fermi-Dirac distribution function and provide basic knowledge of quantum mechanics for quantum computing applications.
4. To familiarize students with semiconductors and magnetic materials and their applications.
5. To impart knowledge on low temperature physics and superconductivity and their applications.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Apply the principles of interference, diffraction and polarization to analyze optical systems and engineering applications.(K3)

CO2: Analyze the operation of various laser systems as well as the working principle of optical fibers in relation to communication applications.(K4)

CO3: Interpret the effects of temperature on Fermi energy and Apply the concepts of quantum mechanics to explain modern computational systems like Quantum Computing.(K3)

CO4: Analyse semiconductor characteristics and magnetic material behaviour for engineering and electronic applications.(K4)

CO5: Apply the concepts of low-temperature physics and superconductivity in modern technological applications and intelligent systems.(K3)

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	H	M	–	–	M	–	–	–	–	L	M			
CO 2	H	M	M	L	H	–	–	–	L	L	M			
CO 3	H	H	M	M	H	–	–	–	L	L	M			
CO 4	M	H	M	M	M	L	–	–	L	L	M			

UNIT – I: APPLIED WAVE OPTICS **10**Hrs

Interference: Superposition Principle – Coherence – Types of Interference – Thin-film interference (reflection geometry) – Newton's rings – Determination of wavelength and refractive index.

Diffraction and Optical Surveying: Fresnel and Fraunhofer diffraction – Fraunhofer's diffraction due to single slit, double slit & N-slits (qualitative) – Diffraction Grating and grating spectrum – Dispersive and Resolving power of a grating.

Polarization: Types of polarization – Nicol's prism – Half-wave and Quarter-wave plates.

UNIT – II: QUANTUM PHOTONICS **9**Hrs

Lasers: Principles of Absorption – Spontaneous and Stimulated Emission – Population Inversion – Three level and Four level laser systems – Construction and working of Ruby and He-Ne Laser – Applications (qualitative).
Fiber Optics: Propagation mechanism – Numerical Aperture – Acceptance angle – Types of optical fibres – Classifications and Modes of optical fibres.

UNIT – III: FREE ELECTRON THEORY & QUANTUM MECHANICS **10**Hrs

Classical free electron theory – merits and demerits – Quantum free electron theory – equation for electrical conductivity – Fermi-Dirac statistics – Fermi level and variation with temperature.
Quantum Mechanics: de Broglie concept of matter waves – Heisenberg's uncertainty principle – Wave function – Schrödinger's time dependent and time-independent wave equations – Particle in a one-dimensional potential well – Quantum tunnelling (basic idea).

UNIT – IV: SEMICONDUCTORS & MAGNETIC MATERIALS **10**Hrs

Semiconductors: Formation of energy bands – Classification of solids **-** Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – extrinsic semiconductors: density of charge carriers (qualitative) – dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents – Einstein's equation – Hall effect – Hall coefficient – Applications of Hall effect.
Magnetic Materials: Introduction and classification - Dia, Para, Ferro, Ferri, and Anti-ferro; Hysteresis and Eddy current losses in electrical machines – Skin effect; Soft & Hard magnetic materials.

UNIT – V: LOW TEMPERATURE PHYSICS & SUPERCONDUCTIVITY **9**Hrs

Low Temperature Physics: Introduction – Low temperature and its importance – Properties of materials at low temperatures – Liquefaction of gases (basic concept only) – Liquid Nitrogen and liquid Helium (basic properties and uses).
Superconductors: Properties – Critical parameters – Meissner effect – Type-I and Type-II superconductors – BCS theory – Cooper pairs and energy gap – DC and AC Josephson effect – Applications (qualitative only): SQUIDs, magnetic levitation and lossless power transmission.

Learning Resources:

Textbooks

1. Avadhanulu, M.N., Kshirsagar, P.G., & Murthy, T.V.S.A., A textbook of engineering physics, S. Chand Publishing (2019)
2. P.K. PalaniSamy, Engineering Physics, SciTech Publications (2019)

Reference Books

1. D. K. Bhattacharya & Poonam Tandon, Engineering Physics, Oxford Press, 2015
2. Nielsen & Chuang, Quantum Computation & Quantum Information, Cambridge (2010)

Online Resources:

- NPTEL – nptel.ac.in
- MIT OpenCourseWare – ocw.mit.edu
- HyperPhysics – hyperphysics.phy-astr.gsu.edu
- PhET Simulations – phet.colorado.edu
- Library of Congress – loc.gov/rr/scitech/selected-internet/physics.html

COURSE CODE –	C and Data Structures	CATEGORY ESC	L-T-P-C 4-0-0-4

Pre-requisite: NIL

Course Objectives: *The course is designed to*

- Understand the fundamental concepts of algorithms, structured programming, and abstract data types using the C programming language.
- Apply programming constructs and basic data structures to organize and manipulate data efficiently.
- Develop problem-solving skills by implementing linear and non-linear data structures using C.
- Analyze the performance of searching, sorting, and traversal algorithms using basic complexity measures.
- Apply appropriate data structures to solve computational problems encountered in engineering applications.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Explain the concepts of algorithms, structured programming, abstract data types, and basic complexity analysis (K2)

CO2: Develop C programs using functions, arrays, pointers, dynamic memory allocation, recursion, and user-defined data types (K3)

CO3: Implement linear and non-linear data structures and perform their basic operations using C (K3)

CO4: Analyze the performance of searching, sorting, and graph traversal algorithms for different computational problems (K4)

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO 3
CO1	H	M	–	–	M	–	–	–	–	L	M			
CO2	H	M	M	L	H	–	–	–	L	L	M			
CO3	H	H	M	M	H	–	–	–	L	L	M			
CO4	M	H	M	M	M	L	–	–	L	L	M			

UNIT-I

Programming Fundamentals and Algorithmic Thinking: Programming Fundamentals: Problem-solving methodology; Algorithms; Flowcharts; Characteristics of algorithms; Introduction to C programming; Structure of a C program; Data types; Operators; Input and Output; Control statements; Functions; Arrays; Strings; Pointers (basics); Structures; Introduction to Abstract Data Types (ADT); Need and classification of Data Structures; Introduction to algorithm analysis; Time and space complexity (basic concepts).

UNIT-II

Linear Data Structures: Linear Data Structures: Dynamic memory allocation; Recursion; Linked Lists—Singly, Doubly, and Circular Linked Lists; Basic operations (creation, insertion, deletion, traversal); Applications of Linked Lists; Stacks—Array and Linked List implementations; Basic applications (parenthesis matching, expression conversion and evaluation); Queues—Simple Queue, Circular Queue, Priority Queue; Applications of Queues.

UNIT-III

Trees: Introduction and terminology; Binary Trees; Tree representation; Tree traversals; Binary Search Trees—Insertion, Deletion, Searching; Heap—Min Heap and Max Heap; Introduction to Priority Queue using Heap; Applications of Trees.

UNIT-IV

Graphs: Graph terminology; Graph representations (Adjacency Matrix and Adjacency List); Graph traversals—Breadth First Search (BFS) and Depth First Search (DFS); Introduction to Minimum Spanning Trees (Prim's Algorithm); Applications of Graphs.

UNIT-V

Searching, Sorting and Hashing: Linear Search; Binary Search; Bubble Sort; Selection Sort; Insertion Sort; Merge Sort; Quick Sort; Introduction to Hashing; Hash Functions; Collision Resolution (basic concepts); Comparative analysis of searching and sorting algorithms; Engineering applications and case studies.

Learning Resources:

Text Books:

1. Balagurusamy, E. (2025). Data Structures Using C (2nd ed.). McGraw Hill Education India.
2. Thareja, R. (2023). Data Structures Using C (3rd ed.). Oxford University Press India.

Reference Books:

1. Deshpande, P. S., &Kakde, O. G. C and data structures. Dreamtech Press.
2. Shukla, R. K. Data structures using C and C++. Wiley India.

Web Resources:

- National Programme on Technology Enhanced Learning. (2026). Introduction to Programming in C. IIT Kanpur. https://nptel.ac.in/courses/106104128
- National Programme on Technology Enhanced Learning. (2026). Programming, Data Structures and Algorithms using C. IIT Madras. https://nptel.ac.in/courses/106106127
- National Programme on Technology Enhanced Learning. (2026). Problem Solving Through Programming in C. IIT Kharagpur. https://onlinecourses.nptel.ac.in
- Virtual Labs: https://ds1-iiith.vlabs.ac.in/
- Programiz. Data Structures. https://www.programiz.com/dsa
- Visualgo. Data Structure and Algorithm Visualizations. https://visualgo.net/en

Course Code	AI Tools and Applications	L	T	P	C
		0	1	3	2.5

Pre-requisites: NIL

Course Objectives: To familiarize students with the landscape of AI tools and their underlying working principles.

1. To develop competence in prompt engineering for effective interaction with generative AI systems.
2. To enable students to apply AI tools for data analysis, visualization, and interpretation.
3. To train students in using AI-assisted tools for coding, writing, and productivity tasks.
4. To instill awareness of ethical, legal, and societal considerations in AI tool usage.

Course Outcomes: *After successful completion of this course, students will be able to:*

1. Recall the categories, capabilities, and limitations of major AI tools (text, image, code, data). (K1)
2. Explain the principles of prompt engineering and how generative AI models process instructions. (K2)
3. Apply AI tools to solve first-year engineering problems in analysis, writing, and coding tasks. (K3)
4. Analyze AI-generated outputs for accuracy, bias, and reliability before use. (K4)
5. Evaluate the ethical, academic-integrity, and societal implications of AI tool use, justifying appropriate usage choices. (K5)

CO\PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	M	–	–	–	H	L	L	–	–	–	L			
CO2	M	M	–	–	H	L	–	L	–	M	L			
CO3	H	H	M	M	H	L	L	–	L	M	M			
CO4	M	H	M	H	H	M	M	H	L	M	M			
CO5	L	M	M	M	M	H	H	H	M	H	M			

Unit 1: Introduction to AI and the AI Tools Landscape

What is AI, Machine Learning, and Generative AI — basic definitions and how they relate to one another.

Core categories of AI tools: conversational/text, code assistants, data-analysis tools, image-generation tools, and writing/productivity tools.

How large language models process and generate responses (conceptual, non-mathematical overview).

Criteria for selecting the right AI tool for a given task — accuracy needs, cost, data sensitivity, and output format.

Setting up accounts and workspaces; understanding free-tier versus paid-tier capabilities and limitations.

Widely Used AI Tools by Application (for classroom coverage):

Category	Example Tools	Typical Application
Conversational / General-Purpose AI	ChatGPT, Claude, Gemini, Perplexity	Writing, research, coding help, file/data analysis, cited web search
AI Coding Assistants	GitHub Copilot, Cursor, Claude Code	In-IDE code completion, AI-native editing, multi-file agentic coding
Data Analysis Tools	ChatGPT (Advanced Data Analysis), Microsoft Copilot in Excel, Julius AI	Upload a dataset, generate statistics/charts, spreadsheet formulas via natural language
Image Generation	Midjourney, DALL·E 3, Stable Diffusion / Flux	Illustrations, concept art, design mockups

Writing & Productivity	Grammarly, Gamma, Fathom, Notion AI	Grammar/style checking, slide generation, meeting summaries, task automation
Audio, Video & Presentation (optional)	ElevenLabs, Runway/Sora, Synthesia	Text-to-speech, AI video generation, script-to-video presentations

Teacher Practical Examples (for classroom demonstration):

1. Live comparison of the same general engineering query (e.g., "explain the engineering design process") answered by two different AI chatbots, highlighting differences in response style and accuracy.
2. Walkthrough of an AI tool's interface — settings, conversation history, file upload, and model selection — using a common platform.

Student Exercise Problems (for practice):

1. Create accounts on two AI platforms and compare their responses to a simple engineering question (e.g., "explain the difference between analysis and design").
2. Prepare a one-page comparison chart of five AI tools by category and primary use case.
3. Write a short reflection identifying one task in your daily academic life where an AI tool could help.

Unit 2: Prompt Engineering and Generative AI Tools

Anatomy of a good prompt — context, clear instruction, desired format, and constraints.
Zero-shot, few-shot, and chain-of-thought prompting techniques and when to use each.
Role-based and context-setting prompts (e.g., asking the AI to respond as a reviewer, tutor, or domain expert).
Iterative prompt refinement — diagnosing a poor AI response and rewriting the prompt to fix it.
Using generative AI for brainstorming, summarizing, and drafting technical content.

Teacher Practical Examples (for classroom demonstration):

1. Refine a vague prompt (e.g., "explain project scheduling") into a precise one step-by-step, showing output improvement at each stage.
2. Demonstrate few-shot prompting by providing examples to guide the AI toward a specific output format (e.g., a formatted comparison table).

Student Exercise Problems (for practice):

1. Write three versions of a prompt (basic, detailed, role-based) for the same task and compare outputs.
2. Use an AI tool to summarize a one-page technical article and verify the summary against the original.
3. Draft a chain-of-thought prompt to solve a multi-step numerical/logical problem (e.g., a unit-conversion or estimation problem) and check the reasoning.

Unit 3: AI Tools for Data Analysis and Visualization

AI-assisted spreadsheet and dataset analysis using natural-language commands.
Natural-language querying of datasets to extract summary statistics and insights.
AI tools for generating charts, graphs, and visual summaries from tabular data.
Interpreting AI-generated statistical summaries correctly and recognizing their limitations.
Identifying and correcting errors or misinterpretations in AI-generated data analysis.

Teacher Practical Examples (for classroom demonstration):

1. Upload a small dataset (e.g., class attendance or survey data) to an AI tool and generate a summary-statistics report and chart using natural-language commands.
2. Show an example where an AI tool misinterprets data (e.g., treats a numeric code as text), and demonstrate how to verify and correct it.

Student Exercise Problems (for practice):

1. Use an AI tool to clean and summarize a small sample dataset (e.g., class attendance or marks data).
2. Generate three different chart types from the same dataset using AI prompts and justify which is most appropriate.
3. Cross-check one AI-generated statistical claim manually and report any discrepancy found.

Unit 4: AI Tools for Coding, Writing, and Productivity

AI coding assistants — code generation, explanation, and debugging support for simple programs.
AI writing assistants for reports, emails, and technical documentation.
AI tools for scheduling, note-taking, and meeting/lecture summarization.
AI-assisted presentation and slide-outline generation from a topic prompt.
Integrating AI tools into an efficient day-to-day academic and engineering workflow.

Teacher Practical Examples (for classroom demonstration):

1. Use an AI coding assistant to generate a simple program (e.g., a temperature converter), then intentionally introduce a bug and have the AI debug it.
2. Generate a presentation outline and speaker notes from a topic prompt using an AI writing/productivity tool.

Student Exercise Problems (for practice):

1. Use an AI coding tool to write and debug a simple program for a given problem statement.
2. Draft a formal email or short report using an AI writing assistant, then manually edit it for accuracy and tone.
3. Generate a slide outline for a 5-minute seminar topic using an AI tool and refine it.

Unit 5: Ethics, Reliability, and Emerging Trends

Bias and hallucination in AI outputs, and techniques for detecting and fact-checking them.
Academic integrity and appropriate citation of AI assistance in coursework and submissions.
Data privacy and security considerations, including obligations under India's Digital Personal Data Protection Act, 2023 (DPDP Act), when uploading personal or institutional data.
Copyright and intellectual property considerations in AI-generated text and image content.
Emerging trends — multimodal AI and AI agents — and their implications for future engineering practice.

