RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

PROGRAMME CURRICULUM STRUCTURE UNDER R26 REGULATIONS

B. TECH – COMPUTER SCIENCE AND ENGINEERING -ARTIFICIAL INTELLIGENCE

INDUCTION PROGRAM

S.no	Course	Category	Periodsper Week			Credits
			L	T	P	
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	MC	0	0	6	0
2	Career Counselling	MC	2	0	2	0
3	Orientation to all branches -- career options, tools, etc.	MC	3	0	0	0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	EC	2	0	3	0
5	Proficiency Modules & Productivity Tools	ES	2	1	2	0
6	Assessment on basic aptitude and mathematical skills	MC	2	0	3	0
7	Remedial Training in Foundation Courses	MC	2	1	2	0
8	Human Values & Professional Ethics	MC	3	0	0	0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	BS	2	1	2	0
10	Concepts of Programming	ES	2	0	2	0

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I SEMESTER (I YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT101	Linear Algebra and Calculus	BS	3	0	2	0	4	30	70	100
26PHY109	Physics for Advanced Computing	BS	3	0	0	0	3	30	70	100
26CSE101	Computational Thinking and Problem Solving with Python	ES	3	0	0	0	3	30	70	100
26ENG101	Communicative English	HM	2	0	0	0	2	30	70	100
26CAI101	AI Tools and Applications	ES	1	0	4	0	3	30	70	100
26PHY110	Physic for Advanced ComputingLab	BS	0	0	0	3	1.5	30	70	100
26CSE102	Computational Thinking and Problem Solving with Python Lab	ES	0	0	0	3	1.5	30	70	100
26ENG102	Communicative English Lab	HM	0	0	0	2	1	30	70	100
26HSM103	Health and wellness, Yoga and Sports	HM	0	0	0	1	0.5		100	100
26CSE103	Cybersecurity Awareness for Engineers	MC	2	0	0	0	0	100*	-	100*
TOTAL			14	0	6	9	19.5	240	660	900

* The marks for Mandatory Courses are not considered for calculating SGPA

II SEMESTER (I YEAR)										
Course Code	Title of the Course	Category	Periods perWeek				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT201	Differential Equations & Vector Calculus	BS	3	0	2	0	4	30	70	100
26CHE101	Applied Chemistry for Computer Science	BS	3	0	0	0	3	30	70	100
26MEC101	Engineering Graphics	ES	1	0	4	0	3	30	70	100
26CSE201	Data Structures & Efficient Problem Solving	PC	3	0	0	0	3	30	70	100
26HSM101	Design Thinking	HM	1	0	4	0	3	30	70	100
26CSE202	Data Structures & Efficient Problem SolvingLab	PC	0	0	0	2	1	30	70	100
26MEC102	Engineering Workshop	ES	0	0	0	3	1.5	30	70	100
26CHE102	Applied Chemistry for Computer ScienceLab	BS	0	0	0	3	1.5	30	70	100
26HSM102	NSS/NCC/Scouts & Guides/ Community Service	HM	0	0	0	1	0.5		100	100
TOTAL			11	0	10	9	20.5	240	660	900

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III SEMESTER (II YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Basic Sciences Course	BS	3	0	0	0	3	30	70	100
	Humanities Course	HM	3	1	0	0	3	30	70	100
	Humanities Course	HM	2	0	0	0	2	30	70	100
	Engineering Course	ES	3	0	0	0	3	30	70	100
	Professional Core 2	PC	2	0	2	0	3	30	70	100
	Professional Core 3	PC	2	0	2	0	3	30	70	100
	Engineering Course Lab	ES	0	0	0	2	1	30	70	100
	Professional Core 2 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 3 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement course-I	SEC	1	0	0	2	2	30	70	100
	Audit Course	MC	2	0	0	0	-	100*	-	100*
	TOTAL		**18**	**0**	**4**	**10**	**23**	**300**	**700**	**1000**

* The marks for Mandatory Courses are not considered for calculating SGPA

IV SEMESTER (II YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Humanities Course	HM	2	0	0	0	2	30	70	100
	Engineering Course	ES	1	0	2	0	2	30	70	100
	Professional Core 4	PC	2	0	2	0	3	30	70	100
	Professional Core 5	PC	2	0	2	0	3	30	70	100
	Professional Core 6	PC	2	0	2	0	3	30	70	100
	Professional Core 7	PC	2	0	2	0	3	30	70	100
	Professional Core 4 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 5 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement course-II	SEC	1	0	0	2	2	30	70	100
	Audit Course	MC	2	0	0	0	0	100*	-	100*
	TOTAL		**14**	**0**	**10**	**08**	**21**	**270**	**630**	**900**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation after II year II semester										

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V SEMESTER (III YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Core 8	PC	2	0	2	0	3	30	70	100
	Professional Core 9	PC	2	0	2	0	3	30	70	100
	Professional Core 10	PC	2	0	2	0	3	30	70	100
	Professional Core 11	PC	2	0	2	0	3	30	70	100
	Systems Thinking and Interdisciplinary Engineering	ES	2	0	0	0	2	30	70	100
	Introduction to Quantum Technologies and Applications	SEC	2	0	0	0	2	30	70	100
	Professional Core 8 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 9 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement Course III (Soft Skills)	HM	1	0	0	2	2	30	70	100
	Evaluation of Community Service Internship	PW	0	0	0	0	2	100	-	100
	Tinkering Lab	BS	0	0	0	2	1	30	70	100
	TOTAL		**13**	**0**	**8**	**10**	**24**	**400**	**700**	**1100**

* The Student Development Program (Workshop) shall be conducted at the end of the III Year I Semester and its Outcomes will be reflected in the III Year II Semester
* Mandatory Industry visit in any one of V to VII semester

VI SEMESTER (III YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Core 12	PC	2	0	2	0	3	30	70	100
	Professional Core 13	PC	2	0	2	0	3	30	70	100
	Professional Elective I	PE	3	0	0	0	3	30	70	100
	Professional Elective II	PE	3	0	0	0	3	30	70	100
	Open Elective I	OE	3	0	0	0	3	30	70	100
	Professional Core 12 Lab	PC	0	0	0	3	1.5	30	70	100
	Professional Core 13 Lab	PC	0	0	0	3	1.5	30	70	100
	Skill Enhancement Course IV	SEC	1	0	0	2	2	30	70	100
	Entrepreneurship and Ecosystem	HM	2	0	0	0	2	30	70	100
	Indian Knowledge System	MC	2	0	0	0	0	100*	-	100*
	Student Development Program (Workshop)	PC	0	0	0	0	0	30	70	100
	TOTAL		**18**	**0**	**4**	**08**	**22**	**270**	**630**	**900**
Mandatory Industry Internship of 08 weeks duration during summer vacation										

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VII SEMESTER (IV YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Core 14	PC	2	0	2	0	3	30	70	100
	Management Course	HM	2	0	0	0	2	30	70	100
	Professional Elective III	PE	3	0	0	0	3	30	70	100
	Professional Elective IV	PE	3	0	0	0	3	30	70	100
	Open Elective II	OE	3	0	0	0	3	30	70	100
	Open Elective III	OE	3	0	0	0	3	30	70	100
	Skill Enhancement Course V	SEC	1	0	0	2	2	30	70	100
	Audit Course Gender Sensitization	MC	2	0	0	0	0	100*	-	100*
	Evaluation of Industry Internship	PR	0	0	0	0	2	-	100	100
	Online Examination	PC	0	0	0	0	2	-	100	100
		TOTAL	19	0	2	2	23	210	690	900

* The marks for Mandatory Courses are not considered for calculating SGPA

VIII SEMESTER (IV YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
	Professional Elective V (MOOCS)	PE	3	0	0	0	3	30	70	100
	Open Elective IV (MOOCS)	OE	3	0	0	0	3	30	70	100
	Internship	PR	0	0	0	0	4	-	100	100
	Project	PR	0	0	0	0	8	60	140	200
		TOTAL	6	0	0	0	18	120	380	500

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I SEMESTER (I YEAR)										
Course Code	Title of the Course	Category	Periods per Week				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT101	Linear Algebra and Calculus	BS	3	0	2	0	4	30	70	100
26PHY109	Physics for Advanced Computing	BS	3	0	0	0	3	30	70	100
26CSE101	Computational Thinking and Problem Solving with Python	ES	3	0	0	0	3	30	70	100
26ENG101	Communicative English	HM	2	0	0	0	2	30	70	100
26CAI101	AI Tools and Applications	ES	1	0	4	0	3	30	70	100
26PHY110	Physic for Advanced ComputingLab	BS	0	0	0	3	1.5	30	70	100
26CSE102	Computational Thinking and Problem Solving with Python Lab	ES	0	0	0	3	1.5	30	70	100
26ENG102	Communicative English Lab	HM	0	0	0	2	1	30	70	100
26HSM103	Health and wellness, Yoga and Sports	HM	0	0	0	1	0.5		100	100
26CSE103	Cybersecurity Awareness for Engineers	MC	2	0	0	0	0	100*	-	100*
TOTAL			14	0	6	9	19.5	240	660	900

* The marks for Mandatory Courses are not considered for calculating SGPA

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

LINEAR ALGEBRA AND CALCULUS
(COMMON TO ALL)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
3	0	2	42	0	28	4	30	70	100

1. Course Objectives

- Build strong foundations in linear algebra and multivariable calculus with direct engineering relevance.
- Integrate analytical methods with AI-assisted computational tools for visualization, simulation, and verification.
- Develop outcome-oriented problem-solving skills aligned with NEP 2020 and modern engineering applications.
- Apply matrix methods, eigenanalysis, and multivariable calculus to solve engineering problems.
- Use computational tools for approximation, optimization, differentiation, and integration.

Course Pre/corequisites

2. Course Outcomes (COs)

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

CO1 Apply matrix algebra techniques to Solve systems of linear equations using matrix algebra, elimination techniques, and iterative methods, while leveraging computational tools for large-scale systems.

CO2 Analyze eigenvalue problems, diagonalization, and quadratic forms to interpret linear transformations and engineering systems.

CO3 Apply mean value theorems and polynomial approximations (Taylor and Maclaurin series) to evaluate functions and estimate errors.

CO4 Analyze multivariable functions using partial derivatives, Jacobians and optimization techiniques.

CO5 Evaluate areas, volumes, and coordinate transformations using multiple integrals in engineering contexts.

3. Course Content

UNIT I: Matrix Algebra and Linear Systems

Core Content: Matrices, types of matrices, operations, transpose, inverse, symmetric and skew-symmetric matrices; orthogonal, Hermitian, skew-Hermitian and unitary matrices; determinant properties; rank of a matrix; echelon and normal forms; system of linear equations; consistency conditions; Gauss elimination and Gauss-Jordan methods; iterative methods: Jacobi and Gauss-Seidel; Cramer's rule; matrix inversion method.

AI Integration: Python-based solution of large linear systems using NumPy; visualization of convergence in iterative methods; AI-assisted debugging of matrix algorithms; using ChatGPT/Copilot to explain row operations and rank reduction.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; SymPy for symbolic matrix operations; Jupyter Notebook; Scilab.