Teacher Practical Examples (for classroom demonstration):

1. Show a documented case of AI hallucination (a fabricated fact or citation) and demonstrate how to fact-check it.
2. Walk through an example of properly citing AI assistance in an academic submission per institutional guidelines.
3. Walk through a worked example of checking whether AI-generated text or image output raises a copyright/IP concern (e.g., close paraphrasing of a source).

Student Exercise Problems (for practice):

1. Identify and document a hallucination or bias instance produced by an AI tool on a factual query.
2. Draft an "AI usage declaration" for a hypothetical assignment, citing tools and extent of use appropriately.
3. Review the data-handling/privacy policy of one AI tool used in this course and identify one DPDP Act, 2023 compliance consideration relevant to student data.

Learning Resources:

Text Books

1. Marr, B. (2024). Generative AI in practice: 100+ amazing ways generative artificial intelligence is changing business and society. Wiley.
2. Mollick, E. (2024). Co-intelligence: Living and working with AI. Portfolio/Penguin.

Reference Books

1. Selwyn, N. (2022). Education and technology: Key issues and debates (3rd ed.). Bloomsbury.
2. Susskind, R., & Susskind, D. (2022). The future of the professions: How technology will transform the work of human experts (Updated ed.). Oxford University Press.
3. Russell, S., & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson.

Web Resources

1. Google. (n.d.). Google AI essentials. Grow with Google. https://grow.google/ai-essentials/
2. OpenAI. (n.d.). OpenAI documentation and guides. https://platform.openai.com/docs
3. Anthropic. (n.d.). Prompt engineering overview. Claude Docs. https://docs.claude.com/en/docs/build-with-claude/prompt-engineering/overview
4. UNESCO. (2023). Guidance for generative AI in education and research. https://unesdoc.unesco.org/
5. AICTE. (2025). AICTE inputs on Artificial Intelligence — Year of AI initiative. https://www.aicte.gov.in/downloads/initiatives/AICTE%20inputs%20on%20Artificial%20Intelligence%20-compre hensive.pdf
6. Ministry of Electronics and Information Technology, Government of India. (2023). Digital Personal Data Protection Act, 2023. https://www.meity.gov.in/content/digital-personal-data-protection-act-2023

COURSE CODE	Design Thinking and Innovation		L-T-P-C 0-1-3-2.5

Pre-requisites: NIL

Course Objectives: At the end of the course, the teacher should be able to:

- Introduce students to the principles, mindset and methodologies of **Design Thinking and human-centered problem solving**.
- Develop students' ability to **observe, empathize, analyze user needs and formulate well-defined engineering and societal problems**.
- Develop students' **creative and innovative thinking abilities** through systematic ideation, concept generation and evaluation techniques.
- Enable students to **develop, prototype, test and iteratively improve solutions** using user feedback and appropriate physical/digital tools.
- Develop students' ability to **identify innovation opportunities, create value propositions, understand basic IPR and communicate innovative solutions effectively**.

Course Outcomes: *After successful completion of the course, student will be able to*

1. Explain the principles, processes and mindset of Design Thinking for engineering problem-solving and innovation (K2)
2. Apply empathy, observation and problem-framing techniques to identify user needs and define engineering problems (K3)
3. Apply creative and systematic ideation techniques to generate and select innovative solution concepts (K3)
4. Analyze solution concepts and prototypes using user feedback and appropriate design criteria for iterative improvement (K4)
5. Analyze the innovation potential of solutions considering value proposition, feasibility, sustainability, societal impact and basic IPR aspects (K4)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	L	–	–	L	–	–	L	L	M
CO2	M	H	H	L	L	H	M	L	M	M	M
CO3	L	M	H	L	M	L	L	–	H	M	M
CO4	H	H	H	M	H	M	M	L	H	M	M
CO5	L	M	H	L	M	H	H	M	M	H	H

UNIT I — Design Thinking Foundations & Empathy

Introduction to Design Thinking ; Design thinking mindset and principles ; Design thinking vs. conventional engineering problem-solving ; Human-centered design ; Five-stage design thinking process ; Creativity, curiosity and observation ; Understanding users and stakeholders ; Empathy and user research ; Interviews, observation and contextual inquiry ; Empathy mapping ; Personas and user journeys ; Identifying explicit and latent/unarticulated needs ; Ethical considerations in user research

Practical Activities

- Observation of a real-life problem
- Conducting user interviews

- Preparing an empathy map
- Developing a persona
- Preparing a user journey map

Unit Outcome

Students will be able to **understand users, identify their needs and translate observations into meaningful design opportunities**.

UNIT II — Problem Definition, Analysis & Opportunity Identification

From observations to insights ; Data synthesis and affinity mapping ; Identifying patterns and pain points ; Problem statements ; Point-of-View (POV) statements ; "How Might We" (HMW) questions ; Stakeholder mapping ; 5 Whys and root-cause analysis ; Problem prioritization ; Need–Opportunity mapping ; Problem validation ; Design constraints and specifications ; Social, environmental and sustainability considerations ; Identifying opportunities for innovation

Practical Activities

- Affinity mapping of interview data
- Develop three alternative problem statements
- Prepare POV and HMW statements
- Stakeholder map
- Root-cause analysis
- Select and validate one problem/opportunity

Unit Outcome

Students will be able to **analyze user research, identify root causes, frame well-defined problems and recognize opportunities for innovative solutions**.

UNIT III — Creativity, Ideation & Concept Development

Creativity and innovation mindset; Divergent and convergent thinking ; Brainstorming and brainwriting ; SCAMPER ; Mind mapping ; Reverse brainstorming ; Analogical thinking ; Biomimicry ; Lateral thinking ; Forced connections ; Morphological analysis ; TRIZ — basic principles ; Individual and collaborative ideation ; AI-assisted ideation: opportunities and limitations ; Idea clustering and screening ; Impact–feasibility matrix ; Concept selection ; Design criteria and decision matrix

Practical Activities

- Generate 20–30 ideas for a selected problem
- SCAMPER exercise
- Brainwriting exercise
- Biomimicry-based ideation
- AI-assisted idea generation and critical evaluation
- Prepare an idea-selection matrix
- Select the top 2–3 concepts

Unit Outcome

Students will be able to **generate diverse solution concepts using creative techniques and systematically select promising ideas based on defined criteria**.

UNIT IV — Prototyping, Experimentation & Validation

Concept development ; Prototype mindset ; Types of prototypes: Paper prototype, Physical prototype, Digital prototype, Storyboard, Role-play, Service prototype ; Low-fidelity and high-fidelity prototypes ; Rapid prototyping ; "Fail fast, learn fast" ; Minimum Viable Prototype (MVP) ; Design experimentation ; Prototype evaluation ; User

testing ; Think-aloud method ; Feedback collection ; Usability and functionality testing; Iterative design ; Design critique ; Documentation of iterations ; Use of CAD, simulation and AI-assisted visualization tools

Practical Activities

- Develop a low-fidelity prototype
- Prepare a storyboard
- Build a physical/digital prototype
- Conduct user testing
- Collect structured feedback
- Modify the prototype
- Prepare an iteration log

UNIT V — Innovation, Value Creation & Communication

Innovation: meaning, characteristics and importance: Invention vs. innovation ; Incremental, disruptive and radical innovation ; Product, process, service and social innovation ; Technology-driven vs. need-driven innovation ; Sustainable and frugal innovation ; Innovation opportunities and emerging technologies ; From prototype to innovation ; Desirability, feasibility and viability ; Value Proposition ; Value Proposition Canvas ; Introduction to Business Model Canvas ; Customer segments and stakeholder value; Innovation validation; Market/user validation ; Intellectual Property Rights — introduction; Patents, copyright, trademarks and design protection ; Responsible innovation ; Inclusive and sustainable innovation ; Innovation ecosystem and entrepreneurship ; Communicating innovative ideas ; Innovation pitch

Practical Activities

1. Classify existing products/services as incremental, disruptive or radical innovations.
2. Identify three innovation opportunities from a campus/community problem.
3. Prepare a **Value Proposition Canvas**.
4. Validate the proposed innovation with potential users.
5. Prepare an introductory **Business Model Canvas**.
6. Identify possible IPR protection.
7. Prepare and deliver a **3-minute Innovation Pitch**.

Learning Resources:

Textbook:

1. Chandan Adhikari, Prabir Kumar Das & Tanay Pramanik, Textbook of Design Thinking and Innovation, S. Chand Publishing, 2026.
2. Shalini Rahul Tiwari & Rohit Rajendra Swarup, Design Thinking: A Comprehensive Textbook, Wiley India, 2024

Reference Books:

1. Soni, Pavan, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-Solving, Penguin Random House India.
2. Jauhari, Vinnie & Sudhanshu Bhushan, Innovation Management, Oxford University Press India.

Web Resources:

1. Atal Innovation Mission, NITI Aayog – Innovation and Design Thinking Resources. https://aim.gov.in/
2. Institution's Innovation Council (IIC), Ministry of Education, Government of India, https://iic.mic.gov.in/
3. Startup India, Government of India – Innovation and Entrepreneurship Ecosystem, https://www.startupindia.gov.in/

4. National Innovation Foundation – India – Grassroots and Frugal Innovation, https://nif.org.in/
5. Stanford d.school – Design Thinking Bootleg and Design Thinking Resources, https://dschool.stanford.edu/resources/design-thinking-bootleg
6. IDEO.org – Human-Centered Design and Social Innovation Resources, https://www.ideo.org/
7. IDEO U – Design Thinking and Innovation Resources, https://www.ideou.com/pages/design-thinking
8. NPTEL – Online Courses on Design, Innovation, Creativity and Entrepreneurship, https://nptel.ac.in/
9. SWAYAM – Online Courses on Innovation, Entrepreneurship and Design Thinking, https://swayam.gov.in/

COURSE CODE	PHYSICS FOR ADVANCED COMPUTING LAB (For CSE and Allied Branches of Engineering)	CATEGORY BSC	L-T-P-C 0-0-3-1.5

LIST OF EXPERIMENTS

(Any **TEN** of the following listed experiments)

(Out of which any **TWO** experiments may be conducted in virtual mode)

1. Determination of the thickness of a thin object by the wedge method.
2. Determination of the radius of curvature of a given plano convex lens by forming Newton's rings.
3. Determination of wavelengths of different spectral lines in the mercury spectrum using a diffraction grating in normal incidence configuration.
4. Determination of the resolving power of a telescope.
5. Determination of the dielectric constant of a given capacitor by the charging and discharging method.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Determination of temperature coefficients of a thermistor.
8. Determination of the wavelength of a Laser and a grating element by using a grating.
9. Estimation of Planck's constant using the photoelectric effect.
10. Determination of the Resistivity of a semiconductor by the four probe method.
11. Determination of the energy gap of a semiconductor using a p**-**n junction diode.
12. Study the variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
14. Determination of Acceleration due to gravity and Radius of gyration using a Compound pendulum.
15. Determination of magnetic susceptibility by Kundt's tube method.
16. Verification of Brewster's law.
17. Sonometer: Verification of laws of stretched string.
18. Determination of frequency of electrically maintained tuning fork by Melde's apparatus.

References:

1. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers, 2017.

V-Lab: vlab.co.in

COURSE CODE –	C and Data Structures Lab	CATEGORY ESC	L-T-P-C 0-0-3-1.5

Pre-requisites: Theory Course

Course Objectives: *The course is designed to*

- Develop problem-solving and algorithmic thinking skills through the implementation of fundamental data structures and algorithms using C.
- Apply appropriate linear and non-linear data structures such as linked lists, stacks, queues, trees, heaps and graphs to solve computational problems.
- Analyze the time and space complexity of searching, sorting, traversal and other fundamental algorithms for different input conditions.
- Evaluate and compare alternative data structures and algorithms based on their efficiency, suitability and applicability to engineering problems.
- Develop practical skills in implementing, testing, debugging, simulating and verifying algorithms, including the use of appropriate programming and development tools.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Apply C programming constructs, control statements, functions, and recursion to solve computational problems.
CO2: Apply arrays, strings, pointers, and dynamic memory allocation for efficient data manipulation.
CO3: Design programs using structures, unions, and file handling for organized and persistent data storage.
CO4: Implement and analyze linear data structures such as stacks, queues, and linked lists.
CO5: Select, implement, and evaluate trees, graphs, searching, and sorting algorithms based on efficiency requirements.

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	H	M	M	L	L	–	–	–	–	–	L	H	L
CO2	H	H	M	M	M	–	–	–	–	–	L	H	M
CO3	H	M	H	M	M	–	–	–	–	L	L	H	M
CO4	H	H	H	M	M	–	–	–	–	–	L	H	M
CO5	H	H	H	H	M	–	–	–	–	–	M	H	H

List of Experiments:

1. Implementation of Basic C Programming Constructs Using Data Types, Operators, Input/ Output and Control Statements
2. Implementation of Modular C Programs Using Functions and Recursion
3. Implementation of Data Processing Operations Using One-Dimensional and Two-Dimensional Arrays
4. Implementation of String Processing Operations Using Arrays and String Functions
5. Implementation of Pointer Operations and Dynamic Memory Allocation in C
6. Implementation of Record Management Using Structures, Nested Structures and Unions
7. Implementation of Persistent Record Management Using File Handling in C
8. Implementation of Stack Using Arrays and Linked Lists
9. Implementation of Stack Applications for Parenthesis Matching and Infix-to-Postfix Conversion
10. Implementation of Queue and Circular Queue Using Arrays
11. Implementation of Queue Using Linked Lists for Dynamic Request Processing
12. Implementation of Singly Linked List Operations Using Dynamic Memory Allocation
13. Implementation of Doubly and Circular Linked List Operations

14. Implementation of Binary Search Tree with Insertion, Deletion, Searching and Traversals
15. Implementation of Graph Representations Using Adjacency Matrix and Adjacency List
16. Implementation and Analysis of Linear Search and Binary Search Algorithms
17. Implementation and Comparative Analysis of Bubble, Selection and Insertion Sort
18. Implementation and Performance Analysis of Merge Sort and Quick Sort

Textbooks:

1. Kernighan, B. W., & Ritchie, D. M. The C Programming Language, 2nd Edition, Prentice Hall, 1988.
2. Horowitz, E., Sahni, S., & Anderson-Freed, S. Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2008.
3. Kanetkar, Y. Data Structures Through C, 3rd Edition, BPB Publications, 2020.

COURSE CODE –	IT and Electronics Workshop	CATEGORY ESC	L-T-P-C 0-0-3-1.5

Pre-requisites: NIL

Course Objectives (CO):

- Familiarize students with computer hardware, operating systems, peripheral devices and software installation.
- Develop practical skills in computer networking, internet technologies and collaborative platforms.
- Introduce students to the Linux command-line environment, shell scripting and version control systems.
- Develop hands-on skills in basic electronics, circuit assembly, soldering, measurement, testing and troubleshooting.
- Develop an industry-oriented mini hardware prototype by integrating basic electronics, sensors, embedded software and appropriate documentation.

Course Outcomes (CO): *After successful completion of the course, the student will be able to*:

CO1: Assemble, configure and troubleshoot computer hardware, operating systems and software systems (K3).

CO2: Configure wired and wireless networks and use internet, cloud collaboration and related digital tools (K3).

CO3: Use Linux commands, shell utilities and Git/GitHub for basic software development and collaboration workflows (K3).

CO4: Identify electronic components and instruments, assemble basic electronic circuits, perform soldering, make electrical measurements and troubleshoot simple circuits (K3).

CO5: Develop and demonstrate a working mini hardware prototype integrating electronic components, sensors and embedded software while following basic testing, documentation and presentation practices (K5).

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	-	-	H	-	-	-	M	L	L
CO2	M	H	-	M	H	-	-	-	M	M	L
CO3	M	M	M	-	H	-	-	-	M	M	M
CO4	H	H	H	M	H	-	-	-	M	M	M
CO5	H	H	H	H	H	L	L	M	H	H	H

List of Experiments:

1. PC Hardware Component Identification and Testing
2. Desktop Computer Assembly
3. Windows/Linux Installation and Basic Troubleshooting
4. LAN Configuration and Network Cable Testing
5. Wi-Fi Router Configuration
6. Basic Linux Commands and File Management
7. Bash Scripting Basics
8. Git Repository Creation and Basic Version Control
9. GitHub Collaboration
10. Identification and Testing of Basic Electronic Components
11. Basic Electronic Circuit Assembly Using Breadboard
12. Soldering and Desoldering Practice
13. Measurement and Testing Using a Digital Multimeter
14. Construction and Troubleshooting of a Simple Electronic Circuit

15. Mini Project Development and Demonstration

Learning Resources:

Text Books:

1. V. K. Mehta and Rohit Mehta, Principles of Electronics, S. Chand & Company.
2. B. S. Raghuwanshi, A Course in Workshop Technology, Dhanpat Rai & Sons.
3. Vishnu P. Singh, Computer Hardware Course, Asian Publishers/Computech Publications.

Online Resources:

- **NPTEL – Computer Networks** – for networking fundamentals and practical concepts.
- **NPTEL – Computer Networks and Internet Protocol, IIT Kharagpur** – for TCP/IP and Internet fundamentals.
- **Ubuntu Official Documentation** – for Linux installation, file management, networking and system administration.
- **NPTEL – Basic Electronics, IIT Bombay** – for basic electronic circuits and components.
- **NPTEL – Basic Electronics and Lab, IIT Madras** – particularly useful for the practical electronics component.
- **GitHub Learning Resources** – for Git/GitHub workflows.
- **GitHub Skills** – for hands-on Git/GitHub exercises.
- **Official Git Documentation** – as a reference for version control.
- **Tinkercad Circuits** – for virtual breadboard and circuit prototyping.
- **Arduino Documentation** – for the mini-project/embedded-prototyping component.

COURSE CODE	Universal Human Values – II Understanding Harmony and Ethical Human Conduct		L-T-P-C 2-0-0-0

Pre-requisites: NIL

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes: *After successful completion, student will be able to*

1. Describe the terms like Natural Acceptance, Happiness and Prosperity (K2)
2. Identify one's self, and one's surroundings (family, society nature) (K2)
3. Apply what they have learnt to their own self in different day-to-day settings in real life (K3)
4. Relate human values with human relationship and human society. (K4)
5. Justify the need for universal human values and harmonious existence (K5)
6. Develop as socially and ecologically responsible engineers (K6)

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	–	–	–	–	–	M	M	H	L	L	–
CO2	–	L	–	–	–	H	H	H	M	M	–
CO3	L	M	M	L	L	H	H	H	M	M	L
CO4	–	L	L	–	–	H	H	H	H	M	L
CO5	–	M	L	L	–	H	H	H	M	H	L
CO6	L	M	M	M	L	H	H	H	H	M	M

UNIT I: Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education); Understanding Value Education; Practice Session PS1 Sharing about Oneself; self-exploration as the Process for Value Education; Continuous Happiness and Prosperity – the Basic Human Aspirations; Practice Session PS2 Exploring Human Consciousness; Happiness and Prosperity – Current Scenario; Method to Fulfill the Basic Human Aspirations; Practice Session PS3 Exploring Natural Acceptance

UNIT II: Harmony in the Human Being: Understanding Human being as the Co-existence of the self and the body.; Distinguishing between the Needs of the self and the body; Practice Session PS4 Exploring the difference of Needs of self and body; The body as an Instrument of the self; Understanding Harmony in the self; Practice Session PS5 Exploring Sources of Imagination in the self; Harmony of the self with the body; Programme to ensure self-regulation and Health; Practice Session PS6 Exploring Harmony of self with the body

UNIT III: Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction; 'Trust' – the Foundational Value in Relationship; Practice Session PS7 Exploring the Feeling of Trust; 'Respect' – as the Right Evaluation; Practice Session PS8 Exploring the Feeling of Respect; Other Feelings, Justice in Human-to-Human

Relationship; Understanding Harmony in the Society; Vision for the Universal Human Order; Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV: Harmony in the Nature/Existence: Understanding Harmony in the Nature; Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature; Practice Session PS10 Exploring the Four Orders of Nature; Realizing Existence as Co-existence at All Levels; The Holistic Perception of Harmony in Existence; Practice Session PS11 Exploring Co-existence in Existence.

UNIT V: Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values; Definitiveness of (Ethical) Human Conduct; Practice Session PS12 Exploring Ethical Human Conduct; A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order; Competence in Professional Ethics; Practice Session PS13 Exploring Humanistic Models in Education; Holistic Technologies, Production Systems and Management Models-Typical Case Studies; Strategies for Transition towards Value-based Life and Profession; Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education; PS1 Sharing about Oneself; PS2 Exploring Human Consciousness; PS3 Exploring Natural Acceptance
Practice Sessions for UNIT II – Harmony in the Human Being; PS4 Exploring the difference of Needs of self and body; PS5 Exploring Sources of Imagination in the self; PS6 Exploring Harmony of self with the body
Practice Sessions for UNIT III – Harmony in the Family and Society; PS7 Exploring the Feeling of Trust;
PS8 Exploring the Feeling of Respect; PS9 Exploring Systems to fulfil Human Goal
Practice Sessions for UNIT IV – Harmony in the Nature (Existence); PS10 Exploring the Four Orders of Nature; PS11 Exploring Co-existence in Existence
Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics; PS12 Exploring Ethical Human Conduct; PS13 Exploring Humanistic Models in Education; PS14 Exploring Steps of Transition towards Universal Human Order

READINGS:

Textbook and Teachers Manual

a. The Textbook

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

b. The Teacher's Manual

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

Reference Books

1. *JeevanVidya: EkParichaya,* A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book).
4. *The Story of My Experiments with Truth* - by Mohandas Karamchand Gandhi
5. *Small is Beautiful* - E. F Schumacher.
6. *Slow is Beautiful* - Cecile Andrews
7. *Economy of Permanence* - J C Kumarappa
8. *Bharat Mein Angreji Raj* – PanditSunderlal
9. *Rediscovering India* - by Dharampal

10. *Hind Swaraj or Indian Home Rule* - by Mohandas K. Gandhi
11. *India Wins Freedom* - Maulana Abdul Kalam Azad
12. *Vivekananda* - Romain Rolland (English)
13. *Gandhi* - Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements. In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

COURSE CODE	English for Technical Communications	CATEGORY HSM	L-T-P-C 3-0-0-3

Pre-requisites: NIL

Course Objectives:

- Listen the authentic texts to comprehend and respond appropriately as both audience and conversant;
- Communicate in academic and social (formal) contexts with reasonable fluency and accuracy (neutral accent, social and grammatical appropriateness);
- Comprehend the texts of various types for academic, technical and career purposes;
- Write for academic and professional purposes;
- Communicate across cultures that requires a blend of cognitive, interpersonal, and linguistic skills

Course Outcomes:

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

CO1: Comprehend specific information, context, and central ideas from social, academic, or workplace conversations and audio-visual material. (K2)

CO2: Apply appropriate social norms to bridge the gaps and collaborate effectively across diverse cultural backgrounds (K3)

CO3: Examine discourse features and speech strategies to participate effectively in group discussions, informal exchanges, and short presentations on technical and general topics. (K4)

CO4: Evaluate the content, limitations and ethical aspects of AI tools in communication and language learning, and apply them to create concise, accurate essays/summaries. (K5)

CO5: Construct well-organized paragraphs, essays, critical reviews, and other professional documents suited to academic and workplace contexts. (K6)

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	L	M	–	–	L	M	–	–	L	H	L			
CO2	L	L	L	–	L	H	M	M	H	H	M			
CO3	L	M	L	L	L	M	L	L	H	H	M			
CO4	M	H	M	M	H	L	L	H	M	H	H			
CO5	L	M	L	L	L	M	L	L	H	H	H			

Unit 1 : Effective Communication: Exploring Channels and Methods
Vocabulary: Roots, Prefixes, and Suffixes Homonyms
Grammar: Articles, Prepositions, Tenses.
Reading: Definition and Importance, Skills and Sub-Skills of Reading
Writing :Cohesion and Coherence, Paragraph Writing.
Listening : Listening for main ideas and supporting details, Note-taking
Speaking: Introducing self and others, Describing people and objects, JAM.

Unit 2: Eco-Consciousness: Negotiating for a Sustainable Future
Vocabulary: Contractions, Phrasal Verbs, Idioms & Phrases
Grammar: Subject-Verb Agreement, Conditional Sentences
Reading: Reading for Inference, Point of View, Tone and Perspective.
Writing : Note making, Summarizing, Paraphrasing.
Listening : Listening to various texts and comprehension

Speaking: Role-plays, Extempore.
Unit 3: Disruptive Technologies: Ethical Implications and Future Prospects
Vocabulary: One-Word Substitutes, Commonly Confused Words
Grammar: Degrees of Comparison, Active and Passive Voice, Question Tags.
Reading: Reading the extracts/articles/ essays of the News Papers, Journals and literary texts.
Writing : Paraphrasing, Letter Writing
Listening : Listening to stories, news, documentaries and discussions.
Speaking: Debate, Group Discussions
Unit 4: Entrepreneurship and Start-Up Culture: Emerging Trends
Vocabulary: Business/ Profession/ Career/ Job-related Vocabulary.
Grammar: Sentence Synthesis, Simple, Compound and Complex Sentences.
Reading: Reading various texts for global understanding
Writing : Email Writing, Data Interpretation, Report Wrtiting
Listening : Listening to debates and discussions.
Speaking: Power Point Presentations by Individuals and Teams.
Unit 5: Ethical Leadership: Integrating Social Responsibility and Core Values
Vocabulary: Advanced Vocabulary for GRE/TOEFL/ IELTS/CAT etc.
Grammar: Sentence Synthesis, Para Jumbles.
Reading: Reading texts for global comprehension.
Writing : Book/Film Reviews, Social Media Etiquette
Listening : Listening to the talks/speeches by the eminent personalities
Speaking: Team Discussions and Presentations

Learning Resources:

Textbook:

1. Chekuri, T., & Perumalla, R. K. (2026). NextGen English for engineers: A course book for technical English communication. Cengage.
2. Coelho, P. (2020). The alchemist. HarperCollins. (Non-Detailed Text)

Reference Books:

1. Technical Communication (2nd Ed.) by M. Raman & S. Sharma. Oxford University Press, 2012.
2. Effective Technical Communication by M.A. Rizvi, Tata McGraw-Hill, 2005.
3. English for Engineers and Technologists, Orient Blackswan 2010 (Combined edition, Vol.1 &2).
4. The Oxford Guide to Writing and Speaking by John Seely, Oxford University Press, 2004.

Web Resources:

1. eGyanKosh. (n.d.). National digital repository. https://egyankosh.ac.in/
2. Read Theory. (n.d). Adaptive reading comprehension practice. https://readtheory.org/

COURSE CODE	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisite: Mathematics of 10+2 / Intermediate level (algebra, matrices and basic calculus)

Course Objectives:

- This course is aimed to provide the learner with several methods for solving differential equations and partial differential equations.
- To prepare the student to calculate gradient, surface and volume integrals by applying standard theorems.

Course Outcomes: *After successful completion of this course, the student will be able to*:

CO1: Model simple physical problems involving rate as first order differential equations and solve the resulting equation (K2, K3, K5).

CO2: Apply differential equation techniques to formulate and solve homogeneous and non-homogeneous differential equations, solve simultaneous linear differential equations, and apply these methods to model and analyze L-C-R circuit problems and simple harmonic motion (K2, K3, K5).

CO3: Solve partial differential equations that model physical processes (K2, K3, K5).

CO4: Apply the knowledge of gradient, divergence and curl and interpret the physical meaning of different operators (K2, K3, K5).

CO5: Compute the work done against a field, circulation and flux using vector calculus methods (K2, K3, K5).

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M											
CO2	H	H	M											
CO3	H	H	M											
Co4	H	H	M											
CO5	H	H	M											

UNIT-I

Differential Equations of First Order and First Degree: Exact equations and equations reducible to exact form (integrating factor), Linear differential equations – Bernoulli's equations. Orthogonal Trajectories, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT-II

Linear Differential Equations of Higher Order (Constant Coefficients): Definitions, Homogeneous and non-homogeneous, Complementary function, Particular integral, General solution, Method of variation of parameters-Wronskian. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT-III

Partial Differential Equations: Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, Solutions of first order linear equations using Lagrange's method, Non-linear partial differential equations using Charpit's Method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT-IV

Vector Differentiation: Scalar and Vector point functions, Vector operator Del, Gradient and applications, Directional derivative, Divergence-Solenoidal and Curl-Irrotational Field - Scalar Potential, Vector identities.

UNIT-V

Vector Integration: Line integral – Circulation – Work done by the force, Surface integral-flux, Green's theorem in a plane (without proof), Stoke's theorem (without proof), Volume integral, Divergence theorem (without proof) and their applications.

Learning Resources:

Text Books:

1. Grewal, B.S. (2024). Higher Engineering Mathematics, 45th Edition. Khanna Publishers.
2. Kreyszig, E. (2025). Advanced Engineering Mathematics, 11th Edition. John Wiley & Sons.

Reference Books:

1. Ramana, B.V. (2017). Higher Engineering Mathematics. McGraw Hill Education.
2. James, G. (2018). Advanced Modern Engineering Mathematics. 5th Edition Pearson publishers.
3. Dass, H.K. (2022). Advanced Engineering Mathematics, 22nd Edition. S. Chand Publications.

Web Resources:

- https://mathworld.wolfram.com/First-OrderOrdinaryDifferentialEquation.html
- https://en.wikipedia.org/wiki/Differential_equation
- https://en.wikipedia.org/wiki/Partial_differential_equation
- https://en.wikipedia.org/wiki/Vector_calculus
- https://en.wikipedia.org/wiki/Vector_calculus

COURSE CODE –	APPLIED CHEMISTRY FOR EMERGING TECHNOLOGIES (For CSE and Allied Branches of Engineering)	CATEGORY BSC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

Course Objectives

- Understand the fundamentals of quantum chemistry, including wave-particle duality, quantum numbers, and molecular orbital theory relevant to computing materials.
- Comprehend the chemistry and electronic properties of semiconductor and superconductor materials and the chemical processes involved in semiconductor-device fabrication.
- Evaluate electrochemical principles governing batteries, supercapacitors, and fuel cells as energy-storage technologies for computing systems.
- Design sensors and biosensors and utilize them in computer applications.
- Explore the chemistry, synthesis methods, and properties of nanomaterials used in nanoelectronics, quantum computing, and sustainable electronics.

Course Outcomes (COs)

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

CO1: Apply quantum chemistry principles to analyze molecular systems and explain molecular orbital theory for computing materials. (K3, K4)

CO2: Analyze semiconductor materials, doping chemistry and fabrication processes used in modern electronic devices. (K3, K4)

CO3: Evaluate energy-storage technologies including batteries, super capacitors and fuel cells for computing and data-centre applications. (K3, K4)

CO4: Design sensors and utilize smart materials for modern devices. (K3, K4)

CO5: Design advanced materials solutions using nanotechnology principles and AI-assisted tools for Nano electronics. (K5, K6)

CO/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	L	M	L	-	-	-	-	-	M			
CO2	H	H	M	M	M	-	-	-	-	-	M			
CO3	H	H	M	M	M	M	L	-	-	L	M			
CO4	M	H	H	M	M	M	L	-	-	L	M			
CO5	H	M	H	H	H	M	L	L	-	L	H			

UNIT-1 Quantum Chemistry **9hrs**

Fundamentals of quantum chemistry: black-body radiation, photoelectric effect, wave-particle duality, de Broglie wave equation, Heisenberg's uncertainty principle;

Fundamentals of quantum mechanics: Schrödinger wave equation, significance of Ψ and Ψ^2; quantum numbers; particle in a one-dimensional box.