UNIT II: Eigenvalues, Eigenvectors, Diagonalization & Quadratic Forms

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Core Content: Eigenvalues and eigenvectors; characteristic equation; Cayley-Hamilton theorem; powers and inverse of matrices using Cayley-Hamilton theorem; diagonalization; similarity transformation; quadratic forms; canonical form; reduction by orthogonal transformation; rank, index, signature; positive definite forms.

AI Integration: AI-assisted eigenvalue computation and verification; Python/SciPy visualization of eigenmodes and quadratic surfaces; use of AI tools to explain diagonalization and matrix classification; numerical checking of Cayley-Hamilton theorem.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy; GNU Octave; Google Colab.

UNIT III: Single Variable Calculus and Series Expansions

Core Content: Rolle's theorem; Lagrange's mean value theorem; Cauchy's mean value theorem; Taylor's and Maclaurin's series with remainder; approximation of functions; error estimation.

AI Integration: SymPy-based Taylor and Maclaurin expansion generation; plotting truncation error and convergence; AI-supported derivation checking for mean value theorems.

Free/Open-Source AI Tools: Python (SymPy, NumPy, Matplotlib); Google Colab; Jupyter Notebook; WolframAlpha free tier for verification.

UNIT IV: Multivariable Differentiation and Optimization

Core Content: Functions of several variables; limits and continuity; partial derivatives; higher order partial derivatives; total derivative; chain rule; Jacobians; functional dependence; Taylor expansion of two-variable functions; maxima and minima; second derivative test; Lagrange multipliers and constrained optimization.

AI Integration: Series expansion visualization using Python; AI-assisted Jacobian computation and verification; constrained optimization using SciPy; use of AI tools to interpret saddle points, extrema, and optimization constraints.

Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); Google Colab; Jupyter Notebook; SciPy optimize module.

UNIT V: Multiple Integrals and Coordinate Transformations

Core Content: Double integrals; evaluation over type I and type II regions; change of order of integration; triple integrals; change of variables; polar, cylindrical and spherical coordinates.

AI Integration: Numerical evaluation of double and triple integrals using SciPy; 2D and 3D region visualization; AI-assisted generation of integration code; interpreting Jacobian as geometric scaling factor in transformed coordinates.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); Google Colab; SymPy; Jupyter Notebook; 3D plotting tools.

Textbooks

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2018.
3. G. B. Thomas, M. D. Weir, J. Hass, Thomas' Calculus, 14th Edition, Pearson, 2018.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5th Edition, Alpha Science International, 2021.

Reference Books

1. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Wellesley-Cambridge Press, 2016.

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2. David C. Lay, Steven R. Lay, Judi J. McDonald, Linear Algebra and Its Applications, 5th Edition, Pearson, 2015.
3. George B. Arfken, Hans J. Weber, Frank E. Harris, Mathematical Methods for Physicists, 7th Edition, Academic Press, 2012.
4. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, 6th Edition, Jones & Bartlett, 2018.
5. E. Kreyszig, Elementary Linear Algebra, 2nd Edition, Wiley, 1983.

Web Resources & NPTEL Links

1. NPTEL: Linear Algebra – https://nptel.ac.in
2. MIT OpenCourseWare – Linear Algebra: https://ocw.mit.edu
3. MIT OpenCourseWare – Multivariable Calculus: https://ocw.mit.edu
4. Python SymPy Documentation: https://docs.sympy.org
5. Google Colab for Python: https://colab.research.google.com
6. SciPy Documentation: https://docs.scipy.org
7. NumPy Documentation: https://numpy.org/doc

Recommended Free & Open-Source AI/Computational Tools

1. Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for matrix computation, visualization, and numerical analysis.
2. SymPy (free, open-source) – for symbolic algebra, calculus, matrix operations, and verification.
3. scikit-learn (free, open-source) – for regression, classification, and exploratory predictive modeling.
4. Jupyter Notebook (free, open-source) – for interactive computation and lab documentation.
5. OpenCV (free, open-source) – for image-based experimentation and visualization support where needed.
6. GNU Octave (free, open-source) – MATLAB-like numerical computing for matrix and calculus workflows.
7. TensorFlow / Keras (free, open-source) – for optional AI demonstrations in regression and classification tasks.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

PHYSICS FOR ADVANCED COMPUTING
(Common to CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
3	0	0	42	0	0	3	30	70	100

1. Course Objectives

To equip students with the concepts of interference, diffraction and polarization and their applications in optics and communication systems with basic AI-assisted analysis.

To introduce lasers, fiber optics and advanced sensing technologies along with simple AI-assisted signal processing techniques.

To provide basic knowledge of quantum mechanics and quantum computing with simple AI-assisted quantum applications.

To familiarize students with semiconductors and magnetic materials and their applications using basic AI-assisted material analysis methods.

To impart knowledge on low temperature physics and superconductivity and their applications with simple AI-assisted monitoring techniques.

Course Pre/corequisites: Engineering Mathematics, Basic Electronics, Computer Science Fundamentals

2. Course Outcomes (COs)

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

CO 1: Apply the principles of interference, diffraction and polarization to analyze optical systems and engineering applications.

CO 2: Analyze the working of lasers, fiber optics and sensing systems with basic AI-assisted optical communication concepts.

CO 3: Apply the concepts of quantum mechanics and quantum computing to explain modern computational and secure communication systems.

CO 4: Analyse semiconductor characteristics and magnetic material behaviour for engineering and electronic applications.

CO 5: Apply the concepts of low-temperature physics and superconductivity in modern technological applications and intelligent systems.

3. Course Content

UNIT I: Wave Optics and Quantum Information Processing

Content: Interference: Principle of superposition and coherence; Interference; Types of interference; Interference in thin films (reflection geometry) and Newton's rings. Applications: Determination of wavelength and refractive index.

Diffraction: Introduction to diffraction; Fresnel and Fraunhofer diffraction; Fraunhofer diffraction due to single, double slit, Diffraction Grating, Dispersive power and Resolving power of grating. Applications: CD/DVD data storage, Barcode scanners.

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

AI Integration: AI-assisted polarization management for quantum key distribution. AI-integrated holographic interferometry for surface flatness analysis. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT II: Quantum Photonics and Advanced Sensing

Content: Lasers: Interaction of radiation with matter; Requisites and conditions for laser action; He-Ne laser; Nd-YAG laser;. Laser-based data communication, Optical data storage, Photonic computing basics, Applications of lasers.

Fiber Optics: Propagation mechanism; Numerical aperture; Acceptance angle; Types of optical fibres; Classifications and Modes of optical fibres; V-Number, Attenuation in optical fibers; Distributed Fiber Optic Sensing (DFOS) with AI-Powered Signal Analysis.

AI Integration: AI-powered signal analysis for distributed fiber optic sensing. Python simulation of laser propagation and fiber optic signal attenuation. Free/Open-Source AI Tools: Google Colab, Python, NumPy, SciPy and Scikit-learn/TensorFlow.

UNIT III: Introduction to Quantum Mechanics and Quantum Computing

Content: Introduction to quantum mechanics; de-Broglie concept (matter waves); Heisenberg's Uncertainty Principle; Postulates of Quantum Mechanics; Physical Significance of wave function, Schrödinger's time-independent wave equation; Particle in a one-dimensional potential well; Quantum tunnelling (basic idea).

Introduction to Quantum Computing: Classical bits vs Qubits; Concept of superposition and Entanglement; Basic Quantum Operations: Hadamard gate (idea of superposition), Pauli-X gate; Basic idea of quantum measurement.

Applications (qualitative only): AI-Assisted Tunnel Diodes and cold emission of electrons; Basic idea of quantum cryptography and secure communication.

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts. AI-Assisted Quantum Key Distribution for Secure Communication. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

UNIT IV: Semiconductors and Magnetic Materials

Content: Semiconductors: Introduction, Fermi level in intrinsic and extrinsic semiconductors; Expression for concentration of electrons in conduction band, holes in valence band and Charge carrier concentration in intrinsic semiconductors, Electrical conductivity in intrinsic semiconductors, Expressions for drift and diffusion currents; Hall effect; Expression for Hall coefficient and its applications.

Magnetism: Origin of magnetism; Dia, Para, Ferro, Ferri and Anti-ferro magnetic materials; Hysteresis; Soft and Hard magnetic materials. Applications (qualitative only): Magnetic data storage (MRAM), Hard Disk Drive and Magnetic shielding.

AI Integration: AI-Assisted Hall Effect Analysis for Semiconductor Characterization. AI-Assisted Magnetic Data Storage and MRAM Optimisation. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

UNIT V: Low Temperature Physics and Superconductivity

Content: 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). Applications (basic ideas): MRI, Rocket fuels, Cryogenic Cooling of High-Performance Computing System.

Superconductors: Definitions; Meissner effect; Type I and Type II superconductors; BCS theory: Cooper pairs and energy gap (qualitative); DC and AC Josephson effect. Applications (qualitative only): SQUIDs, magnetic levitation and lossless power transmission. Superconducting qubits: Charge, Flux, Phase.

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AI Integration: AI-Assisted Cryogenic Cooling Optimization for High-Performance Computing Systems. AI-Assisted Stability Control in Superconducting Magnetic Levitation Systems. Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

Textbooks

1. Avadhanulu, M. N., Kshirsagar, P. G., & Arun Murthy, T. V. S. (2019). Engineering Physics. S. Chand.
2. Bhattacharya, D. K., & Tandon, P. (2015). Engineering Physics. Oxford Press.

Reference Books

1. Pandey, B. K., & Chaturvedi, S. (2021). Engineering Physics. Cengage Learning.
2. Pillai, S. O. (n.d.). Solid State Physics. New Age International.
3. Nielsen, M. A., & Chuang, I. L. (n.d.). Quantum Computation & Quantum Information. Cambridge University Press.
4. Saleh, B. E. A., & Teich, M. C. (n.d.). Fundamentals of Photonics. Wiley.
5. Keiser, G. (n.d.). Optical Fiber Communications. McGraw Hill.
6. Tinkham, M. (n.d.). Introduction to Superconductivity. Dover Publications.

Online Resources

1. NPTEL – nptel.ac.in
2. MIT OpenCourseWare – ocw.mit.edu
3. HyperPhysics – hyperphysics.phy-astr.gsu.edu
4. PhET Simulations – phet.colorado.edu
5. IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab

Recommended Free & Open-Source AI/Computational Tools

1. Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and signal analysis
2. IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab
3. TensorFlow / Keras (free, open-source) – For photonic and optical pattern recognition
4. scikit-learn (free, open-source) – For semiconductor property prediction and LiDAR signal classification
5. PhET Interactive Simulations (free) – For wave optics, quantum mechanics and semiconductors.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON

(COMMON TO ALL)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
3	0	0	42	0	0	3	30	70	100

Course Objectives

1. Introduce students to computational thinking and problem-solving techniques.
2. Develop the ability to design algorithms, flowcharts, and pseudocode.
3. Provide foundational knowledge of Python programming — data types, operators, and I/O.
4. Enable students to implement logic using control structures and data structures.
5. Develop skills in modular programming, file handling, and basic OOP concepts.

Course Pre/corequisites:

Course Outcomes :

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

CO1 Apply computational thinking concepts to design algorithms, flowcharts, and basic Python programs.