Molecular orbital theory: bonding in homonuclear and heteronuclear diatomic molecules; energy-level diagrams of O_2, N_2, CO and HF; π-molecular orbitals of butadiene and benzene; calculation of bond order.

UNIT II Chemistry of Semiconductors and Superconductors **10 hrs**

- Band theory of semiconductors, Intrinsic and extrinsic semiconductors, Preparation of pure and doped semiconductor material, silicon dioxide (SiO_2) formation and properties, Chemistry of compound

semiconductors (GaAs, InP, SiC), Advanced semiconductor materials (Organic semiconductors, Perovskite semiconductors)
Photolithography: Basic principle, applications

- Superconductors: Characteristics, Type-I and Type-II, Low temperature and high temperature superconductors, superconducting materials (NbTi, Nb_3Sn), applications
- Ion-trap materials: Basic concept, applications

UNIT III: Triad of Electrochemical Power **9 hrs**

- Galvanic and electrolytic cells, redox reactions, electrode potential, Nernst equation and problems;
- Primary batteries: Dry cell, Lithium battery, sodium-air batteries (construction, working and applications), zinc-air battery, secondary batteries: lead-acid, Ni-Cd, lithium-ion, sodium-ion batteries (construction, charging-discharging reactions and applications). Battery management systems (main functions, basic working, Battery protection)
- Fuel cells: PEMFC, DMFC (working, advantages, applications)
- Supercapacitors: EDLC, pseudo-capacitors, hybrid supercapacitors for energy harvesting, applications

UNIT IV: Sensors, Biosensors and smart materials **9 hrs**

- E-Waste and Recycling: Recovery of metals, Battery recycling, Safe disposal, Reuse of electronic materials, Reducing environmental contamination
- Sensors: Basic Working Principle, Types of Sensors (Gas sensors, Temperature sensors, Pressure sensors, pH sensors, Humidity sensors, Chemical sensors)
- Biosensors: Components of a Biosensor, Applications
- Smart materials: Types and applications (Shape-memory alloys, Piezoelectric materials, Electrochromic materials, Self-healing polymers)

UNIT V: Chemistry of nanomaterials **9 hrs**

- Introduction to Nanochemistry
- Carbon nanomaterials: Fullerenes, carbon nanotubes (CNTs), graphene; synthesis method [chemical vapor deposition (CVD)], Applications.
- Quantum dots: Synthesis, properties, applications in displays and real time applications.
- Metallic nanoparticles: Preparation (sol-gel process) and applications of gold, silver, and copper nanoparticles. Applications in nanoelectronics, interconnects, sensors (optical and biosensors), memory devices.
- Spintronics materials: Magnetic nanoparticles, topological insulators.

Learning Resources

Textbooks

1. Jain, P. C., & Jain, M. (2020). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing Company.
2. Agarwal, S. (2026). Engineering Chemistry (5th ed.). Cambridge University Press.

Reference Books (APA Format)

1. Linden, D., & Reddy, T. B. (Eds.). (2001). Handbook of batteries (3rd ed.). McGraw-Hill.
2. Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2007). The chemistry of nanomaterials: Synthesis, properties and applications (Vols. 1–2). Wiley-VCH.
3. Sharma, B. K., & Gaur, H. (2019). Engineering chemistry. Krishna Prakashan Media.

Web Resources (APA Format)

- NPTEL. (n.d.). Engineering chemistry courses. https://nptel.ac.in
- IBM Quantum. (n.d.). IBM Qiskit learning. https://learning.quantum.ibm.com
- Google. (n.d.). Google Colab. https://colab.research.google.com
- OpenCV. (n.d.). OpenCV Python documentation. https://docs.opencv.org
- Materials Project. (n.d.). Open nanomaterials database. https://materialsproject.org

COURSE CODE	Computational Thinking and Problem Solving Using Python	Category	L-T-P-C 3-0-0-3

Pre-requisite: NIL

Course Objectives: At the end of the course, the teacher should be able to:

- Establish computational thinking , decomposition, pattern recognition, abstraction, and algorithmic reasoning as the foundation for problem-solving, with strong grounding in algorithm design and flowchart construction.
- Develop proficiency in Python control structures while explicitly linking conditionals to abstraction and loops to pattern recognition.
- Build competence in selecting Python data structures (strings, lists, tuples, dictionaries) as an exercise in abstraction and pattern-based organization of information.
- Train students to decompose problems into functions and recursive sub-problems, reason informally about algorithmic efficiency, and use AI coding assistants responsibly.
- Equip students with file handling, exception handling, and basic data analysis/visualization skills framed as decomposing a larger data workflow into manageable, robust steps and to integrate these skills in a capstone mini-project.

Course Outcomes : *At the end of the course, student will be able to*

CO1: Explain the principles of computational thinking and interpret algorithms and flowcharts that represent problem-solving logic.(K2)

CO2: Apply pattern recognition and abstraction, via Python control structures, to implement step-by-step algorithmic solutions (K3)

CO3: Analyze problems to select and manipulate appropriate data structures (strings, lists, tuples, dictionaries) as an abstraction and organization exercise (K4)

CO4: Evaluate the correctness and efficiency of decomposed, modular algorithms and Python programs through tracing, testing, debugging, and exception handling (K5)

CO5: Create modular, well-structured Python programs by decomposing problems into functions, recursion, file handling, and data analysis, culminating in an integrative capstone project (K6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	L	L	M	-	-	-	L	-	M
CO2	H	H	M	M	H	-	-	L	L	-	M
CO3	H	H	M	M	H	-	-	L	L	-	M
CO4	H	H	M	H	H	-	L	L	M	-	H
CO5	H	H	H	H	H	L	L	M	H	L	M

UNIT – 1: Computational Thinking, Algorithm Design & Flowcharting

Computational thinking pillars - decomposition, pattern recognition, abstraction, algorithmic thinking, and the problem-solving process. Algorithm design - characteristics of a good algorithm, stepwise refinement, pseudocode. Flowcharts - standard symbols, construction rules, and manual tracing for verification.

Translating algorithms and flowcharts into Python code - variables, data types, operators, and input/output.

Introduction to good coding practice - docstrings, inline comments, and print-based debugging, threaded through every unit from here on

UNIT – 2: Control Structures

Conditional statements - as abstraction over multiple cases.
Loops (for, while) - as pattern recognition of repetition.
Nested loops and loop control (break, continue, pass) - as decomposition of complex repetitive logic.
UNIT – 3: Data Structures — Strings, Lists, Tuples & Dictionaries
Strings - pattern matching and abstraction of text as a sequence.
Lists - abstraction of ordered, mutable collections.
Tuples and dictionaries - abstraction of fixed and key-based data
UNIT – 4: Functions & Modular Programming
Functions - decomposition of a program into independent, reusable sub-problems.
Recursion - algorithmic thinking applied to self-similar sub-problems.
Basic algorithmic efficiency - informal comparison of iterative vs. recursive approaches and their time trade-offs.
Modules and built-in libraries, including responsible AI-assisted coding practices.
UNIT – 5: File Handling, Exception Handling, Data Analysis & Capstone Project
File handling - decomposition of a data workflow into read/process/write stages.
Exception handling - abstraction of error cases into predictable, manageable patterns.
Introduction to data analysis and visualization (NumPy/Pandas/Matplotlib basics) - pattern recognition in real datasets. Capstone integration - combining all prior units into one end-to-end project.

Learning Resources:
Text Books:

1. Downey, A. B. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.
2. Guttag, J. V. (2021). Introduction to computation and programming using Python: With application to computational modeling and understanding data (3rd ed.). MIT Press.

Reference Books:

1. Sweigart, A. (2025). Automate the boring stuff with Python: Practical programming for total beginners (3rd ed.). No Starch Press.
2. McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
3. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35. https://doi.org/10.1145/1118178.1118215

Web References:

1. Python Software Foundation. (n.d.). The Python tutorial. https://docs.python.org/3/tutorial/
2. W3Schools. (n.d.). Python tutorial. https://www.w3schools.com/python/
3. NPTEL. (n.d.). Programming, data structures and algorithms using Python. https://nptel.ac.in

Course Code	Digital Logic Design	L	T	P	C
		3	0	0	3

Pre-requisites: NIL

Course Objectives: *The course is designed to*

- Understand number systems, digital codes, Boolean algebra, logic operations, and Boolean function minimization.
- Analyze and design combinational logic circuits using standard logic gates and combinational building blocks.
- Understand and design sequential logic circuits, including latches, flip-flops, registers, and counters.
- Understand finite state machines and their analysis and design using appropriate state representation and flip-flop realization.
- Understand programmable logic devices and their basic structures, including PROM, PAL, PLA, CPLD, and FPGA.
- Apply Verilog HDL for modeling, simulation, and design of combinational and sequential digital circuits.

Course Outcomes: *After successful completion of the course, student will be able to*

CO1: Explain number systems, digital codes, Boolean algebra, logic operations, and the principles of Boolean function minimization.

CO2: Apply Karnaugh map and Quine–McCluskey methods to simplify Boolean functions and realize logic circuits.

CO3: Analyze and design combinational logic circuits including adders, subtractors, comparators, multiplexers, demultiplexers, decoders, encoders, and code converters.

CO4: Analyze and design sequential logic circuits using latches, flip-flops, registers, and synchronous and asynchronous counters.

CO5: Analyze and design finite state machines and explain the basic structures and applications of PROM, PAL, PLA, CPLD, and FPGA.

CO6: Model, simulate, and verify combinational and sequential digital circuits using Verilog HDL.

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	L	–	L	–	–	–	–	L	–			
CO2	H	H	H	L	M	–	–	L	–	L	–			
CO3	H	H	H	M	M	–	–	L	L	L	L			
CO4	H	H	H	M	M	–	–	L	L	L	L			
CO5	H	H	H	M	H	L	L	L	L	L	M			
CO6	H	H	H	H	H	L	L	M	M	M	M			

UNIT I: NUMBER SYSTEMS, CODES AND BOOLEAN LOGIC

Number systems and codes; representation of unsigned and signed integers; floating-point representation of real numbers; code conversions; basic error-detection and error-correction concepts; Boolean algebra; laws and theorems of Boolean algebra; De Morgan's theorems; logic operations and logic gates; switching functions; canonical forms of Boolean functions; Sum-of-Products (SOP) and Product-of-Sums (POS) forms; realization of Boolean functions using logic gates; minimization of Boolean functions using Karnaugh maps; Quine–McCluskey algorithm.

UNIT II: COMBINATIONAL LOGIC CIRCUITS

Combinational logic circuits; representation and analysis of combinational logic; design procedure using basic logic gates; adders; half adder and full adder; 4-bit binary adder/subtractor; BCD adder; carry look-ahead adder; subtractors;

magnitude comparator; multiplexers; demultiplexers; decoders; encoders; priority encoders; code converters; implementation of combinational logic using multiplexers, decoders, and other combinational building blocks.

UNIT III : SEQUENTIAL LOGIC CIRCUITS

Basic distinction between combinational and sequential circuits; latches; SR, JK, D and T flip-flops; truth tables and excitation tables; level triggering and edge triggering; timing considerations; conversion of flip-flops; design procedure for sequential circuits; registers; shift registers; universal shift register; asynchronous and synchronous counters; modulo counters; ring counter; Johnson counter.

UNIT IV: FINITE STATE MACHINES AND PROGRAMMABLE LOGIC DEVICES

Finite State Machines (FSMs); types of FSMs; state diagrams and state tables; state assignment; reduction of state tables using partition technique; realization of FSMs using flip-flops; Mealy and Moore models; conversion between Mealy and Moore machines; design of sequence detectors; analysis and design of synchronous sequential systems; programmable logic devices; PROM, PAL and PLA; basic structure of CPLD; basic structure of FPGA; advantages of FPGA-based implementation.

UNIT V: VERILOG HDL FOR DIGITAL SYSTEM DESIGN

Introduction to Verilog HDL; gate-level, structural-level and behavioural-level modelling; specification and modelling of digital logic circuits; Verilog operators; hierarchical Verilog design; Verilog modelling of combinational circuits; conditional operator; if-else statement; case statement; for loop; Verilog constructs for storage elements; blocking and non-blocking assignments; modelling of flip-flops with clear capability; modelling of registers and counters; testbench concepts; simulation and verification of adders, multiplexers, demultiplexers, flip-flops, counters, and other combinational and sequential circuits.

Learning Resources:

Text Books

1. M. Morris Mano, **Digital Design**, 3rd Edition, Prentice Hall of India.
2. Stephen Brown and Zvonko Vranesic, **Fundamentals of Digital Logic with Verilog Design**, 3rd Edition, McGraw-Hill.
3. Thomas L. Floyd, **Digital Fundamentals**, 11th Edition, Pearson Education.

Reference Books

1. Tocci, R. J., Neal S. Widmer, **Digital Systems: Principles and Applications**, 12th Edition, Pearson Education.
2. Zvi Kohavi and Niraj K. Jha, **Switching and Finite Automata Theory**, 3rd Edition, Cambridge University Press.
3. Samir Palnitkar, **Verilog HDL: A Guide to Digital Design and Synthesis**, 2nd Edition, Prentice Hall PTR.
4. D. P. Leach and Albert Paul Malvino, **Digital Principles and Applications**, 7th Edition, Tata McGraw Hill.

COURSE CODE	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY ESC	L-T-P-C 3-0-0-3

Pre-requisite: NIL

Course Objectives:

- To introduce fundamental electrical circuit laws, elements, and network theorems and develop the ability to analyze DC circuits.
- To develop an understanding of single-phase and three-phase AC circuits, phasors, impedance, power factor, and electrical power.
- To explain the operating principles, basic equations, speed-control methods, and applications of transformers, DC and AC machines.
- To familiarize students with semiconductor devices, rectifiers, Zener regulators, BJTs, and their basic electronic applications.
- To introduce operational amplifiers and electricity billing and safety.

Course Outcomes: After successful completion of this course, the student will be able to:

CO1: apply Ohm's law, Kirchhoff's laws, and network theorems to analyze and simplify DC electrical circuits. (K3)
CO2: analyze single-phase and three-phase AC circuits using phasor concepts, impedance, and electrical power calculations. (K4)
CO3: explain the operating principles, basic equations of transformers and DC and AC machines. (K2)
CO4: apply the operating principles of semiconductor devices, rectifiers, Zener regulators, and BJTs in basic electronic circuits. (K3)
CO5: analyze basic operational-amplifier circuits, electricity billing, and electrical safety measures.(K4)

COs / Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	-	L	M	-	-	-	-	-	-			
CO2	H	H	-	L	M	-	-	-	-	-	-			
CO3	H	M	-	-	L	-	-	-	-	-	-			
CO4	H	H	-	L	M	-	-	-	-	-	-			
CO 5	H	H	-	L	H	-	-	-	-	-	-			

UNIT-I

DC Circuits and Network Theorems: Electrical circuit elements and terminology; Ohm's law; Kirchhoff's Current Law (KCL) and Voltage Law (KVL); series-parallel DC circuits; mesh and nodal analysis; Thevenin's theorem; Norton's theorem; Superposition theorem.

UNIT-II

AC Circuits: Generation of alternating EMF; peak, average, RMS values, form factor and peak factor; Voltage and current relationship with phasor diagrams in R, L, and C series circuits only, concept of reactance and impedance, concept of power factor, active power, reactive power and apparent power; Introduction to three-phase systems; star and delta connections(line and phase relations only).

UNIT-III

Electrical Machines: DC machines: Principle of operation of DC Generator, Principle of operation of DC Motor, Torque Equation, types of DC motors, speed control using flux control and armature voltage control methods; Transformers: working principle, EMF equation, losses, and efficiency; Three-phase induction motor: principle of operation and applications; Principle of operation of Stepper Motor and DC Servo motor.

UNIT-IV

Semiconductor Devices and Electronic Circuits: Semiconductor basics: intrinsic and extrinsic semiconductors; PN junction diode and its V-I characteristics; Operation of half-wave and full-wave bridge rectifiers without filters; Zener diode and voltage regulation; BJT: operation, input and output characteristics of CE Configurations.

UNIT-V

Operational Amplifier, Energy Billing and Safety: Operational Amplifiers: Ideal operational amplifier, IC741 op-amp & its features, inverting, non-inverting amplifiers; Electricity Bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Types of Tariff, Calculation of electricity bill for domestic consumers;

Equipment Safety Measures**:** Working principle of Fuse and Miniature Circuit Breaker (MCB), Electric Shock, Safety Precautions to avoid shock.

Learning Resources:

Textbooks

1. Ed Hughes. (2016). Electrical & Electronic Technology (12th edition). Pearson Education.
2. Vincent Del Toro. (2015). Electrical Engineering Fundamentals (2nd edition). Pearson Education.

Reference Books

1. Mehta, V. K., & Mehta, R. (2008). Principles of electrical engineering and electronics. S. Chand Publishing.
2. Charles K. Alexander and Mathew N.O. Sadiku. (2017). Fundamentals of Electrical Circuits (6th edition). Mc Graw-Hill Education, India.
3. V. K. Mehta, Rohit Mehta, (2022). Principles of Power Systems. S. Chand Publishing.

Web Resources

1. https://nptel.ac.in/courses/108105112
2. https://nptel.ac.in/courses/108101091
3. https://nptel.ac.in/courses/108105113

Course Code	English for Technical Communications and MOODLES laboratory	Category HSM	L-T-P 0-0-3	CREDITS 1.5

Part – A

Course Objectives:

- Develop active listening skills and the traits of an effective listener using lab activities and Ai-based listening tools.
- Develop speaking and presentation skills through structured practice and AI-speech coaching tools.
- Apply reading techniques and Analyze the texts to strengthen comprehension and employability.
- Apply writing techniques for technical and professional letters, emails, resumes and report writing to enhance employability.

Course Outcomes:

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

CO1: Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.
CO2: Apply appropriate reading strategies to interpret content/material related to engineering and technology domain.
CO3: Participate in discussions and presentations on general and technical topics.
CO4: Possess an ability to write clearly on topics related to technology and workplace communication.
CO5: Choose functional language, cohesive devices and skills of organization to express clearly in speaking.
CO6: Demonstrate proficiency in using Moodle LMS and digital learning tools to access learning resources, manage academic activities, submit assignments, participate in quizzes and discussions, and organize learning effectively.
CO7: Apply digital communication, academic, research, and presentation skills while demonstrating academic integrity, responsible use of AI and digital technologies, and professional online behaviour.

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	–	M	–	–	L	M	–	M	M	H	–
CO2	L	H	–	M	M	M	–	–	–	M	M
CO3	–	M	–	–	M	M	–	H	H	H	M
CO4	–	M	–	–	M	M	–	M	M	H	M
CO5	–	M	–	–	L	M	–	H	H	H	M
CO6	–	M	–	–	H	M	–	M	M	M	H
CO7	–	M	L	M	H	M	M	H	H	H	H

List of Experiments for the subject English for Technical Communication Lab

(Any 10 experiments in Part A)

1. Phonetics & Accent Neutralisation

- Sound Lab Drills — Students record minimal pairs (/p/–/b/, /t/–/d/) and compare waveforms using free apps like Voice Recorder.
- Pronunciation Clinics — Peer-correction circles where each student reads a short passage focusing on stress and intonation.
- IPA Treasure Hunt — Give IPA transcriptions; students identify the words and pronounce them.
- Shadowing Practice — Students mimic short clips (newsreader, documentary narrator) to reduce mother-tongue influence.

2. Introducing Self and Others

- Speed Networking — Students rotate every 2 minutes and introduce themselves to a new partner.
- Identity Cards — Each student prepares a "professional identity card" and introduces another student using it.
- Role-based Introductions — Introduce yourself as a student, intern, job applicant, club member, etc.

3. Brief Talk in Formal/Informal Contexts, JAM/Extempore
   - JAM Box — A box with random topics; students pick one and speak for 60 seconds.
   - Context Switch — Students speak on the same topic twice: once formally (seminar), once informally (friends).
   - Prompt Cards — Situational prompts: "Convince your friend to join a club", "Address a class meeting".

4. Listening Comprehension
   - Audio Quizzes — Play short clips (announcements, interviews) and ask MCQs.
   - Gap-fill Listening — Provide partially blank transcripts; students fill missing words.
   - Error Spotting — Students listen to a narration and identify factual inconsistencies.

5. Audio-based Note Taking & Narrating Events
   - Event Reconstruction — Play an audio describing an incident; students reconstruct the event in 5–6 bullet points.
   - Timeline Creation — Students listen to a process or story and create a chronological timeline.
   - Peer Narration — One student listens to an audio; narrates it to a partner who writes notes.

6. Process Description & Paragraph Writing (Technical Lab Context)
   - Lab-to-Paragraph — After a lab experiment, students write a process description using sequence markers.
   - Flowchart to Paragraph — Provide a technical flowchart; students convert it into a coherent paragraph.
   - Reverse Engineering — Give a paragraph; students convert it back into steps and check accuracy.

7. Group Discussions & Deliberations – Coming to Consensus
   - Consensus Challenge — Groups must agree on one solution to a problem (e.g., "Best way to reduce campus waste").
   - Fishbowl GD — Inner circle discusses; outer circle observes and gives feedback.
   - Ranking Task — Groups rank items (e.g., skills for employability) and justify their consensus.

8. Micro Presentations (2–5 minutes)
   - One-Slide Presentation — Students prepare a single slide and speak for 3 minutes.
   - Teach a Concept — Students explain a simple technical idea (e.g., "How Wi-Fi works").
   - Object Talk — Students bring an object and present its use, history, or mechanism.

9. Explaining Concepts – Technical Text-based
   - Concept Simplification — Students take a technical paragraph and rewrite it for a layperson.
   - Peer Teaching — Each student teaches a concept from their discipline to a partner from another discipline.
   - Diagram Explanation — Provide a technical diagram; students explain it verbally.

10. Presenting Logical Arguments – Debates
    - Two-Minute Debates — Quick debates with timed arguments and rebuttals.
    - Evidence Hunt — Students gather data or examples to support their stance before debating.

- Role-based Debates — Students debate from assigned roles (environmentalist, policymaker, student).

11. Talking About Social Issues & Data Interpretation
    - Data Talk — Provide charts/graphs (literacy rates, pollution levels); students interpret and present insights.
    - Issue Circles — Groups discuss a social issue and propose one actionable solution.
    - Poster-to-Speech — Students convert an infographic into a 2-minute talk.

12. Interviews – Formal & Semi-formal
    - Mock Interview Panels — Students face a panel of peers acting as interviewers.
    - Resume-based Q&A — Students ask each other questions based on their resumes.
    - Situational Interviews — Semi-formal scenarios: club membership, internship, volunteer role.

Lab Manual

- Propel: A Course Book for Technical English Communication. Cengage Publishers, 2026.

Reference Books:

1. Raman Meenakshi,Sangeeta-Sharma.TechnicalCommunication.OxfordPress.2018.
2. Taylor Grant: English Conversation Practice,Tata McGraw Hill Education India,2016.
3. Hewing's, Martin. Cambridge Academic English (B2).CUP, 2012.
4. J.Sethi & P.V.Dhamija. A Course in Phonetics and Spoken English, (2ndEd), Kindle, 2013
5. Richards, Jack C., Jonathan Hull, and Susan Proctor. Interchange Level 3 Student's Book with Self-study DVD-ROM. Vol. 3. Cambridge University Press, 2012.

Web Resources:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw
12. https://www.youtube.com/user/letstalkaccent/videos
13. https://www.youtube.com/c/EngLanguageClub/featured
14. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
15. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Part B
(Any 4 Experiments in Part B)

Moodle Learning Management System: Digital learning an Academic Skills

Course Objectives

- To become familiar with model LMS and on-line learning

- To develop basic Digital and Academic Skills needed for Engineering students
- To learn effective on-line communication and collaboration
- To develop skills in Assignments, Quizzes, Presentation and Refreshing
- To practice Academic Integrity and Responsible use of Digital Technology

Moodle Learning Management System: Digital learning to enhance Academic Skills. Students familiarize with model LMS and on-line learning, communication and collaboration. They develop skills in Assignments, Quizzes, Presentation and online interviews. They exercise academic Integrity and responsible use of Digital Technology. They adopt the usage of Grammarly, ChatGPT, CultureWizard, Quizlet AI and Google Speech –to-text to enhance their respective skills.

List of Experiments

1. **Introduction to Moodle LMS**
   - Introduction to Moodle
   - Student login and profile management
   - Moodle dashboard and course navigation
   - Accessing announcements and course materials
   - Notifications and calendars

2. Learning Through Moodle
   - Accessing PDFs, videos, web resources, and lecture materials
   - Downloading and organizing study materials
   - Moodle lessons and learning activities
   - Tracking course completion
   - Managing deadlines and study schedules

3. Assignments, Quizzes and Assessments
   - Understanding assignment instructions
   - Creating and uploading assignments
   - File formats and file naming
   - Online quizzes and question types
   - Viewing marks and teacher feedback
   - Resubmission and revision

4. Digital Communication and Collaboration
   - Moodle forums and discussions
   - Academic email etiquette
   - Online communication and netiquette
   - Group activities and peer learning
   - Collaborative learning tools
   - Digital presentation skills

5. Academic Skills for Engineering Students
   - Effective note-taking
   - Reading and understanding technical material

- Time management and study planning
- Problem-solving and critical thinking
- Basic research and information-search skills
- Preparing reports and presentations
- Introduction to citations and referencing

6. Academic honesty

- Plagiarism and how to avoid it
- Copyright and fair use
- Responsible use of AI tools
- Digital privacy and cybersecurity
- Evaluating reliable online information
- Professional behavior in online environments
- Practical Activities

7. Students can complete activities such as:

- Create and update a Moodle profile.
- Download course material and organize it into folders.
- Submit an assignment through Moodle.
- Attempt an online quiz.
- Participate in a Moodle discussion forum.
- Upload a revised assignment after receiving feedback.
- Prepare a short technical presentation.

COURSE CODE	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB	CATEGORY ESC	L-T-P-C 0-0-3-1.5

Pre-requisite: NIL

Course Objectives:

- To develop practical skills in measuring voltage, current, power, and power factor in DC and AC electrical circuits and in experimentally verifying basic circuit laws and analysis methods.
- To develop practical understanding of the operation, characteristics, and speed-control methods of DC shunt motors.
- To familiarize students with the characteristics and applications of semiconductor devices, rectifier and transistor circuits and domestic energy consumption.

Course Outcomes: After successful completion of this course, the student will be able to:

CO1: **apply** electrical measuring instruments and circuit analysis methods to measure electrical quantities and verify circuit laws, theorems, mesh, and nodal analysis. **(K3)**

CO2: analyze the speed-control methods of DC shunt motorand analyze the characteristics of PN junction and Zener diodes.(K4)

CO3: **analyze** the operation of rectifier and transistor circuits, and the operation of integrator and differentiator circuits using IC 741 operational amplifiers and domestic energy consumption. **(K4)**

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	-	M	H	-	-	L	-	-	-			
CO2	H	H	-	M	M	-	-	L	-	-	-			
CO3	H	H	-	M	H	-	-	L	-	-	-			

List of Experiments

(Any 10 of the following experiments are to be conducted)

1. Verification of Kirchhoff's voltage and current laws.
2. Measurement of voltage, current, and power in a DC circuit.
3. Measurement of voltage, current, power and power factor in a AC circuit.
4. Verification of superposition theorem.
5. Measurement of voltages and currents using mesh and nodal analysis in a circuit.
6. Verification of Thevenin's theorem and determine its equivalent parameters.
7. Verification of Norton's theorem and determine its equivalent parameters.
8. Speed control of DC shunt motor using armature voltage control method.
9. Speed control of DC shunt motor using field control method.
10. Investigate the characteristics of a Zener Diode as voltage regulator.
11. Plot the V-I characteristics of a PN junction diode.
12. Analyze the Input and Output waveforms of Half-Wave Rectifier.
13. Analyze the Input and Output waveforms of Full-Wave Rectifier.
14. Analyze the input and output characteristics of BJT in CE configuration.

15. Determination of Electrical Energy Consumption in Domestic Premises.

Learning Resources:

Textbooks

1. Ed Hughes. (2016). Electrical & Electronic Technology (12th edition). Pearson Education.
2. Vincent Del Toro. (2015). Electrical Engineering Fundamentals (2nd edition). Pearson Education.

Reference Books

1. Mehta, V. K., & Mehta, R. (2008). Principles of electrical engineering and electronics. S. Chand Publishing.
2. Charles K. Alexander and Mathew N.O. Sadiku. (2017). Fundamentals of Electrical Circuits (6th edition). Mc Graw-Hill Education, India.
3. V. K. Mehta, Rohit Mehta. (2022). Principles of Power Systems. S. Chand Publishing.

Web Resources

1. https://bes-iitr.vlabs.ac.in/List%20of%20experiments.html
2. https://be-iitkgp.vlabs.ac.in/List%20of%20experiments.html

COURSE CODE	Computational Thinking and Problem Solving Using Python Lab		L-T-P-C 0-0-3-1.5

Pre-requisite: NIL

Course Objectives: *At the end of the course, the teacher should be able to*:

- Establish computational thinking, decomposition, pattern recognition, abstraction, and algorithmic reasoning as the foundation for problem-solving, with strong grounding in algorithm design and flowchart construction.
- Develop proficiency in Python control structures while explicitly linking conditionals to abstraction and loops to pattern recognition.
- Build competence in selecting Python data structures (strings, lists, tuples, dictionaries) as an exercise in abstraction and pattern-based organization of information.
- Train students to decompose problems into functions and recursive sub-problems, reason informally about algorithmic efficiency, and use AI coding assistants responsibly.
- Equip students with file handling, exception handling, and basic data analysis/visualization skills framed as decomposing a larger data workflow into manageable, robust steps and to integrate these skills in a capstone mini-project.

Course Outcomes: *At the end of the course, student will be able to*

CO1: Explain the principles of computational thinking and interpret algorithms and flowcharts that represent problem-solving logic (K2)

CO2: Apply pattern recognition and abstraction, via Python control structures, to implement step-by-step algorithmic solutions (K3)

CO3: Analyze problems to select and manipulate appropriate data structures (strings, lists, tuples, dictionaries) as an abstraction and organization exercise (K4)

CO4: Evaluate the correctness and efficiency of decomposed, modular algorithms and Python programs through tracing, testing, debugging, and exception handling (K5)

CO5: Create modular, well-structured Python programs by decomposing problems into functions, recursion, file handling, and data analysis, culminating in an integrative capstone project (K6)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	M	L	L	M	-	-	-	L	-	M
CO2	H	H	M	M	H	-	-	L	L	-	M
CO3	H	H	M	M	H	-	-	L	L	-	M
CO4	H	H	M	H	H	-	L	L	M	-	H
CO5	H	H	H	H	H	L	L	M	H	L	M

Week 1 (Unit 1):

(1) Find the largest of three numbers.
(2) Check whether a given year is a leap year.