CO2 Develop programs using decision-making and looping constructs to solve logical problems.

CO3 Analyse and manipulate data using strings, lists, tuples, and sets for problem solving.

CO4 Design modular programs using functions, recursion, and dictionaries to improve code reusability.

CO5 Implement file handling, exception handling, and basic object-oriented programming concepts in Python applications.

Course Content:

UNIT I: COMPUTATIONAL THINKING AND PROGRAMMING BASICS

Content: **Computational thinking:** characteristics, problem-solving strategies, steps in problem solving; algorithms — definition and properties; flowcharts — symbols and construction; pseudocode — writing and conversion; abstraction, decomposition, pattern recognition, algorithm efficiency basics.

Introduction to Python: installation and execution environment; variables, identifiers, keywords; data types, type conversion; input and output statements; expressions and operators — arithmetic, relational, logical, assignment; operator precedence.

Source: TB1: Chapters 1–3 (Spronck — computational thinking, algorithms, flowcharts, Python basics); TB2: Chapters 1–2 (Thareja — introduction to programming, Python fundamentals)

AI Integration: Use Flowgorithm to design and simulate algorithms (e.g., largest of 3 numbers); draw flowcharts using Lucidchart; use Algorithm Visualizer to trace algorithm execution; use ChatGPT to convert pseudocode to Python and verify output.

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UNIT II: DECISION MAKING AND LOOPING

Content: Decision control statements: Boolean expressions; if, if-else, if-elif-else, nested if; conditional expressions (ternary operator).

Looping statements: while loop, for loop, iteration techniques, nested loops, infinite loops; loop control — break, continue, pass; else with loops.

Practical problem solving: prime number check, pattern programs using nested loops, menu-driven programs using control statements.

Source: TB2: Chapters 4–5 (Thareja — decision making, loops, control statements); TB1: Chapters 4–5 (Spronck — conditions, loops, iteration)

AI Integration: Use Python Tutor to visualize if-else and loop execution step by step; use Thonny to debug loop-based programs; use Replit Decision control statements: Boolean expressions; if, if-else, if-elif-else, nested if; conditional expressions (ternary operator).

Looping statements: while loop, for loop, iteration techniques, nested loops, infinite loops; loop control — break, continue, pass; else with loops.

Practical problem solving: prime number check, pattern programs using nested loops, menu-driven programs using control statements.

for online coding practice; use ChatGPT to generate test cases for control flow programs.

. UNIT III: STRINGS AND DATA STRUCTURES

Content: Strings: representation, indexing, slicing, operations, built-in functions and methods.

Lists: creation, indexing and slicing, operations, functions, methods, nested lists.

Tuples: creation, operations, packing and unpacking.

Sets: creation, set operations — union, intersection, difference; frozen sets.

Source: TB2: Chapters 6–8 (Thareja — strings, lists, tuples, sets, dictionaries); TB1: Chapters 6–7 (Spronck — strings, lists, tuples)

AI Integration: Use NLTK and TextBlob to perform text analysis (sentiment, word frequency) on strings; use Pandas and NumPy for list and array operations; use ChatGPT to explain string slicing and list comprehensions with concrete examples.

UNIT IV: FUNCTIONS AND PROBLEM SOLVING

Content: Dictionaries: creation, operations, methods; dictionary-based applications.

Functions: built-in and user-defined functions; function definition and calling; arguments — positional, keyword, default, variable-length; scope of variables (local and global).

Recursion: recursive functions — factorial, Fibonacci; lambda functions (anonymous functions); applications of functions in problem solving.

Source: TB2: Chapters 9–10 (Thareja — functions, recursion, lambda, dictionaries); TB1: Chapters 8–9 (Spronck — functions, recursion, problem solving)

AI Integration: Use Jupyter Notebook for interactive function experiments; use SymPy for symbolic mathematical expressions; use PyCharm for modular program development; use ChatGPT to trace recursive function calls step by step.

UNIT V: FILE HANDLING, EXCEPTION HANDLING, AND OOP

Content: Modules and packages: creating and importing modules; standard library modules.

File handling: opening, reading, writing, and closing files; file modes; working with text files; processing CSV and Excel files.

Exception handling: types of errors (syntax, runtime, logical); try, except, finally blocks; raising exceptions.

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Introduction to OOP: classes, objects, attributes, methods, constructors, self keyword; basic applications of OOP in Python.

Source: TB2: Chapters 11–13 (Thareja — modules, file handling, exception handling, OOP); TB1: Chapter 10 (Spronck — file handling, exceptions, object-oriented programming)

AI Integration: Use Pandas and OpenPyXL to read and write CSV/Excel files; use Pytest for testing exception handling; use ChatGPT to explain OOP class design with real-world examples; use Django for a simple mini web application as a capstone project.

Textbooks

1. TB1: Pieter Spronck, Computational Thinking with Python, (course textbook — covers computational thinking, algorithms, and Python programming).
2. TB2: Reema Thareja, Programming in Python, Oxford University Press. (Primary implementation reference — all five units.)

Reference Books

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media. (Free at greenteapress.com)
2. Eric Matthes, Python Crash Course, 2nd Edition, No Starch Press.

Online Resources

1. Algorithm & Flowchart: Flowgorithm – flowgorithm.org | Lucidchart – lucidchart.com | Algorithm Visualizer – algorithm-visualizer.org
2. Programming & Debugging: Python Tutor – pythontutor.com | Thonny – thonny.org | Replit – replit.com
3. Data & Scientific: Pandas – pandas.pydata.org | NumPy – numpy.org | SymPy – sympy.org
4. NLP & Text: NLTK – nltk.org | TextBlob – textblob.readthedocs.io
5. Development: Jupyter Notebook – jupyter.org | PyCharm – jetbrains.com/pycharm | OpenPyXL – openpyxl.readthedocs.io
6. NPTEL – Problem Solving through Programming in C / Python – nptel.ac.in

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COMMUNICATIVE ENGLISH

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	**T**	**Pr**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
2	0	0	28	0	0	2	30	70	100

Course Objectives

1. Build a solid foundation in core English grammar, vocabulary, phonetics, and communication frameworks tailored for the workplace.
2. Strengthen listening, speaking, reading, and writing abilities through interactive exercises and AI-driven platforms.
3. Craft polished professional emails, reports, and presentations with the assistance of AI writing tools.
4. Analyse communication patterns, structural barriers, and discourse using AI analytical tools.
5. Practice ethical AI use by fact-checking generated content, upholding academic honesty, and leveraging AI as a learning aid rather than a replacement for critical thought.

Course Outcomes (COs)

CO1 Apply fundamental rules of English grammar, syntax, and communication dynamics, utilizing AI-driven tools to enhance language accuracy, real-time feedback, and vocabulary acquisition.

CO2 Demonstrate effective oral communication, active listening, and persuasive presentation skills in group discussions, debates, and public speaking, while leveraging AI tools for real-time speech analysis and dynamic visual content creation.

CO3 Apply diverse reading strategies, expand academic vocabulary, and draft structured written texts—ranging from paragraphs to creative reviews—while utilizing AI tools to analyze readability, optimize sentence structure, and generate content outlines.

CO4 Construct professional workplace communications—including business emails, short reports, resumes, and digital profiles—while leveraging AI tools to refine tone, optimize for ATS filters, and streamline document structure.

CO5 Evaluate the role, benefits, and ethical implications of Artificial Intelligence in modern communication, using AI tools responsibility for language learning, cross-cultural translation, content creation, and e-portfolio development while adhering to academic integrity

Prerequisites: *Basic English (Intermediate level)*

Course Content

UNIT I: Foundations of English Communication

Core Content:

Basics of Communication: process, types (verbal/non-verbal), and barriers. Parts of Speech: nouns, pronouns, verbs, adjectives, adverbs. Tenses: simple, continuous, perfect, and perfect continuous. Subject-verb agreement and correction of sentences.

AI Integration:

Grammar explanation, error identification, and instant Q&A on language rules, Real-time grammar, spelling, and punctuation correction with detailed explanations, Phonetics practice – voice recording for pronunciation and intonation feedback, Word-of-the-day, etymology, and interactive vocabulary quizzes.

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Free/Open-Source AI Tools:

Grammarly (free); ChatGPT / Gemini (free tiers); Google Speech-to-Text (free); Merriam-Webster Vocabulary Builder (free)

UNIT-II Listening and Speaking Skills

Core Content:

Principles of Effective Speaking and Active Listening. Group Discussion (GD): techniques, etiquette, and evaluation criteria. Presentation Skills: design principles, slide preparation, and delivery techniques. Debate: argument construction, evidence use, and rebuttal techniques.

AI Integration:

AI-powered presentation design – structured, visual, professional slides, Fluency analysis, filler-word detection, pacing, and confidence scoring, Auto-transcription and keyword analysis of spoken communication, Visual communication design – infographics, posters, and slide aesthetics

Free/Open-Source AI Tools:

Gamma.app (free); Orai AI Speech Coach (free); Otter.ai (free tier); Canva AI (free)

UNIT III Reading Comprehension & Writing Skills

Core Content:

Reading Strategies: skimming, scanning, intensive and extensive reading. Comprehension passages, synonyms, antonyms, words often confused, homonyms, homophones, and homographs. Paragraph Writing: topic sentence, supporting details, clincher sentence. Creative Writing — features and techniques — movie reviews and blogs.

AI Integration:

AI paraphrasing tool – rewrite passages at varying complexity levels, Readability scoring, passive voice detection, and sentence simplification, Essay outline generation, argument structuring, and content brainstorming, Vocabulary simplification for improving comprehension of complex texts

Free/Open-Source AI Tools:

QuillBot (free); Hemingway Editor (free online); ChatGPT (free); Rewordify (free)

UNIT IV Professional & Business Communication

Core Content:

Email Writing and Letter Writing: formal and informal. Short Report Writing: structure, types (formal/informal), and format. Note-Making and Summarization Techniques. Resume / CV Writing and LinkedIn Profile Optimization.

AI Integration:

Draft and refine professional emails, cover letters, reports, and proposals, AI-powered resume builder with ATS-optimized templates, Report structuring, agenda writing, and knowledge management, Tone detection, formality check, and professional register evaluation

Free/Open-Source AI Tools:

ChatGPT (free); Kickresume (free tier); Grammarly (free); Notion AI (free tier)

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UNIT V Use of AI in Language Learning

Core Content:

Artificial Intelligence in Communication: meaning, basics, benefits and limitations of AI in human interaction. AI chatbots and virtual assistants in education: grammar correction, vocabulary building, AI-based speaking and pronunciation tools, writing assistants, e-portfolio creation. AI in Global Communication: automated translation, summarizing large texts, finding information in different languages. Digital Communication and AI Ethics: responsible use of AI in education, plagiarism and academic honesty, fake information and AI-generated content, privacy, bias, and ethical communication online.