Week 2 (Unit 1):

(1) Compute simple interest given principal, rate, and time.
(2) Compute the area and perimeter of a rectangle from user input.
(3) Swap two numbers without using a third variable.

Week 3 (Unit 2):

(1) Determine whether a number is positive, negative, or zero.
(2) Check if a given number is prime
(3) Convert temperature between Celsius and Fahrenheit based on user choice
(4) Determine BMI category (underweight/normal/overweight/obese) using elif.
(5) Classify a triangle as equilateral, isosceles, or scalene.

Week 4 (Unit 2):

(1) Print all Armstrong numbers between 1 and 1000.
(2) Generate the Fibonacci series up to n terms using a loop
(3) Find the GCD and LCM of two numbers using a while loop
(4) Simulate a simple ATM PIN-entry system allowing a maximum of 3 attempts.
(5) Find the first n prime numbers using nested loops with break.

Week 5 (Unit 3):

(1) Encrypt a message using a Caesar cipher.
(2) Check if two given strings are anagrams of each other.
(3) Check whether a given string is a palindrome using slicing and string methods
(4) Count vowels, consonants, digits, and spaces in a given string

Week 6 (Unit 3):

(1) Find the second-largest element in a list of exam scores.
(2) Merge two sorted lists of student roll numbers into a single sorted list.
(3) Generate squares of all even numbers from 1 to 50 using list comprehension.
(4) Store and retrieve student records using a dictionary (roll number as key, tuple of name/marks as value)

Week 7 (Unit 3):

(1) Store coordinates (x, y) as tuples in a list and compute the distance between consecutive points.
(2) Count the frequency of each word in a paragraph using a dictionary
(3) Maintain an inventory system (item name as key, tuple of price and quantity as value) that updates stock after each transaction.

Week 8 (Unit 4):

(1) Using a function, check if a number is "perfect," and list all perfect numbers up to 10,000.
(2) Using *args, compute the total resistance of resistors in series or parallel.
(3) Define a function with default/keyword arguments to compute the area of different shapes based on shape type and use it.
(4) Write a function that returns the mean, median, and mode of a list of numbers

Week 9 (Unit 4):

(1) Compute the GCD of two numbers recursively using the Euclidean algorithm.
(2) Compute factorial using recursion
(3) Solve the Tower of Hanoi problem for n disks recursively and count the number of moves.
(4) Compute the range and maximum height of a projectile given initial velocity and angle, using the math module.

Week 10 (Unit 5):

(1) Count the words, lines, and characters in a given text file.
(2) Read a log file of sensor readings and append a new set of readings with a timestamp.
(3) Read a text file of daily temperature readings and write the maximum, minimum, and average to an output file

Week 11 (Unit 5):

(1) Build a simple calculator that gracefully handles ZeroDivisionError, ValueError, and invalid operators.
(2) Safely compute the roots of a quadratic equation using try-except-finally, abstracting invalid input and division-by-zero into predictable, handled error patterns.
(3) Read a CSV of student marks and write the names of students scoring above 75% to a new file
(4) Validate user input for a unit-conversion tool and raise a custom exception for out-of-range values.
(5) Using Pandas, read a CSV of daily electricity consumption and plot a line graph over a month, recognizing weekday/weekend consumption patterns.

Week 12 (Unit 5):

(1) Capstone Mini-Project: "Dataset Health-Check & Insights Tool" — decompose the workflow into read → validate → clean → analyze → visualize → report stages, using exception handling and NumPy/Pandas/Matplotlib, submitted with a one-page reflection.

Learning Resources:

Text Books:

3. Downey, A. B. (2015). Think Python: How to think like a computer scientist (2nd ed.). O'Reilly Media.
4. Guttag, J. V. (2021). Introduction to computation and programming using Python: With application to computational modeling and understanding data (3rd ed.). MIT Press.

Reference Books:

4. Sweigart, A. (2025). Automate the boring stuff with Python: Practical programming for total beginners (3rd ed.). No Starch Press.
5. McKinney, W. (2022). Python for data analysis: Data wrangling with pandas, NumPy, and Jupyter (3rd ed.). O'Reilly Media.
6. Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35. https://doi.org/10.1145/1118178.1118215

Web References:

1. Python Software Foundation. (n.d.). The Python tutorial. https://docs.python.org/3/tutorial/
2. W3Schools. (n.d.). Python tutorial. https://www.w3schools.com/python/
3. NPTEL. (n.d.). Programming, data structures and algorithms using Python. https://nptel.ac.in

COURSE CODE –	Applied Chemistry for Emerging Technologies Lab	CATEGORY BSC	L-T-P-C 0-0-3-1.5

Pre-requisite: NIL

Course Objectives:

- To provide hands-on experience in determining fundamental constants and semiconductor band-gap energy through optical and photoelectric experiments.
- To train students in conductometric, potentiometric and cell-based electrochemical measurement techniques.
- To familiarize students with the performance evaluation of batteries, supercapacitors and biosensors.
- To develop skills in the preparation and characterisation of nanomaterials and in safe laboratory practice, data analysis and technical reporting.

Course Outcomes (COs): ***At the end of the course, students will be able to***

CO1: Estimate fundamental physical quantities such as Planck's constant and the band-gap energy of a semiconductor from photoelectric and optical absorption measurements. (K3).

CO2: Determine electrochemical parameters including EMF, specific and equivalent conductance, and pH using conductometric, potentiometric and cell-based methods. (K3)

CO3: Analyse the charge-discharge characteristics and performance of batteries and supercapacitors used in computing devices. (K4)

CO4: Synthesize and examine nanomaterials and evaluate their optical and adsorption properties for engineering applications. (K4)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	L	H	M	-	-	M	L	-	M			
CO2	H	M	-	H	M	-	-	M	L	-	M			
CO3	H	H	M	H	M	-	-	M	L	-	M			
CO4	H	H	M	H	M	M	-	M	L	-	M			

LIST OF EXPERIMENTS

(Any **TEN** of the following listed experiments)
(Out of which any **TWO** experiments may be conducted in virtual mode)

1. Verification of the photoelectric effect and estimation of Planck's constant.
2. Study of the emission spectrum of a hydrogen/mercury-vapour Lamp using a spectrometer.
3. Determination of the band-gap energy of a semiconductor sample from its optical absorption edge.
4. Determination of a strong acid against a strong base by using a conductometer.
5. Determination of the EMF of a Daniel cell and verification of the Nernst equation.
6. Determination of the charge–discharge characteristics of a lithium-ion battery/supercapacitor cell.
7. Determination of the specific and equivalent conductance of an electrolyte solution.
8. Assemble a simple Zn-carbon (or lead-acid) cell and measure its voltage and approximate capacity.
9. Construction and performance evaluation of a simple enzyme based electrochemical biosensor for glucose detection (demo)
10. Preparation and observation of colloidal gold/silver nanoparticles (size-dependent colour- change)
11. Determination of the viscosity of a polymer/nanomaterial-dispersion solution using an Ostwald

viscometer.

12. Determination of the pH of an electronic-grade (deionized) water sample used in wafer/PCB cleaning.
13. Determination of strong acid against a strong base by using potentiometer.
14. Determination of conductivity of an electronic-grade (deionized) water sample used in wafer/PCB cleaning.
15. Redox titration by using potentiometer.
16. Determination of strength of an acid in Pb-Acid battery.
17. Adsorption capacity of a nanomaterial (e.g., activated carbon nanoparticles or nano-iron oxide) for removal of a dye or metal ion from water.
18. Study of galvanic corrosion using a zinc–iron electrochemical couple.

References:

- Vogel, A. I. (2012). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education.
- Ahluwalia, V. K., & Dhingra, S. (2017). Comprehensive practical organic chemistry. Universities Press.
- Virtual Labs, Ministry of Education, Government of India. https://vlab.co.in

COURSE CODE	NSS / NCC	CATEGORY MNC	L-T-P-C 0-0-2-0

Course Objectives:

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes: After completion of the course the students will be able to

CO1: Understand the importance of discipline, character and service motto.

CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.

CO3: Explore human relationships by analyzing social problems.

CO4: Determine to extend their help for the fellow beings and downtrodden people.

CO5: Develop leadership skills and civic responsibilities.

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i. Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
ii. Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii. Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv. Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities:

i. Best out of waste competition.
ii. Poster and signs making competition to spread environmental awareness.
iii. Recycling and environmental pollution article writing competition.
iv. Organising Zero-waste day.
v. Digital Environmental awareness activity via various social media platforms.
vi. Virtual demonstration of different eco-friendly approaches for sustainable living.
vii. Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

i. Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
ii. Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii. Conducting consumer Awareness. Explaining various legal provisions etc.
iv. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v. Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol; I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)

2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, Directorate General of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering", McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

ANNEXURE

Concept Note on Integration of WISER Quantum Courses into B.Tech and Conventional Degree Curriculum as PEC(Professional Elective courses)

1. Background

The Washington Institute for STEM, Entrepreneurship and Research (WISER), Washington DC, has prepared a semester-based learning pathway in Quantum Technologies for the State of Andhra Pradesh, in accordance with the National Curriculum Framework and as part of the Amaravati Quantum Valley initiative. The Learning Pathway of WISER is intended to introduce students to foundational, intermediate and advanced areas of quantum technologies through modular, self-paced video lessons that may also be facilitated in classroom or cohort-based mode.

In view of the growing importance of quantum technologies in computing, communication, sensing, cybersecurity, materials, chemistry, optimisation, artificial intelligence, high-performance computing and scientific simulation, there is a need to provide students of engineering, sciences, interdisciplinary programmes, management, humanities and applied sciences with structured exposure to this emerging area. The proposed WISER courses may support quantum literacy, computational thinking, research orientation, employability and innovation readiness among undergraduate learners.

Accordingly, the possibility of integrating WISER quantum courses into B.Tech and conventional degree programmes is placed before the Hon'ble Vice-Chancellors for academic consideration.

2. Overview of WISER Quantum Courses

Based on the course documents and learning pathway, the immediately available courses are structured as 3/4-credit, 45/60-hour courses. The courses follow a 40:60 assessment model consisting of assignments/quizzes and end-term examination. The learning pathway also indicates upcoming courses in cryptography, optimisation, chemistry and quantum error correction.

Code	Course / Track	Level	Credits / Hours	Prerequisite
QT-101	Quantum Foundation and Applied Technologies	Foundational	3/4 credits 45/ 60 hours	None
QT-102	Quantum Computing and Artificial Intelligence	Intermediate	3/4 credits 45/ 60 hours	Foundational course QT-101 recommended
QT-103	Quantum Computing for Differential Equations	Advanced	3/4 credits 45/ 60 hours	Intermediate course QT-102 recommended

*** 3 Credits for Engineering Programmes and 4 Credits for Conventional Degree Programmes**

**** 45 hours for Engineering Programmes and 60 hours for Conventional Degree Programmes**

The WISER learning pathway recommends a structured progression from QT-101 to QT-102 and thereafter to advanced courses. However, the pathway also states that adherence to the sequence need not be mandatory, and that students may select courses based on interest, academic requirements, career aspirations, existing knowledge and institutional guidelines.

WISER/QISE Platform and Certifications

All video lessons, quizzes and assignments are indicated as being accessible through the WISER/QISE learning platform. WISER/QISE is expected to host course content, learning resources, quizzes, assignments and assessment materials through the centralized Learning Management System wherever feasible. Upon successful completion of course requirements and assessments, learners may be eligible to receive industry-recognized certificates issued by WISER.

Additional Learning Opportunities

The pathway also indicates value-added opportunities for high-performing learners, including Global WISER Summer School scholarships for top performers, international conference participation for selected learners, research and innovation micro-grants for outstanding proposals and possible future access to WISER research fellowships, industry projects and collaborative international programmes. These may be treated as enrichment opportunities, subject to WISER's programme availability and selection criteria.

3. Course-wise Syllabus Structure

The syllabus of each course is organised in five units. The following summaries indicate the academic structure proposed for integration.

QT-101: Quantum Foundation and Applied Technologies

Quantum Foundation and Applied Technologies is proposed as a 4-credit, 60-hour foundation / interdisciplinary / skill-oriented course. Builds quantum literacy through foundations of quantum science, quantum computing, sensing, communication, networking, hardware systems, software platforms, real hardware workflows, HPC-AI convergence and entrepreneurship.

Unit	Title
Unit I	Foundations of Quantum Science and Technologies
Unit II	Quantum Communication, Networking and Hardware Systems
Unit III	Quantum Computing Fundamentals and Algorithms
Unit IV	Quantum Hardware, Noise and Variational Computing

Unit	Title
Unit V	Quantum Ecosystem, HPC, AI and Entrepreneurship

QT-102: Quantum Computing and Artificial Intelligence

Quantum Computing and Artificial Intelligence is proposed as a 4-credit, 60-hour intermediate level / interdisciplinary / skill-oriented course. Introduces the convergence of quantum computing and artificial intelligence, including quantum algorithms for AI, quantum machine learning, hybrid quantum-classical models, quantum optimisation and AI for quantum technologies.

Unit	Title
Unit I	Foundations of Quantum Computing and Artificial Intelligence
Unit II	Quantum Algorithms for Artificial Intelligence
Unit III	Quantum Machine Learning Foundations and Advanced Models
Unit IV	Quantum Optimisation and Integrated Quantum-AI Systems
Unit V	AI for Quantum Technologies and Emerging Applications

QT-103: Quantum Computing for Differential Equations

Quantum Computing for Differential Equations is proposed as a 4-credit, 60-hour advanced level / interdisciplinary / skill-oriented course. Applies quantum computing to differential equations and scientific computing, covering quantum circuits, algorithmic primitives, quantum simulation, HHL, QSVT, block encoding, hybrid solvers, error mitigation, benchmarking and practical limitations.

Unit	Title
Unit I	Foundations of Quantum Computing and Quantum Circuits
Unit II	Quantum Algorithms and Computational Foundations

Unit	Title
Unit III	Quantum Simulation and Differential Equation Solvers
Unit IV	Advanced Quantum Algorithms and Computing Applications
Unit V	Quantum Hardware, Error Mitigation and Benchmarking

4. Upcoming Courses in the WISER Pathway

The WISER learning pathway also lists the following upcoming courses. These may be considered separately after detailed syllabi, assessment structure and implementation readiness are formally submitted and examined by the universities.

QT-104: Quantum Cryptography and Cybersecurity (Intermediate) - Foundations of quantum theory for secure technologies; quantum communication, networks and cryptographic foundations; quantum security principles and post-quantum cryptography; quantum hardware security and secure network implementation; quantum cybersecurity platforms, applications and industry readiness.

QT-105: Quantum Computing for Optimization (Advanced) - Foundations of quantum computing and algorithmic thinking; optimization theory, complexity and quantum annealing; gate-based quantum optimization algorithms; advanced quantum optimization techniques; performance, error mitigation and benchmarking.

QT-106: Quantum Computing for Chemistry (Advanced) - Foundations of quantum computing and algorithmic principles; quantum chemistry and molecular systems; quantum algorithms for chemical simulations; advanced algorithms for chemistry and materials discovery; hardware performance, error analysis and benchmarking.

QT-107: Quantum Error Correction (Advanced) - Foundations of quantum computing, algorithms and noise; mathematical foundations of quantum error correction; error-correcting codes and fault diagnosis; fault-tolerant architectures; benchmarking, performance evaluation and scalable quantum systems.

5. Proposed Integration into B.Tech and Conventional Degree Curriculum

The B.Tech curriculum may provide integration as Open Electives, MOOCs/online learning, minor/elective baskets, blended learning components, internship-linked learning or project-based learning. Conventional degree programmes may integrate the courses through Skill Enhancement Courses, Major Electives.

Course	Title	Credits and Hours*	Suggested NCrF/NSQF Level	Suggested Integration in B.Tech	Suggested Integration in Conventional Degree Programmes
QT-101	Quantum Foundation and Applied Technologies	3/4 credits 45/ 60 hours	4.5	Open Elective course in any of the Semesters 5	Optional SEC in semester 2; suitable for Computer Science, AI/Data Science and allied conventional programmes.
QT-102	Quantum Computing and Artificial Intelligence	¾ credits 45/ 60 hours	5.0	Open Elective course in any of the Semester 6	Major Elective in Semester 6 for Computer Science, AI/Data Science and allied programmes, subject to lab/mentoring and university assessment.
QT-103	Quantum Computing for Differential Equations	¾ credits 45/ 60 hours	5.0	Open Elective course in any of the Semester 7	Major Elective in Semester 6 for Computer Science, AI/Data Science and allied programmes, subject to lab/mentoring and university assessment.

***3 Credits for Engineering Programmes and 4 Credits for Conventional Degree Programmes**

45 hours for Engineering Programmes and 60 hours for Conventional Degree Programmes

6. Assessment and Academic Safeguards

Component	Weightage	Remarks
Assignments / Quizzes	40%	Quizzes and assignments may be administered through the WISER/QISE LMS wherever feasible. Non-attempted quizzes may be treated as zero as per the WISER pathway, subject to university rules.
End-Term Examination	60%	Mode, pattern, number of questions, schedule and examination process should be communicated in advance and aligned with university regulations.

- Students should complete the prescribed WISER modules, quizzes, assignments and end-term assessment as per the approved course design.
- Only after the student obtains WISER completion evidence or certificate may the same be considered for conversion into marks/grades, as per the mechanism approved by the concerned university.
- The college may conduct Continuous Internal Assessment separately through assignments, tutorials, mentoring records, presentations, lab/practical demonstrations, mini-projects or viva, wherever required by the university.
- The 40:60 model proposed by WISER may be adopted, adapted or mapped to the university's assessment framework, subject to statutory approval.
- Where examinations, practical evaluations, proctored assessments, project reviews or viva examinations are required outside the LMS, WISER/QISE may coordinate with participating universities and relevant academic authorities.
- Final approval, course placement, assessment pattern, mark/grade conversion, result processing and examination responsibility shall remain with the concerned university and statutory bodies.

7. Quality Assurance and Institutional Coordination

- WISER shall be responsible for academic quality assurance of educational content delivered through the programme. It also indicates that curriculum materials, assessments and learning resources undergo review and validation involving industry experts, internationally recognised academics and subject matter specialists from the global quantum and emerging technologies ecosystem.
- For each course, WISER maintains a dedicated Education Board responsible for curriculum quality, academic standards, learning outcomes and continuous improvement. Course teams and subject matter experts are

expected to work with lecturers, instructors and content contributors to ensure alignment with the approved curriculum framework and learning objectives.

- Universities may, however, undertake their own academic scrutiny before adoption, including verification of syllabus depth, level appropriateness, prerequisites, faculty facilitation capacity, assessment mapping, certificate validity, data/reporting mechanism and student support requirements.

8. Target Learners and Institutional Use

The WISER courses are positioned for a broad range of learners across engineering, sciences, interdisciplinary and applied domains. They may be particularly useful for the following learner groups:

- Core engineering disciplines such as Computer Science Engineering, Electronics and Communication Engineering, Electrical Engineering, Instrumentation Engineering, Mechanical Engineering, Engineering Physics, Materials Science Engineering and Chemical Engineering.
- Interdisciplinary and emerging engineering disciplines such as AI/ML, Data Science, Robotics, Nanotechnology, Photonics, Optical Engineering, Cybersecurity, Telecommunication Engineering, Aerospace Engineering, Biomedical Engineering, Mathematics and Computing, Industrial Engineering and Mechatronics.
- Core science branches such as Physics, Mathematics, Computer Science, Chemistry, Statistics and Data Science.
- Interdisciplinary science and emerging domains such as Quantum Physics, Computational Science, Materials Science, Nanoscience, Photonics, Biophysics, AI and Machine Learning.
- Arts, humanities and applied science learners in Economics, Philosophy, Psychology, Design, Digital Media, Public Policy, Business Analytics, Finance and allied domains who require foundational exposure to emerging technologies.
- Beginners without prior knowledge of quantum computing but willing to pursue structured quantum learning.
- Institutions and universities seeking to introduce quantum education as part of their curriculum.

9. Role of APSCHE and Universities

APSCHE may facilitate academic discussion with universities, coordination with WISER/QISE, model curriculum mapping and broad framework development for integration of WISER quantum courses into B.Tech and conventional degree programmes. APSCHE may also facilitate consultation among universities to identify common routes of adoption and assessment safeguards.

The concerned universities shall decide the final course placement, credits, eligibility/prerequisites, assessment model, grade/mark conversion, result processing and examination responsibility. Universities may also decide whether to adopt the courses as credit-bearing courses, elective courses, value-added courses, MOOCs/online learning components, skill courses or enrichment modules.

10. Suggested Resolution for Consideration of Vice-Chancellors

The Vice-Chancellors may agree in principle to explore the integration of WISER quantum courses into B.Tech and conventional degree curricula, subject to university-level academic approval, confirmation of course content and delivery arrangements, WISER/QISE LMS access, assessment and certification mechanism, college-level facilitation and CIA wherever required, approved conversion of WISER completion evidence into marks/grades, and compliance with the concerned university/statutory regulations.

11. Conclusion

WISER quantum courses may be considered as structured, emerging-technology learning pathways that can support Andhra Pradesh's academic preparedness for the Amaravati Quantum Valley initiative. The courses offer a progressive route from quantum foundations to quantum-AI convergence and advanced scientific computing applications. Integration may be undertaken through suitable curriculum slots such as Skill Enhancement Courses, Professional/Open Electives, Major Electives, Multidisciplinary Courses, value-added courses, online learning components or project-linked learning, subject to university-approved academic safeguards and assessment mechanisms.

Appendix:

WISER Course Syllabi

The following syllabi are drawn from the WISER course documents supplied for academic consideration. Universities may adapt the final wording, course codes and assessment details according to their statutory approval processes.

QT-101: Quantum Foundation and Applied Technologies

Parameter	Details
Course Code	QT-101
Credits	3/4
Total Hours	45/60
Course Type	Foundation / Interdisciplinary / Skill-Oriented Course
Mode of Delivery	Self-paced modular video lessons; may be facilitated in classroom / cohort-based learning
Assessment Pattern	Assignments / Quizzes - 40%; End-Term Examination - 60%

Course Objectives

Objective 1: Introduce the fundamental principles and concepts of quantum science and build a strong foundation in quantum technologies.

Objective 2: Develop the ability to analyse and differentiate classical and quantum systems based on the fundamental principles of quantum mechanics.

Objective 3: Provide exposure to quantum algorithms, circuits, protocols, software platforms, real quantum hardware and quantum research laboratory environments.

Objective 4: Familiarise students with quantum simulators, noise models, variational quantum algorithms, high-performance computing, artificial intelligence and scalable quantum computing systems.

Objective 5: Prepare students for academic, research and industry opportunities in quantum technologies and entrepreneurship.

Course Learning Outcomes

CO1: Explain the fundamental concepts, evolution and significance of quantum science and quantum technologies.

CO2: Differentiate classical and quantum systems using concepts such as qubits, superposition, entanglement and quantum measurement.

CO3: Describe the principles, components and applications of quantum computing, sensing, communication, networking and hardware systems.

CO4: Construct and interpret basic quantum circuits and explain key algorithms, simulators, noise models and real hardware workflows.

CO5: Analyse quantum applications in industry and demonstrate awareness of HPC, AI integration, scalable systems, careers, innovation and entrepreneurship.

Unit-wise Syllabus

Unit and Title	Title and Contents
Unit I: Foundations of Quantum Science and Technologies	Introduction to quantum science, its evolution and significance in modern technology; quantum systems, qubits and quantum information; basic mathematical terminology used in quantum computing; comparison of classical and quantum computing paradigms; overview of the quantum ecosystem, emerging technologies, future research directions, quantum sensing, quantum annealing and selected applications in chemistry and materials science.
Unit II: Quantum Communication, Networking and Hardware Systems	Quantum communication, quantum networking and the quantum internet; entanglement-based communication, quantum data transmission and network architectures; applications in power and energy systems; fundamentals of quantum hardware, superconducting systems, cryogenic infrastructure and

Unit and Title	Title and Contents
	dilution refrigeration; exposure to quantum research laboratories and hardware environments.
Unit III: Quantum Computing Fundamentals and Algorithms	Global landscape of quantum computing; DiVincenzo criteria, qubits and core quantum principles; quantum states, measurement, superposition, entanglement, two-qubit gates, GHZ states, superdense coding and quantum teleportation; quantum protocols, circuits and algorithms; IBM Qiskit for creating and visualising circuits; Quantum Fourier Transform, Quantum Phase Estimation, Grover's Algorithm and introductory QAOA applications.
Unit IV: Quantum Hardware, Noise and Variational Computing	Quantum simulators, noise modelling and execution of algorithms on real platforms; trapped-ion quantum computers and high-fidelity qubit control; variational quantum algorithms, parameterised quantum circuits, optimisation techniques and the variational computing framework; ZX Calculus and emerging applications in scientific computing and computational fluid dynamics.
Unit V: Quantum Ecosystem, HPC, AI and Entrepreneurship	Scalable quantum computing, hybrid architectures and resource estimation; HPC, AI and integration with quantum technologies; fault-tolerant quantum systems, benchmarking and evaluation of hardware and algorithms; applications in weather modelling, optimisation, energy and chemistry; global quantum ecosystem, workforce needs, careers, innovation and entrepreneurship.

Suggested Textbooks and References

Reference 1: Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information.

Reference 2: Robert S. Sutor, Dancing with Qubits: How Quantum Computing Works and How It Can Change the World.

Reference 3: Phillip Kaye, Raymond Laflamme and Michele Mosca, An Introduction to Quantum Computing.

Reference 4: Jack D. Hidary, Quantum Computing: An Applied Approach.

Reference 5: Rodney Van Meter, Quantum Networking.

Reference 6: Daniel A. Lidar and Todd A. Brun, Quantum Error Correction.

Reference 7: Eric Ries, The Lean Startup.

QT-102: Quantum Computing and Artificial Intelligence

Parameter	Details
Course Code	QT-102
Credits	3/4
Total Hours	45/60
Course Type	Intermediate level / Interdisciplinary / Skill-Oriented Course
Mode of Delivery	Self-paced modular video lessons; may be facilitated in classroom / cohort-based learning
Assessment Pattern	Assignments / Quizzes - 40%; End-Term Examination - 60%

Course Objectives

Objective 1: Develop a foundational understanding of quantum computing, artificial intelligence and their emerging convergence.

Objective 2: Introduce the mathematical principles and computational techniques that underpin quantum machine learning.

Objective 3: Provide practical exposure to quantum machine learning algorithms, hybrid quantum-classical models and quantum computing platforms.

Objective 4: Develop analytical and problem-solving skills for applying quantum-enhanced approaches to data analysis, optimisation and intelligent systems.

Objective 5: Build awareness of emerging research directions, industry applications, innovation opportunities and future careers in quantum computing and artificial intelligence.

Course Learning Outcomes

CO1: Explain the fundamental concepts, principles and applications of quantum computing and artificial intelligence.

CO2: Describe the mathematical foundations and computational techniques used in quantum machine learning.

CO3: Apply quantum machine learning algorithms and hybrid quantum-classical approaches to solve computational problems.

CO4: Analyse the role of quantum computing in enhancing machine learning, optimisation and intelligent systems.

CO5: Evaluate emerging applications, research opportunities and industry use-cases at the intersection of quantum computing and artificial intelligence.

Unit-wise Syllabus

Unit and Title	Title and Contents
Unit I: Foundations of Quantum Computing and Artificial Intelligence	Introduction to quantum computing, artificial intelligence and their convergence; quantum systems, qubits, circuits and programming; foundations of machine learning and AI, learning paradigms and programming workflows; AI in scientific discovery with examples from materials and atmospheric sciences; opportunities, challenges and future directions.
Unit II: Quantum Algorithms for Artificial Intelligence	Quantum algorithmic principles relevant to AI; quantum parallelism and computational advantage; Grover's Search Algorithm, Quantum Fourier Transform and HHL Algorithm; quantum sampling and probability distributions; applications in machine learning and data analysis; role of quantum algorithms in computational challenges and quantum-enhanced AI.
Unit III: Quantum Machine Learning Foundations and Advanced Models	Hybrid quantum-classical machine learning; data encoding, feature maps, embeddings, ansatze and parameterised circuits; quantum kernels, quantum neural networks, variational quantum models and variational quantum classifiers; quantum convolutional neural networks and ZX-Calculus; expressibility, trainability, complexity, advantages, limitations and scalability.
Unit IV: Quantum Optimisation and Integrated Quantum-AI Systems	Optimisation in quantum computing, AI and machine learning; Variational Quantum Eigensolver, QAOA and circuit optimisation; classical, quantum and hybrid optimisation; classical optimisers in variational algorithms; integration of quantum computing with HPC and AI; hybrid workflows, HPC-Quantum architectures, challenges and opportunities.
Unit V: AI for Quantum Technologies and Emerging Applications	AI in quantum circuit design, optimisation, control, calibration and error mitigation; integration of quantum computing with large language models, combinatorial reasoning and intelligent computational frameworks; AI for quantum communication and networks; quantum-AI for scientific computing, discovery and optimisation; generative quantum algorithms and emerging software frameworks.

Suggested Textbooks and References

Reference 1: Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information.

Reference 2: Maria Schuld and Francesco Petruccione, Machine Learning with Quantum Computers.

Reference 3: Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach.

Reference 4: Jack D. Hidary, Quantum Computing: An Applied Approach.

Reference 5: Rajkumar Buyya, Rodrigo N. Calheiros and Amir V. Dastjerdi, High-Performance Computing: Foundations and Applications.

Reference 6: Maria Schuld, Supervised Learning with Quantum Computers.

QT-103: Quantum Computing for Differential Equations

Parameter	Details
Course Code	QT-103
Credits	3/4
Total Hours	45/60
Course Type	Advanced level / Interdisciplinary / Skill-Oriented Course
Mode of Delivery	Self-paced modular video lessons; may be facilitated in classroom / cohort-based learning
Assessment Pattern	Assignments / Quizzes - 40%; End-Term Examination - 60%

Course Objectives

Objective 1: Develop a strong foundation in quantum circuits, quantum algorithms and the computational principles of quantum computing.

Objective 2: Introduce the mathematical foundations linking differential equations, scientific computing and quantum computing.

Objective 3: Develop and implement hybrid quantum-classical approaches for solving differential equations and scientific computing problems.

Objective 4: Provide practical exposure to advanced quantum algorithms, quantum simulation techniques and emerging computational applications.

Objective 5: Build awareness of variational, fault-tolerant and emerging quantum computing approaches, current research directions and application opportunities.

Course Learning Outcomes

CO1: Explain the fundamental principles of quantum circuits, quantum algorithms and quantum computational models.

CO2: Describe the mathematical foundations linking differential equations, scientific computing and quantum computing.

CO3: Apply quantum simulation techniques and hybrid quantum-classical approaches to solve computational and scientific problems.