AI Integration:

Plagiarism detection, paraphrase checker, and academic integrity analysis, High-accuracy translation supporting intercultural communication understanding, AI literacy modules – understanding AI bias, ethics, and responsible usage, E-portfolio creation platform for showcasing communication artifacts

Free/Open-Source AI Tools:

Copyleaks / Turnitin (institutional access); DeepL Translator (free); Wix (free); Adobe Portfolio (free for students); ChatGPT / Gemini (free tiers)

Textbooks

1. Raman M. and Sharma S., Technical Communication: Principles and Practice, Oxford University Press, 4th Edition, 2022.
2. Shetty J. and Pareek R., Communicative English for Engineers and Professionals, Wiley India, 3rd Edition, 2021.

Reference Books

1. Rizvi M.A., Effective Technical Communication, Tata McGraw-Hill, 2nd Edition, 2018.
2. Murphy H.A., Effective Business Communication, McGraw-Hill Education, 7th Edition, 2019.
3. Wren P.C. and Martin H., High School English Grammar and Composition, S. Chand, Revised Edition, 2019.

Web Resources & NPTEL Links

- British Council – Learn English – https://learnenglish.britishcouncil.org
- NPTEL – Communication Skills – https://nptel.ac.in/courses/109104101
- Purdue OWL (Online Writing Lab) – https://owl.purdue.edu

BBC Learning English – https://www.bbc.co.uk/learningenglish

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AI Tools and Applications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	**T**	**P**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
1	0	4	14	0	56	3	30	70	100

Course Objectives :

1. Introduce students to AI concepts and the landscape of AI tools available for everyday academic and professional use.
2. Develop practical skills in using AI for document creation, presentations, writing, and academic tasks applicable across all engineering disciplines.
3. Build proficiency in AI-powered data analysis, spreadsheet automation, and intelligent research tools without requiring programming knowledge.
4. Expose students to AI tools in visual design, media creation, and note-taking, and progressively to AI applications specific to their engineering branch.
5. Cultivate responsible AI habits: verifying outputs, protecting privacy, respecting intellectual property, and understanding ethical and legal boundaries of AI use.

Course Outcomes (COs

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

CO1 Explain what AI is, how it works conceptually, and describe the landscape of AI tools across text, image, audio, video, and code categories.

CO2 Use AI tools to create documents and presentations; apply prompt engineering and NotebookLM to improve writing, research, and study habits.

CO3 Perform data analysis using AI without coding; use AI-powered research and note-taking tools to find, verify, organize, and summarize information.

CO4 Apply AI tools in visual design, diagrams, and media; identify and verify AI applications relevant to their own engineering discipline.

CO5 Demonstrate responsible AI usage — bias, privacy, ethics, governance; design and present an AI-assisted mini-project using tools from all units.

Course Content

UNIT – I UNDERSTANDING AI AND AI FOR DOCUMENTS AND PRESENTATIONS

Core Content

What is AI: AI vs. ML vs. Deep Learning vs. Generative AI; brief history (Turing Test → ChatGPT → generative AI era); how LLMs work (training data, next-token prediction, temperature, hallucinations, context windows, knowledge cutoffs). AI ecosystem: ChatGPT, Claude, Gemini, Microsoft Copilot strengths and differences. AI for presentations: Gamma.app — full slide deck from a paragraph prompt; Microsoft Copilot in PowerPoint — slide generation, design suggestions, speaker notes; Canva AI Magic Design, text-to-presentation, brand kits; Beautiful.ai smart slide layouts; comparing AI-generated vs. manually created presentations. AI for document writing: Microsoft Copilot in Word draft, rewrite, summarize; Gemini in Google Docs writing assistance and inline Q&A; Notion AI meeting notes, project plans, knowledge base; Claude Projects organizing documents and having a persistent AI assistant over

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a set of files. AI writing assistance: Grammarly grammar, tone, clarity, plagiarism; ChatGPT and Claude for lab reports, proposals, and letters; academic integrity AI as an assistant not an author; disclosure norms; identifying AI-generated content using GPTZero.

AI Integration

Use Gamma.app to generate a presentation on an engineering topic in under 2 minutes; use Copilot in Word or Gemini in Docs to draft and improve a report; compare ChatGPT, Claude, Gemini, and Microsoft Copilot on the same writing task; use Grammarly to review your own writing.

Unit II – AI For Research, Note- Taking, Data, And Spreadsheets

Core Content

NotebookLM (Google): uploading lecture notes, textbooks, PDFs, and research papers as sources; asking questions grounded in uploaded documents; generating study guides, timelines, briefing documents, and audio overviews (podcast-style summaries) from sources; source-grounded answers that cite the exact passage eliminating hallucination risk. AI for research: Perplexity AI (real-time web search with citations), Gemini Deep Research (multi-step research reports), Elicit and Consensus (academic paper search with evidence summaries); verifying AI-generated citations on Google Scholar; why AI fabricates references and how to detect it. Prompt engineering: zero-shot, one-shot, few-shot, chain-of-thought, role-based prompting; iterative refinement; negative prompting; building effective prompts for summarization, comparison, explanation, and data extraction; using ChatGPT custom instructions and Claude Projects for persistent context. AI for spreadsheets and data analysis: Microsoft Copilot in Excel VLOOKUP, IF, COUNTIF, pivot tables from natural language; Gemini in Google Sheets formula generation and chart creation; ChatGPT Advanced Data Analysis and Julius AI uploading CSV files, computing statistics, generating charts, interpreting patterns no coding required.

AI Integration

Upload your own lecture notes to NotebookLM and generate a study guide and audio overview; use Perplexity AI and Gemini Deep Research to research a topic; verify citations on Google Scholar; use Wolfram Alpha or Symbolab to solve and verify equations from your current semester subjects; use Copilot in Excel or ChatGPT ADA to analyse a real dataset.

UNIT – III AI For Visual Design, Diagrams, And Media

Core Content

AI for image generation: DALL-E 3 (via ChatGPT), Canva AI (text-to-image, Magic Design, background remover), Adobe Firefly, Ideogram — writing effective image prompts (style, subject, composition, colour); iterative prompt refinement for posters, diagrams, and mockups. AI for diagrams and visual thinking: Napkin.ai — converting text or concepts into visual diagrams, charts, and infographics automatically; Whimsical AI — AI-generated mind maps, flowcharts, and wireframes from a description; Miro AI — collaborative whiteboard with AI summarization and diagramming. AI for audio and video: ElevenLabs — text-to-speech and voice cloning for presentations and voiceovers; Suno and Udio — AI music generation for project videos; Runway and Pika — generating short video clips from text prompts; HeyGen — AI avatars for video presentations; current limitations and appropriate use cases. AI content detection and critical evaluation: GPTZero, Originality.ai for AI-text detection; Google Lens and reverse image search for AI-generated images; fact-checking workflows — cross-referencing primary sources; deepfakes and synthetic media — recognition, risks, and responsible creation.

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AI Integration

Use Napkin.ai to convert a paragraph of text into a diagram; use Whimsical AI to generate a mind map of a course topic; use DALL-E 3 or Canva AI to create an event poster through 3 prompt iterations; use ElevenLabs to create a voiceover; test GPTZero on 5 samples and analyse confidence scores.

UNIT – IV AI Across Engineering Disciplines

Core Content

AI in Mechanical Engineering: generative design in CAD (Autodesk Fusion 360 — AI-optimized structures for weight and load); predictive maintenance using sensor data and ML; AI-assisted FEA simulation; manufacturing process optimization; digital twins. AI in Civil and Electrical Engineering: structural health monitoring using ML; smart grid load forecasting and energy management; AI for circuit simulation and PCB layout optimization (Altium AI); VLSI design automation — floor planning and routing; power systems fault detection. AI in Electronics and Communication: AI-assisted signal processing and filtering; speech recognition for embedded systems; computer vision for industrial quality inspection; AI in antenna design and spectrum management; MATLAB AI and Deep Learning Toolbox. AI in Computer Science and allied branches: GitHub Copilot for code generation, explanation, and review; AI-powered testing (Testim, Selenium AI); AI in cybersecurity — anomaly detection and intrusion detection; no-code/low-code platforms (Bubble, Glide, Webflow AI); AI for data science (Jupyter AI, DataRobot).

AI Integration

Each student identifies 5 real AI tools in their own engineering branch using Claude or ChatGPT and verifies each using official product pages or research publications; present findings in a 3-minute class presentation with a structured comparison table.

Unit – V Responsible AI, Ethics, And Capstone Project

Core Content

AI bias and fairness: sources of bias (data, model, deployment); real documented cases — Amazon hiring algorithm (2018), COMPAS recidivism (2016), facial recognition disparities (NIST 2019); fairness metrics; misinformation, deepfakes, and synthetic media risks. Privacy and intellectual property: what happens to data entered into public AI tools; PII risks; data retention policies of ChatGPT (OpenAI), Claude (Anthropic), and Gemini (Google); who owns AI-generated content; copyright status globally; academic plagiarism with AI; personal data safety protocol. AI governance frameworks: EU AI Act risk tiers (unacceptable, high, limited, minimal); UNESCO AI Ethics Recommendation; India's NITI Aayog Responsible AI Guidelines; India Digital Personal Data Protection Act 2023 (DPDP Act); environmental cost of AI — energy and carbon footprint of LLM training and inference. Capstone Mini-Project: each student (or pair) defines a real engineering problem, selects at least 3 AI tool categories from Units I–IV, produces a quality-verified deliverable (report, presentation, diagram, or automation), and presents in 5 minutes. Evaluation: problem clarity, tool selection, output quality, human refinement, responsible AI disclosure.

AI Integration

Read and compare data retention policies of ChatGPT, Claude, and Gemini; classify 5 daily-use AI systems using EU AI Act risk tiers; use GPTZero and Google Lens to detect AI-generated content; design and present the Capstone Mini-Project integrating tools from all five units.

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Text Books and Reference Books

1. Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio/Penguin, 2024.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
3. Reid Blackman, Ethical Machines, Harvard Business Review Press, 2022.
4. Google – Fundamentals of AI – grow.google/intl/en_in/ai-learning-resources
5. Microsoft – AI Skills Navigator – microsoft.com/en-us/ai/ai-skills
6. Andrew Ng – AI for Everyone (Coursera, free to audit) – coursera.org/learn/ai-for-everyone
7. Elements of AI – University of Helsinki (free, beginner) – elementsofai.com
8. AI Assistants: ChatGPT – chat.openai.com | Claude – claude.ai | Gemini – gemini.google.com | Microsoft Copilot – copilot.microsoft.com
9. Research & Notes: NotebookLM – notebooklm.google.com | Perplexity AI – perplexity.ai | Elicit – elicit.org | Consensus – consensus.app
10. Presentations & Docs: Gamma.app | Notion AI – notion.so | Beautiful.ai | Copilot in Office 365 | Gemini in Google Workspace
11. Diagrams & Design: Napkin.ai | Whimsical AI – whimsical.com | Miro AI – miro.com | Canva AI – canva.com | DALL-E 3 via ChatGPT
12. Data & Spreadsheets: ChatGPT Advanced Data Analysis | Julius AI – julius.ai | Copilot in Excel | Gemini in Sheets
13. Math & Equations: Wolfram Alpha – wolframalpha.com | Symbolab – symbolab.com | Mathway – mathway.com | Microsoft Math Solver – math.microsoft.com | Photomath – photomath.com | Desmos – desmos.com | GeoGebra – geogebra.org
14. Audio & Video: ElevenLabs – elevenlabs.io | Suno – suno.com | Runway – runwayml.com | HeyGen – heygen.com
15. Detection & Automation: GPTZero – gptzero.me | Originality.ai | Google Lens | Make.com | GitHub Copilot

Online Resources

https://www.youtube.com/@JoyofLearningCSE/featured

EU AI Act – eur-lex.europa.eu | UNESCO AI Ethics – unesco.org | NITI Aayog – niti.gov.in India DPDP Act 2023 – meity.gov.in | ProPublica COMPAS – propublica.org | MIT Technology Review – technologyreview.com |

* The students can access free, freely accessible AI tools for all mandatory course activities.

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COMPUTATIONAL THINKING AND PROBLEM SOLVING WITH PYTHON LAB

(COMMON TO ALL)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	**T**	**P**	**L**	**T**	**P**	**C**	**CIE**	**SEE**	**Total**
0	0	3	0	0	42	1.5	30	70	100

Course Objectives

- Introduce students to computational thinking and problem-solving techniques.
- Develop the ability to design algorithms, flowcharts, and pseudocode.
- Provide foundational knowledge of Python programming including data types, operators, and input/output.
- Enable students to implement logic using control structures and Python data structures.
- Develop skills in modular programming, file handling, and basic object-oriented programming.

List of Experiments

MODULE I: COMPUTATIONAL THINKING & PROGRAMMING BASICS

Topics: Computational thinking — decomposition and abstraction; algorithms, flowcharts, and pseudocode; Python environment setup; variables, data types, input/output, and operators; basic computational problems.

AI Integration: Generate alternate solutions and test inputs; verify flowchart correctness; compare solution efficiency; explain type conversion.

Suggested Tools: Python, Flowgorithm, draw.io AI, ChatGPT, Microsoft Copilot

Experiments:

- **Experiment 1: Problem Solving using Computational Thinking —** Select three daily-life problems; apply decomposition and abstraction; write algorithms, draw flowcharts, and convert them into pseudocode.
- **Experiment 2: Flowchart Design and Algorithm Simulation —** Design flowcharts for largest of three numbers, student grade calculation, and electricity-bill generation; simulate execution and verify outputs.
- **Experiment 3: Python Programming Fundamentals —** Install the Python environment; write programs using variables, data types, input/output, and operators; solve simple interest, area, and unit-conversion problems.

MODULE II: DECISION MAKING & LOOPING

Topics: Decision-control statements; looping and iterative problem solving; nested loops and pattern generation.

AI Integration: Generate boundary and test cases; verify decision logic; trace loop execution; compare loop alternatives; optimize nested loops.

Suggested Tools: Python, Python Tutor, ChatGPT, Microsoft Copilot

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Experiments:

- **Experiment 4: Decision Control Statements —** Develop Python programs for largest among three numbers, grade calculation, leap-year checking, and a menu-driven calculator.
- **Experiment 5: Looping and Iterative Problem Solving —** Implement programs for prime-number generation, Armstrong numbers, factorial computation, and multiplication tables.
- **Experiment 6: Nested Loops and Pattern Generation —** Generate number, pyramid, diamond, and character patterns.

MODULE III: STRINGS & DATA STRUCTURES

Topics: String processing; lists and nested lists; tuples and sets.

AI Integration: Generate string test cases and sample datasets; explain slicing and immutable structures; compare list approaches and suggest optimizations.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiments:

- **Experiment 7: String Processing Applications —** Develop programs for string reversal, palindrome checking, frequency counting, and word-occurrence analysis.
- **Experiment 8: List and Nested List Operations —** Perform sorting, searching, list merging, and matrix operations using nested lists.
- **Experiment 9: Tuple and Set Applications —** Implement tuple packing/unpacking, student-record storage, and set union, intersection, and difference operations.

MODULE IV: FUNCTIONS & PROBLEM SOLVING

Topics: User-defined functions; recursion; dictionaries and lambda functions.

AI Integration: Generate function examples and datasets; verify outputs; generate recursion trees; compare iterative and recursive solutions; explain lambda execution.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiments:

- **Experiment 10: User-Defined Functions —** Implement positional, keyword, default, and variable-length arguments.
- **Experiment 11: Recursive Problem Solving —** Develop recursive solutions for factorial, Fibonacci, GCD, and Tower of Hanoi.
- **Experiment 12: Dictionary and Lambda Applications —** Implement a student database, dictionary operations, dictionary sorting, and lambda-based computations.

MODULE V: FILE HANDLING, EXCEPTION HANDLING & OOP

Topics: File processing and data storage; exception handling and testing; object-oriented programming — classes, objects, constructors, methods.

AI Integration: Generate datasets and error scenarios; verify file outputs; recommend exception strategies; generate class diagrams and suggest object interactions.

Suggested Tools: Python, ChatGPT, Microsoft Copilot

Experiments:

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- **Experiment 13: File Processing and Data Storage —** Develop programs to create and read text files, count words, and process CSV data.
- **Experiment 14: Exception Handling and Testing —** Implement try-except, finally, and custom exceptions; apply exception handling to division operations, file access, and input validation.
- **Experiment 15: Object-Oriented Programming Mini Project —** Develop a Python application using classes, objects, constructors, and methods.

Suggested Mini Projects:

1. Student Management System
2. Library Management System
3. Banking System

Text Books

1. Pieter Spronck, *Computational Thinking with Python*.
2. Reema Thareja, *Programming in Python*, Oxford University Press.

Reference Books

1. Allen B. Downey, *Think Python: How to Think Like a Computer Scientist*.
2. Eric Matthes, *Python Crash Course*.
3. John Zelle, *Python Programming: An Introduction to Computer Science.*

Recommended AI / Computational Tools

AI Assistants: ChatGPT, Microsoft Copilot – code generation, explanation and test-case generation.
Flowchart & Diagramming: Flowgorithm, Lucidchart AI, draw.io AI – algorithm and flowchart design.
Visualization: Algorithm Visualizer, Python Tutor – execution tracing and recursion visualization.

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PHYSICS FOR ADVANCED COMPUTING LAB
(Common to CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	3	0	0	42	1.5	30	70	100

Course Objectives

- Provide hands-on experimental verification of the physical principles underlying optics, electromagnetism, and semiconductor behaviour.
- Develop skill in the use of standard laboratory instruments for measuring optical, electrical, and magnetic quantities.
- Train students to record, analyse, and interpret experimental data with appropriate error estimation.
- Introduce AI/ML and Python-based computational tools for simulation and analysis of physics experiments.

Course Prerequisites: Engineering Physics (Theory)

Course Outcomes (COs)

CO1 Determine the dispersive power of a prism, thickness by the wedge method, radius of Curvature by Newton's rings, and wavelengths of the mercury spectrum and a LASER using a diffraction grating; record, tabulate, and interpret optical measurement data.

CO2 Estimate Planck's constant from photoelectric-effect data relating results to quantum concepts relevant to computing devices.

CO3 Trace B–H curves of magnetic materials, measure resistivity by the four-probe method, determine the energy gap of a semiconductor using a p–n junction diode, and analyse and compare experimental values with theoretical/standard values.

CO4 Determine the temperature coefficient of a thermistor, Stefan's constant, and the magnetic field along a coil axis by Stewart & Gee's method; evaluate results against theoretical predictions.

CO5 Automate optical fringe analysis using OpenCV, extract Planck's constant by regression on photoelectric data, and perform dispersive-power curve fitting with Matplotlib/NumPy; evaluate computational-model accuracy using percentage error and R2.

Course Content

PART A -List of Experiments

Any 10 of the following experiments

1. Determination of the thickness of a thin object by the wedge method.
2. Determination of the radius of curvature of the lens by Newton’s rings.
3. Determination of wavelengths of various colours of mercury spectrum using a diffraction grating in the normal incidence method.
4. Determination of the dispersive power of the prism.

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5. Determination of wavelength of a LASER using a diffraction grating.
6. Determination of particle size using a diode laser
7. Estimation of Planck's constant using the photoelectric effect.
8. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
9. Determination of the energy gap of a semiconductor using a p-n junction diode.
10. Determination of magnetic field along the axis of a current-carrying circular coil by Stewart & Gee's Method.
11. Determination of temperature co-efficient of a given material –Thermistor
12. Determination of Numerical Aperture of an optical fiber.
13. Determination of bending loss in plastic optical fiber.
14. Determination of the resistivity of semiconductor by Four Probe Method
15. Determination of e/m of an electron by Thomson Method

PART B

AI Integration Lab Exercises

Any two (2) of the following AI exercises must be completed using Python / Google Colab or an equivalent AI/LLM tool.

1. **Optics Data Automation (Python / Matplotlib):** input raw angle-of-deviation data from the prism experiment; fit a polynomial to the deviation-vs-angle curve; extract the angle of minimum deviation and compute the dispersive power; overlay the fitted curve on the experimental data points.

2. **Fringe Analysis using OpenCV (Python / Google Colab):** import Newton's-ring or wedge-fringe images; apply Gaussian blur and Canny edge detection to locate fringe centres; compute fringe diameters automatically; calculate radius of curvature or thickness and compare with manual measurements.

3. **Planck's Constant Estimation (Python / NumPy):** input stopping-potential vs. frequency data from the photoelectric experiment; apply linear regression (V0 vs. ν); extract the slope to compute h and the y-intercept to find the work function; plot the regression line and quantify percentage error against the accepted value 6.626 × 10−34 J·s.

AI Integration:

AI integration adds two to three exercises after the regular experiments: (i) Python automation of prism deviation curve-fitting and dispersive-power extraction using Matplotlib/NumPy; (ii) OpenCV-based fringe-image analysis for Newton's rings and the wedge method, automating diameter measurement and radius-of-curvature computation; (iii) linear regression on photoelectric-effect data to extract Planck's constant and the work function — reinforcing the connection between the physical experiment and quantum theory, and giving CSE students hands-on practice applying programming and data-analysis skills to experimental physics.

Textbooks

As prescribed by the department – refer to the corresponding Engineering Physics theory course textbooks and the laboratory manual issued by the Department of Physics.

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Reference Books

As prescribed by the department – refer to the corresponding Engineering Physics theory course reference books and the laboratory manual issued by the Department of Physics.

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and EM field analysis
- scikit-learn (free, open-source) – for semiconductor property prediction and EMI data analysis
- OpenEMS (free, open-source) – for 3D electromagnetic field simulation and power system analysis
- PhET Interactive Simulations (free) — wave optics, semiconductors, and quantum phenomena: phet.colorado.edu
- Virtual Labs — IIT (free): https://iitb.vlabs.co.in/discipline.html?discipline=Physical_Sciences — online simulation of optics, semiconductor, and EM experiments
- HyperPhysics (free) — concept reference for optics, quantum, and EM theory: hyperphysics.phy-astr.gsu.edu.

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COMMUNICATIVE ENGLISH LAB

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	28	1	30	70	100

1. Course Objectives

1. Build strong oral communication abilities through targeted speaking and listening activities.
2. Refine pronunciation, tone, and spoken fluency using AI-driven voice tools.
3. Develop key career-ready skills in group discussions, debates, and public speaking.
4. Train students to produce high-quality workplace documents, including emails, formal reports, and cover letters.
5. Utilize AI technology for self-evaluation, real-time feedback, and ongoing skill development.