CO4: Analyse advanced quantum algorithms, variational methods and their applications in scientific and engineering domains.

CO5: Evaluate the impact of noise, error mitigation, benchmarking and fault-tolerant approaches in practical quantum computing systems.

Unit-wise Syllabus

Unit and Title	Title and Contents
Unit I: Foundations of Quantum Computing and Quantum Circuits	Quantum circuit model of computation; single-qubit and multi-qubit circuits; gates and circuit construction; reversibility, uncomputation and information flow; quantum interference and computational advantage; phase estimation, amplitude amplification and Quantum Fourier Transform; principles underlying modern quantum algorithms and computational frameworks.
Unit II: Quantum Algorithms and Computational Foundations	Major families of quantum algorithms and computational primitives; Grover's algorithm and amplitude amplification; quantum simulation for physical, chemical and engineering systems; quantum optimisation and optimisation landscapes; ODEs and PDEs, operator formulations, boundary value problems and numerical methods; classical PDE solver complexity and motivation for quantum algorithms.
Unit III: Quantum Simulation and Differential Equation Solvers	Quantum state preparation and Quantum Fourier Transform; Hamiltonian simulation frameworks, sparse and dense Hamiltonian representations; QSVT, HHL algorithm and block encoding for quantum linear algebra and scientific computing; Lie-theoretic approaches and computational methods underpinning modern quantum algorithms.
Unit IV: Advanced Quantum Algorithms and Computing Applications	Quantum algorithms for linear and nonlinear differential equations, including sparse Hamiltonians, product formula methods, qubitization and quantum access models; variational quantum algorithms and hybrid solvers; quantum arithmetic and algorithm design; applications in computational fluid dynamics, weather modelling, coupled dynamical systems and large-scale scientific simulations.
Unit V: Quantum Hardware, Error Mitigation and Benchmarking	Noise sources including decoherence, gate errors and measurement errors; circuit depth, fidelity and hardware limitations; error mitigation, quantum error correction, NISQ and fault-tolerant architectures; resource estimation, error-correction overheads and practical implementation; quantum advantage, utility and benchmarking methodologies.

Suggested Textbooks and References

Reference 1: Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information.

Reference 2: Jack D. Hidary, Quantum Computing: An Applied Approach.

Reference 3: Noson S. Yanofsky and Mirco A. Mannucci, Quantum Computing for Computer Scientists.

Reference 4: Andrew M. Childs and Yuan Su, Quantum Simulation.

Concept Note on Integration of IBM Courses into B.Tech and Conventional Degree Curriculum as PEC(Professional Elective courses)

(Note: IBM has given each track as 4 credit courses. But JNTUK taken those courses as a 3 credit courses)

Integration of IBM Skills Build Tracks into B.Tech and Conventional Degree Curriculum

Purpose of this note: This concept note is intended for IBM's reference to clearly explain how the proposed IBM Skill sBuild tracks may be integrated into the curriculum framework of universities and colleges in Andhra Pradesh. It also reiterates the syllabus/module structure, hours assigned to each module, indicative credit mapping, and assessment approach required for academic adoption.

1. Background and Objective

IBM Skills Build has proposed digital skilling tracks for undergraduate learners in Artificial Intelligence, Cyber Security, Data Analytics/Data Science, and Entrepreneur + Career Management Essentials. These tracks may be useful for improving digital skills, employability, career readiness and exposure to emerging technologies.

For formal integration into B.Tech and conventional degree curricula, the IBM tracks have to be mapped to specific curriculum components such as Skill Enhancement Courses, Professional/Open Electives, Multidisciplinary Courses, value-added courses, blended learning components, or project/capstone-linked learning. IBM is therefore requested to provide course-wise syllabi in university format, module-wise hours, learning outcomes, assessment details, capstone requirements and certification/micro-credential details.

2. Overview of IBM Skills Build Tracks and Indicative Credit Assignment

The following table summarises the four IBM tracks, their broad nature, total hours and indicative academic credit treatment. The credit assignment is suggestive and shall be subject to approval by the concerned university/statutory bodies.

S. No.	IBM Track	Approval Status as Indicated	Total Hours	Nature of Course	Indicative Credit Treatment

1	Artificial Intelligence	NCVET Approved	Approx. 54 hours	Emerging technology / AI skill track	May be mapped as 4 credits, or split into two 2-credit SEC/elective modules after university-format syllabus approval.
2	Cyber Security	NCVET Approved	Approx. 60-64 hours	Cybersecurity certificate pathway	May be mapped as 4 credits, or split into two 2-credit SEC modules; may also be considered as PE/OE where appropriate.
3	Data Analytics / Data Science	NCVET Approved	Approx. 60-65 hours	Data analytics certificate pathway	May be mapped as 4 credits, or split into two 2-credit SEC modules; may also be considered as PE/OE where appropriate.
4	Entrepreneur + Career Management Essentials	Not shown as NCVET Approved	Approx. 47-50 hours	Employability, entrepreneurship and workplace readiness	May be mapped as a 4 -credit value-added/MDC/career readiness course, subject to university approval.

3. Proposed Curriculum Integration Model

IBM Track	Suggested Integration in B.Tech Curriculum	Suggested Integration in Conventional Degree Curriculum	Academic Remarks
Artificial Intelligence	Skill Enhancement Course / Domain Specific Skill Course for CSE, AI & ML, Data Science, IT, ECE and allied branches; optional Open Elective for non-CSE branches.	Optional SEC in Semester I or II; value-added/digital credential course where credit integration is not immediately feasible.	Full 54-hour pathway may be treated as 4 credits; split model possible only after proper grouping and university approval.
Cyber Security	Optional domain-specific SEC or Professional Elective for CSE, Cyber Security, IT, AI & ML, Data Science, ECE and allied branches; optional Open Elective for non-CSE branches.	4/3-credit SEC across Semesters III and IV; Major Elective in Computer Science/Cyber Security/allied programmes in Semester V or VI.	Requires lab/practice support, ethical/legal orientation, capstone completion and university-approved assessment.

Data Analytics / Data Science	SEC/Open Elective across engineering branches; Professional Elective for CSE, IT, AI & ML, Data Science, ECE, Mechanical, Civil, Electrical and allied branches.	4/3-credit SEC across Semesters III and IV; Major Elective in Computer Science/Data Analytics/allied programmes in Semester V or VI.	Branch-specific examples may be used for engineering and conventional degree disciplines.
Entrepreneur + Career Management Essentials	Value-added/employability/entrepreneurship/career-readiness programme linked to induction, placement training, entrepreneurship cell, innovation/start-up activities or soft skills.	May be offered in lieu of two 2-credit Multidisciplinary Courses in Semesters III and IV, assigning 4/3 credits, subject to approval.	Since it is not shown as NCVET-approved, it may preferably be treated as value-added/MDC/career readiness unless formally approved as credit course.

4. Track-wise Syllabus, Module Hours and Indicative Credits

IBM is requested to confirm the following module-wise syllabus and hours, and provide the full university-format syllabus for each track. The credits indicated below are proposed only for curriculum discussion and shall be finalised by the university.

4.1 Artificial Intelligence Track

Proposed academic mapping: Approx. 54 hours; indicative 4 credits. The track may be integrated as one 4/3-credit SEC/elective or as two 2-credit components, subject to university approval and suitable grouping of modules.

Course Cluster	Module	Duration
AI Fundamentals	Introduction to Artificial Intelligence	75 minutes
AI Fundamentals	Natural Language Processing and Computer Vision	90 minutes
AI Fundamentals	Machine Learning and Deep Learning	120 minutes
AI Fundamentals	Run AI Models with IBM Watson Studio	105 minutes
AI Fundamentals	AI Ethics	105 minutes
AI Fundamentals	Your Future in AI: The Job Landscape	90 minutes
Advanced AI Concepts	Machine Learning Methods and Tools	165 minutes
Advanced AI Concepts	Data Analytics and Machine Learning	205 minutes
Advanced AI Concepts	Supervised Learning Methods	225 minutes

Advanced AI Concepts	Natural Language Processing	210 minutes
Advanced AI Concepts	Unsupervised Learning Methods	270 minutes
Advanced AI Concepts	AI Applications + Capstone Projects	780 minutes

Indicative credit assignment: 4/3 credits for the full pathway after completion of IBM assessments, digital credentials and capstone. If split, the university may structure it as AI Foundation/Applications - 2 credits and Advanced AI with Capstone - 2 credits, with additional faculty-led sessions/labs wherever required.

4.2 Cyber Security Track

Proposed academic mapping: Approx. 60-64 hours; indicative 4 credits. The track may be integrated as one 4/3-credit SEC/elective or as two 2-credit SEC modules, subject to university approval.

Course / Micro-Credential Area	Key Modules / Components	Hours / Duration
Cybersecurity Fundamentals	Basic cybersecurity concepts and practices	6 hours
Governance, Risk, Compliance and Data Privacy	Data and Privacy; Governance, Risk and Compliance; Capstone: Evaluate an Organization's Data Security Posture	9 hours
Vulnerability Management	Threats and Vulnerabilities; Vulnerability Management; Capstone: Impact Analysis to Address Vulnerabilities	9 hours
System and Network Security	System Security; Network Security; Capstone: Design a Secure Network for Increased Security	8 hours
Cloud Security	Cloud Computing and Virtualization; Securing Cloud Infrastructure; Capstone: Proposed Cloud Services and Security Measures	8 hours
Security Operations and Management	Security Operations; Security Monitoring; Capstone: Assemble a SOC Team and Perform Security Monitoring Tasks	8 hours
Incident Response and Systems Forensics	Incident Response; Digital System Forensics; Capstone: Investigate an Endpoint Through Digital Forensics	8 hours
IBM SkillsBuild Cyber Security Certificate	Emerging Threats and Future of Cybersecurity Technologies; Final Assessment; Final Capstone Project Part 1 and Part 2	8 hours

Indicative credit assignment: 4 credits for the full certificate pathway. Alternatively, Cyber Security Foundations - 2 credits and Applied Cyber Security/Security Operations with Capstone - 2 credits may be considered.

4.3 Data Analytics / Data Science Track

Proposed academic mapping: Approx. 60-65 hours; indicative 4/3 credits. The track may be integrated as one 4-credit SEC/elective or as two 2-credit SEC modules, subject to university approval.

Course / Micro-Credential Area	Key Modules / Components	Hours / Duration
Data Fundamentals	Foundational data concepts and related graph usage	7 hours
Data Classification	Classifying and Labelling Data; Data Types used in Organizations; Externally Sourced Data; Capstone: Classify Data to Enhance Market Visibility	12 hours
Data Usability for Organisations	Data Usability; Data Manipulation; Capstone: Manipulate Data to Achieve Usability for an Organisation	10.5 hours
Introduction to Inferential and Descriptive Statistics	Introduction to Statistics; Statistical Samples; Statistics in Decision Making and Risk Assessments; Capstone: Statistical Analysis for Data-Driven Decisions	12 hours
Data Collection and Analysis	The Data Analysis Process; Capstone: Apply Data Analysis Process to Strengthen a Financial Position	4 hours
Data Preparation for Analysis	Getting Deeper into the Data; Capstone: Data-Driven Decisions to Improve Sales and Customer Satisfaction	4.5 hours
Data Visualisation and Presentation	Communicating the Data Story; Importance of Data Visualization; Capstone: Data Story on Renewable Energy Trends and Insights	7 hours
IBM SkillsBuild Data Analytics Certificate	Emerging Technologies and Future of Data Analytics; Final Assessment; Data Science Final Capstone Project Part 1 and Part 2	8 hours

Indicative credit assignment: 4 credits for the full pathway. Alternatively, Data Foundations and Statistics - 2 credits and Data Visualization/Applied Analytics with Capstone - 2 credits may be considered.

4.4 Entrepreneur + Career Management Essentials Track

Proposed academic mapping: Approx. 47-50 hours; indicative 4/3 credits, preferably as value-added/career readiness/MDC-linked course unless separately approved as a credit-bearing course.

Component	Module	Duration
Be an Entrepreneur	Intro to Entrepreneurship	120 minutes
Be an Entrepreneur	Lean Canvas & Iterative Design	150 minutes
Be an Entrepreneur	Ideation and Sources of Opportunity	150 minutes
Be an Entrepreneur	Evaluating Opportunities	90 minutes
Be an Entrepreneur	Lean Market Research	240 minutes

Be an Entrepreneur	Providing Value to Customers	180 minutes
Be an Entrepreneur	Competitive Advantage	180 minutes
Be an Entrepreneur	Marketing a Business	120 minutes
Be an Entrepreneur	Transitioning a Customer Segment	120 minutes
Be an Entrepreneur	Promotional Channels	120 minutes
Be an Entrepreneur	The Cost of Doing Business	180 minutes
Be an Entrepreneur	Delivering Products and Services	150 minutes
Be an Entrepreneur	The Economics of One Unit of Sale	150 minutes
Be an Entrepreneur	Financing a Startup	150 minutes
Career Management Essentials	Focus Your Direction with Workplace Research	150 minutes
Career Management Essentials	Develop Your Professional Network and Brand	200 minutes
Career Management Essentials	Create a Useful Professional Portfolio	180 minutes
Career Management Essentials	Ace Your Professional Interview	280 minutes

Indicative credit assignment: 4/3 credits as value-added/MDC/career-readiness course, or two 2-credit modules such as Entrepreneurship Essentials and Career Management Essentials, subject to university approval.

5. Assessment, Certification and Grade/Mark Conversion

For smooth curriculum integration, the assessment and certification process may be structured as follows:

- IBM shall conduct platform-based learning activities, assessments and capstone projects wherever applicable, and issue micro-credentials/digital credentials/digital completion certificates after successful completion of the prescribed pathway.
- Only after the student obtains the IBM digital completion certificate and/or prescribed micro-credentials may the university consider the IBM completion evidence, grade, score or competency status, wherever provided, for conversion into marks/grades for the semester-end evaluation as per an approved conversion mechanism.
- The college shall conduct Continuous Internal Assessment separately through assignments, quizzes, viva, lab work, mentoring records, presentations, progress reviews or mini-projects. This CIA may be combined with the IBM credential-based semester-end component in the manner approved by the university.
- Where IBM does not provide numerical marks/grades, the university shall prescribe a transparent conversion mechanism based on completion status, micro-credentials, capstone completion, learner performance evidence, and/or any score or grade made available by IBM.

6. Academic Inputs Required from IBM

To enable universities to consider formal curriculum integration, IBM is requested to provide the following for each track/course in editable academic format:

16. Detailed syllabus in university format, with course title, course objectives, course outcomes and learning outcomes.
17. Module-wise/unit-wise content with exact duration/hours for each module and the total notional learning hours.
18. Suggested L-T-P structure, practical/lab/project components, capstone project methodology and completion criteria.
19. Details of IBM assessments, rubrics, question types, project evaluation method, micro-credentials, digital credentials and final certificates.
20. Clarification on whether IBM provides grades/scores/competency status and the manner in which the same can be shared with institutions/universities for mark/grade conversion.
21. Official NCVET/NSQF evidence, approval scope, validity, level mapping and details of whether the approval applies to the full pathway, individual courses or micro-credentials.

7. Way Forward

IBM may confirm the proposed curriculum integration routes and provide the required syllabus and assessment documentation for all four tracks. After receipt of these details, APSCHE/universities may place the proposal before the competent academic bodies for deciding the final course placement, credits, assessment pattern, semester-end conversion mechanism and implementation modalities.

This concept note is therefore intended to help IBM understand the academic requirements of universities and to align IBM SkillsBuild content with the B.Tech and conventional degree curriculum structures of Andhra Pradesh.