2. Course Outcomes

CO1 To speak English with proper pronunciation using phonetic standards while displaying smooth, natural vocal fluency.

CO2 To demonstrate strong listening comprehension in English and communicate appropriately across various social and professional settings.

CO3 To present well-reasoned arguments confidently during group discussions, debates, and formal presentations.

CO4 To compose well-structured, error-free professional documents—including emails, reports, and resumes—tailored to specific audience needs.

CO5 To apply AI-driven tools to support language learning, assess personal progress, and continuously refine English skills.

3. Lab Syllabus – 12 Topics with AI Integration

S.No	Lab Topic	Lab Activities	AI Activity	AI Tools	COs
1	**Phonetics & Pronunciation Practice**	Record & playback vowel/consonant articulation; IPA chart drill; Minimal pair exercises	Use AI speech-to-text to detect mispronunciations; real-time phoneme feedback via ELSA Speak	ELSA Speak, Google Speech Recognition, Speechling	**CO1, CO5**
2	**Listening Comprehension &Note-Taking**	Listen to TED Talks/podcasts; fill-in-the-blank exercises; summarise audio passages	Auto-generate transcripts; compare student notes with AI-generated summaries using Otter.ai	Otter.ai, YouTube Auto-captions, Whisper AI	**CO2, CO5**
3	**Spoken English & Fluency Building**	Impromptu speaking (1–2 min); picture description; story completion tasks	AI analyses speech for filler words, pace, and clarity; ChatGPT prompts for spontaneous speaking	Speeko, ChatGPT, Google Assistant	**CO1, CO3, CO5**

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4	**Group Discussion Techniques**	Role-based GD on current topics; turn-taking practice; consensus building	AI evaluates argument structure and language; ChatGPT generates counter-arguments for practice	ChatGPT, Gemini, Mentimeter	**CO2, CO3**
5	**Public Speaking & Presentations**	Prepare and deliver 3-minute presentations; use of visual aids; Q&A handling	AI slide deck generation; real-time delivery feedback on pacing and confidence	Beautiful.ai, Gamma.app, Microsoft Copilot	**CO3, CO5**
6	**Interview Skills & Mock Interviews**	HR round simulation; STAR method answers; body language and eye contact	AI-powered mock interview with instant feedback on content, grammar, and tone	Yoodli, Interview Warmup by Google, ChatGPT	**CO1, CO3, CO5**
7	**Professional Email & Business Writing**	Draft formal emails, complaints, and requests; subject line formulation; netiquette	AI refines email drafts; tone & clarity check; compare student draft with AI-improved version	Grammarly, ChatGPT, Gemini	**CO4, CO5**
8	**Resume & Cover Letter Writing**	ATS-friendly resume design; action verbs usage; tailoring cover letters to job descriptions	AI resume scanner; keyword optimisation suggestions; ChatGPT cover letter generation and critique	Kickresume, Resume.io, Jobscan, ChatGPT	**CO4, CO5**
9	**Reading Comprehension & Critical Thinking**	Read articles/editorials; identify main idea, inference, and tone; speed reading drills	AI generates comprehension questions; text summarisation and comparative analysis	Quillbot, Speechify, NotebookLM	**CO2, CO4**
10	**Debate & Argumentation Skills**	Structured debate (for/against); Rebuttal techniques; logical fallacy identification	AI generates arguments on both sides; evaluate logical structure using ChatGPT	ChatGPT, Claude.ai, Kialo Edu	**CO2, CO3**
11	**Report Writing & Technical Communication**	Lab report, incident report, and project report formats; headings, data presentation	AI improves report coherence and passive/active voice usage; grammar and structure feedback	Grammarly Business, ChatGPT, Hemingway Editor	**CO4, CO5**

12	**Etiquette, Netiquette & Personal Branding**	Workplace conversation role play; LinkedIn profile creation; professional social media etiquette	AI reviews LinkedIn summaries; digital persona analysis; personal brand statement via ChatGPT	ChatGPT, Canva AI, LinkedIn AI features	**CO3, CO4, CO5**

4. Text Books

Raman, Meenakshi & Sharma, Sangeeta. Technical Communication: Principles and Practice (3rd Ed.). Oxford University Press, 2022.
Krishnaswamy, N. & Krishnaswamy, L. The Story of English in India. Foundation Books, Cambridge University Press, 2021.

5. Reference Books

- Swan, Michael. Practical English Usage (4th Ed.). Oxford University Press, 2016.
- Murphy, Raymond. English Grammar in Use (5th Ed.). Cambridge University Press, 2019.
- Rizvi, M. Ashraf. Effective Technical Communication (2nd Ed.). McGraw-Hill Education, 2018.
- Turton, N.D. & Heaton, J.B. Longman Dictionary of Common Errors. Pearson Longman, 2017.
- Lesikar, Raymond V. & Flatley, Marie E. Basic Business Communication (12th Ed.). McGraw-Hill, 2020.
- Rutherford, Andrea J. Basic Communication Skills for Technology (3rd Ed.). Pearson, 2019.

6. Online Resources

- BBC Learning English – https://www.bbc.co.uk/learningenglish (Grammar, pronunciation, and listening)
- British Council Learn English – https://learnenglish.britishcouncil.org
- TED Talks – https://www.ted.com/talks (Listening & speaking practice)
- Coursera English Communication Skills Specialisation – https://www.coursera.org
- edX English for Professional and Academic Purposes – https://www.edx.org
- Grammarly Blog – https://www.grammarly.com/blog (Writing tips)
- ELSA Speak (App) – https://elsaspeak.com (AI pronunciation coach)

7. Youtube Channels

- English with Lucy – @EnglishwithLucy (Vocabulary, speaking, British accent)
- Learn English with TV Series – @LearnEnglishWithTVSeries
- Rachel's English – @rachelsenglish (American accent and pronunciation)
- TED-Ed – @TEDEd (Critical thinking and communication ideas)
- Spoken English Hub – @SpokenEnglishHub (Indian context, interview prep)
- JenniferESL – @JenniferESL (Grammar and business English)

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NPTEL / SWAYAM COURSES

Course Name	Platform	Provider	Link
Developing Soft Skills and Personality	NPTEL / SWAYAM	IIT Kanpur	https://swayam.gov.in
Business English Communication Suite	Coursera (Free Audit)	University of Washington	https://coursera.org
Speak English Professionally: In Person, Online & On the Phone	Coursera	Georgia Tech	https://coursera.org
English and Academic Preparation	NPTEL	IIT Bombay	https://nptel.ac.in
Technical English for Engineers	NPTEL / SWAYAM	IIT Roorkee	https://swayam.gov.in

8. LAB Software & AI Tools Required

Software / Tool	Type	Purpose
Grammarly	AI Writing Assistant	Grammar, punctuation, style correction
ChatGPT / Claude.ai	Generative AI Chatbot	Conversation practice, writing assistance, debate prep
Otter.ai	AI Transcription Tool	Transcribe and analyse spoken content
Yoodli	AI Public Speaking Coach	Presentation and interview delivery analysis
Hemingway Editor	Writing Clarity Tool	Improve readability and sentence structure
Mentimeter	Interactive Presentation	Live polls, word clouds during GD sessions
Audacity	Audio Recording Software	Record and review pronunciation exercises
Google Meet / Zoom	Video Conferencing	Mock interviews and virtual presentations
Canva / Beautiful.ai	AI Presentation Design	Create professional visual presentations

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Health and wellness, Yoga and Sports

(COMMON TO ALL)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	1	0	0	14	0.5	---	100	100

Course Objectives

- Create awareness about holistic health, wellness and preventive healthcare among students.
- Train students in yogic practices (asanas, pranayama, meditation) for physical and mental well-being.
- Enable students to design evidence-based personal fitness and nutrition plans.
- Develop sportsmanship, team spirit, fair play and physical fitness through indoor and outdoor sports.
- Integrate technology and AI tools for health monitoring, performance analysis and wellness management.

Course Outcomes (COs)

CO1 Explain the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.

CO2 Demonstrate correct yogic practices – asanas, pranayama and meditation – for physical and mental health.

CO3 Design a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.

CO4 Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.

CO5 Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.

Unit-wise Syllabus with Learning Outcomes

Topics

UNIT 1 : Health, Wellness and Preventive Healthcare

- Concept of health, wellness and fitness – definitions and seven dimensions
- WHO definition of health; holistic health model (Physical, Mental, Social, Spiritual)
- Nutrition basics – macronutrients, micronutrients, balanced diet, BMI calculation
- Lifestyle diseases – diabetes, hypertension, obesity – causes and prevention
- Mental health & stress management – causes, symptoms, COPE model
- Sleep hygiene and circadian rhythm regulation
- Substance abuse – awareness, prevention and rehabilitation
- Personal hygiene, sanitation and communicable disease prevention
- Ergonomics and occupational health for students

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UNIT 2 Yoga, Pranayama, Meditation and Mind-Body Practice

- Introduction to Yoga – history, philosophy, Patanjali's Ashtanga Yoga
- Surya Namaskar – 12-step sequence with correct breathing
- Asanas for flexibility: Tadasana, Trikonasana, Paschimottanasana, Sarvangasana
- Asanas for strength & balance: Virabhadrasana I & II, Vrikshasana, Naukasana
- Pranayama techniques: Anulom-Vilom, Bhastrika, Kapalbhati, Bhramari
- Meditation and mindfulness – Dharana, Dhyana, body-scan, guided relaxation
- Yoga Nidra for sleep and stress relief
- Yoga for specific conditions – stress, back pain, PCOD/PCOS, anxiety
- Shatkarmas (cleansing processes) – an overview; International Day of Yoga

UNIT 3: Physical Fitness, Sports Skills and Sports Technology

- Physical fitness components – strength, endurance, flexibility, agility, speed, coordination
- Principles of training overload, progression, specificity, reversibility, individuality
- Warm-up, cool-down and dynamic stretching routines
- Indoor sports: Badminton, Table Tennis, Chess, Carrom – rules and basic skills
- Outdoor sports: Cricket, Football, Volleyball, Kabaddi, Athletics – rules and skills
- Sports injuries – types, RICE method, prevention and return-to-play protocol
- Sports psychology – motivation, goal setting, concentration and visualisation
- Gender equity and inclusivity in sports; Para-sports awareness
- Sports technology – wearables, fitness trackers, GPS analytics, performance dashboards

Text Books

1. Health and Physical Education, Dr. S. K. Mangal & Shubhra Mangal, PHI Learning Pvt. Ltd., 2021
2. The Science of Yoga, William J. Broad, Simon & Schuster, 2012

Reference Books

1. Yoga: The Iyengar Way, Silva, Mira & Shyam Mehta Dorling Kindersley, 2019
2. Sports Medicine Essentials, Jim Clover, Cengage Learning, 2020
3. Foundations of Physical Education & Sport Charles A. Bucher, McGraw-Hill Education, 2018
4. Mindfulness: An Eight-Week Plan for Finding Peace Mark Williams & Danny Penman, Rodale Books, 2011

Web Resources

- Ministry of AYUSH – https://main.ayush.gov.in
- Yoga for Youth (International Day of Yoga) – https://yoga.ayush.gov.in
- National Health Portal – https://nhp.gov.in
- ICMR Dietary Guidelines – https://www.icmr.nic.in

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- Sports Authority of India – https://www.sportsauthorityofindia.nic.in
- WHO Physical Activity Guidelines – https://www.who.int/news-room/fact-sheets/detail/physical-activity
- Khelo India Programme – https://kheloindia.gov.in
- NIMHANS (Mental Health Resources) – https://nimhans.ac.in

YouTube Resources

- Surya Namaskar – Complete 12-Step Tutorial – https://youtu.be/surya_tut_01
- Pranayama for Beginners (Swami Ramdev) – https://youtu.be/pranayama_sr_02
- Mindfulness Meditation (10 Min) – https://youtu.be/mindful_med_03
- Balanced Nutrition Explained (ICMR) – https://youtu.be/nutrition_icmr_04
- Sports Injury Prevention Tips – https://youtu.be/injury_prev_05
- Mental Health Awareness for Students – https://youtu.be/mh_students_06
- Yoga for Stress Relief – Isha Foundation – https://youtu.be/yoga_isha_07
- Fit India Movement – PM Modi Launch – https://youtu.be/fitindia_pmo_08

AI-Integrated Activities

1. AI Fitness Assessment Dashboard Log BMI, steps and sleep for 2 weeks using Google Fit / Apple Health; generate AI health-insight reports and compare with WHO benchmarks.
2. Personalised Diet Planner with AIUse NutriAI / Eat Right Now app to design a 7-day balanced meal plan; compare output with ICMR dietary guidelines.
3. Yoga Pose Correction using ML Camera Use YogaNotch / KAIA Health app for real-time AI posture feedback; record before/after improvement videos.
4. Mental Health Chatbot Interaction & Reflection Engage with Woebot / Wysa AI mental-health chatbot for one week; write a critical reflection on AI vs human counsellor effectiveness.
5. Sports Performance Analytics with Python Analyse a cricket/football dataset on Google Colab using Pandas; visualise player performance KPIs with Matplotlib / Seaborn.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

Cybersecurity Awareness for Engineers
(COMMON TO ALL)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	28	0	0	0	100*	---	100*

Course Objectives

- Introduce students to the fundamentals of cybersecurity and secure digital practices in modern society.
- Create awareness about cyber threats, cybercrimes, and methods for protecting personal and institutional digital assets.
- Develop responsible digital citizenship through cyber ethics, privacy awareness, and legal understanding.
- Enable students to adopt cyber hygiene practices for secure use of digital technologies.
- Familiarize students with emerging cybersecurity concerns in cloud, digital platforms, and AI-enabled environments.

Course Outcomes

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

CO1 Explain fundamental cybersecurity concepts and their importance in digital environments.

CO2 Identify common cyber threats, cyberattacks, and social engineering techniques.

CO3 Apply safe practices for secure use of devices, networks, email, cloud services, and online platforms.

CO4 Demonstrate awareness of cyber ethics, privacy protection, and cyber laws.

CO5 Develop cyber hygiene habits and respond appropriately to common cybersecurity incidents.

Course Content

UNIT 1: Introduction to Cyberspace and Cybersecurity

Core Content

- Introduction to cyberspace and cybersecurity; Evolution of information systems and Internet; Importance of cybersecurity in engineering and society.
- Information security concepts; CIA Triad (Confidentiality, Integrity, Availability); Digital footprint and digital identity; Security governance basics.
- Cyber threat actors; Engineering ethics and responsible digital behavior; Cyber hygiene practices.

AI Integration

Use of cybersecurity awareness platforms and threat-intelligence dashboards to map real-world CIA triad violations. Free/Open-Source Tools: National Cyber Security Awareness Portal (India); CERT-In resources.

Unit – 2: Cyber Threats, Cybercrime and Social Engineering

Core Content

- Cyber threats and vulnerabilities; Cybercrime and cyber offenders; Malware: Virus, Worm, Trojan, Spyware, Ransomware; Cyberattack lifecycle and common attack methods.
- Phishing, Spear Phishing, Smishing and Vishing; Social engineering attacks; Password attacks and credential theft; Identity theft and financial fraud.
- Insider threats; AI-enabled cyber threats and deepfakes; Case studies of major cyber incidents.

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AI Integration

Analysis of deepfake detection demos and AI-generated phishing email recognition exercises. Free/Open-Source Tools: OWASP Foundation resources; National Cyber Crime Reporting Portal case studies.

UNIT – 3: Personal Cyber Safety and Cybersecurity Technologies

Core Content

- Password management and Multi-Factor Authentication; Authentication and access control concepts; Safe browsing practices; Email and communication security.
- Mobile device security; Cloud security basics; Secure use of Wi-Fi and public networks; Data backup and recovery.
- Cryptography and digital signatures (awareness level only); Safe use of AI tools and digital platforms.

AI Integration

Practical exercises using free password managers and MFA setup; NIST Cybersecurity Framework self-assessment activity. Free/Open-Source Tools: NIST Cybersecurity Framework Resources.

UNIT – 4 : Privacy, Cyber Ethics and Cyber Laws

Core Content

- Data protection and privacy concepts; Personal data and sensitive information; Cyber ethics and responsible digital behavior.
- Overview of cyber laws in India; Information Technology (IT) Act and related provisions (awareness level); Common cybercrimes and legal implications.
- Cybercrime reporting mechanisms and grievance redressal; Digital evidence basics; Social media responsibility and legal considerations.

AI Integration

Case discussion using CERT-In advisories and IT Act provisions applied to AI-generated content disputes. Free/Open-Source Tools: National Cyber Crime Reporting Portal; CERT-In.

UNIT – 5 : Cyber Hygiene and Secure Digital Practices

Core Content

- Cybersecurity risk awareness; Password management and Multi-Factor Authentication; Secure use of email, web, cloud and public networks.
- Safe digital transactions and digital payment awareness; Secure use of social media and AI tools; Cybersecurity awareness in IoT and emerging technologies.
- Incident awareness and cyber hygiene best practices.

AI Integration

Cisco Networking Academy module on Introduction to Cybersecurity as a self-paced AI-assisted learning supplement. Free/Open-Source Tools: Cisco Networking Academy – Introduction to Cybersecurity.

Textbooks

1. Singh, A. (n.d.). Introduction to Cyber Security: Concepts, Principles, Technologies and Practices. Universities Press / Orient BlackSwan.
2. Godbole, N., & Belapure, S. (n.d.). Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. Wiley India.

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Reference Books

1. Brooks, C. J., Grow, C., Craig, P., & Short, D. (n.d.). Cybersecurity Essentials. Wiley.
2. Stallings, W., & Brown, L. (n.d.). Computer Security: Principles and Practice. Pearson.
3. Whitman, M. E., &Mattord, H. J. (n.d.). Principles of Information Security. Cengage Learning.
4. Kizza, J. M. (n.d.). Guide to Computer Network Security. Springer.
5. Cole, E. (n.d.). Cybersecurity for Beginners. Wiley.

Online Resources

- National Cyber Security Awareness Portal (India)
- CERT-In (Indian Computer Emergency Response Team)
- National Cyber Crime Reporting Portal
- NIST Cybersecurity Framework Resources
- OWASP Foundation
- Cisco Networking Academy – Introduction to Cybersecurity

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II SEMESTER (I YEAR)										
Course Code	Title of the Course	Category	Periods perWeek				Credits	Scheme of Examination Maximum Marks		
			L	T	Pr	P	C	Internal	External	Total
26MAT201	Differential Equations & Vector Calculus	BS	3	0	2	0	4	30	70	100
26CHE101	Applied Chemistry for Computer Science	BS	3	0	0	0	3	30	70	100
26MEC101	Engineering Graphics	ES	1	0	4	0	3	30	70	100
26CSE201	Data Structures & Efficient Problem Solving	PC	3	0	0	0	3	30	70	100
26HSM101	Design Thinking	HM	1	0	4	0	3	30	70	100
26CSE202	Data Structures & Efficient Problem SolvingLab	PC	0	0	0	2	1	30	70	100
26MEC102	Engineering Workshop	ES	0	0	0	3	1.5	30	70	100
26CHE102	Applied Chemistry for Computer ScienceLab	BS	0	0	0	3	1.5	30	70	100
26HSM102	NSS/NCC/Scouts & Guides/ Community Service	HM	0	0	0	1	0.5		100	100
TOTAL			**11**	**0**	**10**	**9**	**20.5**	**240**	**660**	**900**

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Differential Equations and Vector Calculus

(COMMON TO ALL)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
3	0	2	42	0	28	4	30	70	100

Course Objectives

- Develop analytical and computational competence in solving ordinary and partial differential equations arising in engineering systems.
- Enable students to interpret vector differential and integral operators in physical and engineering contexts.
- Integrate mathematical modeling, visualization, and simulation using modern AI-assisted computational tools in alignment with NEP 2020 and outcome-based education.
- Apply ODE and PDE solution methods to model real-world engineering phenomena such as circuits, vibrations, heat transfer, and fluid flow.
- Use computational tools for solving, verifying, and visualizing differential equations and vector field problems.

Course Outcomes (COs)

CO1 Apply analytical techniques and computational tools to solve first-order differential equations and simulate real-world engineering systems.

CO2 Analyze higher-order linear ODEs and interpret solutions in dynamic engineering systems such as circuits and oscillators.

CO3 Formulate and solve first-order and selected higher-order PDEs relevant to engineering models including wave, heat, and Laplace equations.

CO4 Interpret and compute gradient, divergence, and curl of scalar and vector fields and explain their physical significance in engineering contexts.

CO5 Apply Green's, Stokes', and Divergence theorems to compute work, circulation, and flux and evaluate engineering field behaviour.

Course Content

UNIT I: First-Order Ordinary Differential Equations

Core Content: Classification of ODEs by order, degree, and linearity; linear first-order ODEs and integrating factor method; Bernoulli's equation; exact equations and integrating factors; engineering applications of first-order ODEs:Newton's law of cooling and natural growth/decay models; electrical circuit models (RC and RL circuits).

AI Integration: Python SymPy dsolve for symbolic ODE solution and verification; direction field (slope field) visualization using Matplotlib; AI-assisted debugging of integrating factor derivations; using ChatGPT/Copilot to explain solution families and physical interpretations; SciPy solve_ivp for numerical ODE solution with initial conditions.

Free/Open-Source AI Tools: Python (SymPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; Wolfram Alpha free tier for solution verification; GNU Octave for ODE routines.

UNIT II: Higher-Order Linear Differential Equations

Core Content: Superposition principle; Wronskian and linear independence; complementary function for constant-coefficient ODEs (distinct real, repeated, and complex roots); particular integral by operator

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method; variation of parameters; simultaneous linear ODEs; Cauchy's (Euler) equation; Legendre's equation; applications to LCR circuits, simple harmonic motion.

AI Integration: Python/SymPy for Variation of Parameters; AI-Assisted Wronskian Computation using sympy;

Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib) on Google Colab; Jupyter Notebook; GNU Octave / MATLAB (optional) for LCR and mechanical system simulation;WolframAlpha free tier.

UNIT III: Partial Differential Equations

Core Content: Introduction and classification of PDEs; formation by elimination of arbitrary constants; formation by elimination of arbitrary functions; first-order linear PDEs and Lagrange's method (auxiliary equations); homogeneous linear PDEs with constant coefficients (CF and PI); second-order PDE applications : Definitions of wave equation, heat equation, and Laplace's equation.

AI Integration: Python SymPy for PDE formation and symbolic verification; 3D surface plot visualization of PDE solution families using Matplotlib; SciPy finite-difference simulation of the 1D heat equation with animation; AI-assisted PDE classification using the discriminant; prompting AI to classify mixed-derivative PDEs and student verification of AI reasoning.

Free/Open-Source AI Tools: Python (SymPy, NumPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; WolframAlpha free tier for PDE classification verification; Scilab.

UNIT IV: Vector Differentiation

Core Content: Scalar and vector fields; del (∇) operator; gradient and directional derivative; unit normal to surfaces; angle between surfaces; divergence and physical interpretation; curl and physical interpretation; vector identities; conservative fields and scalar potentials; Laplacian.

AI Integration: Python NumPy and Matplotlib for 2D and 3D gradient, divergence, and curl field visualization (quiver plots, level-surface overlays); SymPy for symbolic verification of vector identities; using AI tools to interpret Maxwell's equations in terms of divergence and curl operators; AI-assisted explanation of irrotational and solenoidal field classification.

Free/Open-Source AI Tools: Python (NumPy, SymPy, Matplotlib, mpl_toolkits) on Google Colab; Jupyter Notebook; SciPy for numerical gradient computation; GNU Octave.

UNIT V: Vector Integration and Integral Theorems

Core Content: Line integrals over scalar and vector fields; work done and path independence; surface integrals and flux; Green's theorem in the plane and its applications (without proof); Stokes' theorem (without proof); Gauss Divergence theorem(without proof) .

AI Integration: Python SciPy integrate for numerical computation of line and surface integrals; 3D flux visualization with colour-coded normal flux using Matplotlib; numerical verification of Green's and Stokes' theorems; AI-assisted physical interpretation of the Divergence theorem in terms of source density; prompting AI to explain connections to Gauss's law and student evaluation of AI explanations.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; SymPy for symbolic integral verification; WolframAlpha free tier; 3D plotting tools.

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Textbooks

- Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2018.
- B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017.
- G. B. Thomas, M. D. Weir, J. Hass, Thomas' Calculus, 14th Edition, Pearson, 2018.
- R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 5th Edition, Alpha Science International, 2021.

Reference Books

- Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, 6th Edition, Jones & Bartlett, 2018.
- George B. Arfken, Hans J. Weber, Frank E. Harris, Mathematical Methods for Physicists, 7th Edition, Academic Press, 2012.
- Ian N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.
- H. F. Davis and A. D. Snider, Introduction to Vector Analysis, 7th Edition, Hawkes Publishing, 1995.

Web Resources & NPTEL Links

- NPTEL: Ordinary Differential Equations and Applications – https://nptel.ac.in
- NPTEL: Partial Differential Equations – https://nptel.ac.in
- NPTEL: Vector Calculus – https://nptel.ac.in
- MIT OpenCourseWare – Differential Equations (18.03): https://ocw.mit.edu
- MIT OpenCourseWare – Multivariable Calculus (18.02): https://ocw.mit.edu
- Python SymPy Documentation: https://docs.sympy.org
- SciPy Documentation: https://docs.scipy.org
- Google Colab for Python: https://colab.research.google.com
- NumPy Documentation: https://numpy.org/doc

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for ODE/PDE solving, vector field visualization, and numerical integration.
- SymPy (free, open-source) – for symbolic ODE/PDE solution, gradient/divergence/curl computation, and algebraic verification.
- Jupyter Notebook (free, open-source) – for interactive computation, experiment documentation, and lab reporting.
- GNU Octave (free, open-source) – MATLAB-compatible numerical computing for ODE simulation and matrix workflows.
- WolframAlpha (free tier) – for quick verification of ODE solutions, PDE classification, and integral computation.
- Matplotlib / mpl_toolkits (free, open-source) – for 2D and 3D vector field quiver plots, solution surface visualization, and PDE animation.
- scikit-learn (free, open-source) – for optional AI demonstrations in regression and data-driven modeling tasks.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

Applied Chemistry for Computer Science

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
3	0	0	42	0	0	3	30	70	100

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 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.
- Analyze corrosion mechanisms in electronic devices and design appropriate protective techniques for PCBs, solder joints, and interconnects.
- 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.

CO2 Analyze semiconductor materials, doping chemistry, and fabrication processes used in modern electronic devices.

CO3 Evaluate energy storage technologies including batteries, supercapacitors, and fuel cells for computing and data centre applications.

CO4 Analyze corrosion mechanisms in electronic devices and recommend appropriate protective techniques for PCBs and interconnects.

CO5 Design advanced materials solutions using nanotechnology principles and AI-assisted tools for nanoelectronics and quantum computing.

Course Content

Unit – 1: Quantum Chemistry

Core Content

- 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 and CO.
- π-molecular orbitals of butadiene and benzene; calculation of bond order.

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AI Integration

Simulation of quantum systems using Python (NumPy, SciPy); visualization of molecular orbitals and energy levels using computational chemistry tools (Google Colab); introduction to quantum computing simulations using Qiskit (introductory level). Free/Open-Source AI Tools: Python (NumPy, SciPy), Google Colab, Qiskit.

Unit – 2: Semiconductor Chemistry

Core Content.

- Atomic structure and chemical bonding relevant to semiconductors.
- Band theory: valence band, conduction band, band gap energy.
- Intrinsic and extrinsic semiconductors: silicon, germanium, gallium arsenide.
- Doping chemistry: n-type (phosphorus, arsenic) and p-type (boron, aluminium) dopants.
- Chemical vapour deposition (CVD) for thin film formation; silicon dioxide (SiO_2) formation and properties.
- Chemistry of compound semiconductors: GaAs, InP, SiC.

AI Integration

AI-based prediction of semiconductor properties using ML models; process parameter optimization in semiconductor fabrication using machine learning; Python-based band gap prediction using regression models. Free/Open-Source AI Tools: Python, TensorFlow, Scilab.

Unit – 3: Electrochemistry and Energy Storage

Core Content

- Electrochemical cells: galvanic cells, electrode potential, Nernst equation and problems; potentiometry (redox reactions); conductometry (strong acid vs. strong base, weak acid vs. strong base).
- Primary batteries: Zinc-air battery, Sodium-air battery.
- Secondary batteries: chemistry of charging and discharging of lead-acid, nickel-cadmium, nickel-metal hydride.
- Lithium-ion batteries: construction, working, and applications of $LiCoO_2$.
- Supercapacitors: definition, classification, and applications.
- Fuel cells: construction, working, and applications of hydrogen fuel cells and direct methanol fuel cells (DMFC).
- Battery management systems: overcharge protection and thermal management.

AI Integration

AI models for battery health prediction and state-of-charge optimization using scikit-learn; data analysis for energy efficiency in data centres using Python (Pandas); ML-based prediction of electrochemical impedance spectra. Free/Open-Source AI Tools: Python (Pandas, scikit-learn), Google Colab.

UNIT - 4 : Chemistry of Corrosion and Protective Techniques

Core Content

- Corrosion: definition, examples, types — chemical corrosion and electrochemical corrosion; Pilling-Bedworth rule.
- Galvanic corrosion; factors affecting corrosion.
- Corrosion of printed circuit boards (PCBs): copper oxidation, tin whiskers; corrosion in solder joints and interconnects.

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- Protective techniques: proper design, using pure metals, metal alloys, inhibitors; cathodic protection — sacrificial anodic protection, impressed current cathodic protection.
- Electroplating (nickel) and electroless plating (copper).

AI Integration

Computer vision (OpenCV) for automated defect detection in PCBs; AI-based prediction of corrosion failure in electronic components using TensorFlow; image classification models for identifying corrosion types from microscope images. Free/Open-Source AI Tools: OpenCV, TensorFlow, Python.

Unit – 5: Chemistry of Nanomaterials

Core Content

- Introduction to nanochemistry: size-dependent properties, quantum confinement.
- Carbon nanomaterials: Carbon nanotubes (CNTs), graphene.
- Synthesis methods: chemical vapour deposition (CVD), sol-gel process.
- Quantum dots: synthesis, properties, applications in displays and quantum computing.
- Metallic nanoparticles: preparation and applications of gold, silver, and copper nanoparticles.
- Applications: nanoelectronics, interconnects, sensors (optical and biosensors), memory devices.
- Spintronics materials: magnetic nanoparticles, topological insulators.
- Chemistry of quantum computing materials: superconducting materials (NbTi, Nb_3Sn); ion trap material (Gold)

AI Integration

AI-based nanomaterial property prediction using machine learning (Python, TensorFlow); simulation of nano-devices and quantum materials using open-source tools; generative AI for exploring nanomaterial design spaces. Free/Open-Source AI Tools: Python, TensorFlow, open-source materials simulation platforms.

Text Books

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

Reference Books

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. Poole, C. P., & Owens, F. J. (2003). Introduction to Nanotechnology. John Wiley & Sons.
4. Sharma, B. K., & Gaur, H. (2019). Engineering Chemistry. Krishna Prakashan Media.
5. Dara, S. S., &Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing.

Online Resources

- NPTEL Engineering Chemistry: https://nptel.ac.in/
- IBM Qiskit Learning: https://learning.quantum.ibm.com/
- Google Colab: https://colab.research.google.com/
- OpenCV Python Documentation: https://docs.opencv.org/
- Materials Project (open nanomaterials database): https://materialsproject.org/

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

ENGINEERING GRAPHICS

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
1	0	4	14	0	56	3	30	70	100

Prerequisites: Basic Geometry, Fundamental Python Programming

Lab Course Outcomes

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

Course Outcomes (COs)

CO1 Construct engineering curves and scales using traditional drafting geometry validated by automated algorithmic paths.

CO2 Solve multi-planar projection instances of linear points, segments, and standard regular planar silhouettes.

CO3 Render projections of standard 3D solids and identify variations using structural boundary algorithms.

CO4 Draft complex cross-sectional geometries and mapped surface extensions of sliced geometric forms.

CO5 Produce composite isometric layouts alongside generative text-to-CAD system alternatives for dynamic prototyping.

List of Experiments

Unit 1 : Introduction to Engineering Graphics, Curves and Scales

1. Manual Construction of Engineering Curves

Construct an ellipse using the eccentricity method and general method given the major and minor axes; construct a parabola and a hyperbola using the rectangle/eccentricity method. Verify dimensional accuracy through measurement and document construction steps.

2. Cycloidal Curves and Involutes Construction

Draw a cycloid generated by a rolling circle and an involute of a given circle/polygon using standard geometric construction methods. Annotate the generating points and verify the curve trace against theoretical points.

3. Construction of Plain, Diagonal and Vernier Scales

Construct a plain scale, a diagonal scale, and a vernier scale for given representative fractions and measure specified distances using each. Cross-verify readings between manually constructed scales and a digital scale tool.

4. AI-Assisted Conic Curve Generation and CV Edge Detection

Use AI prompt engineering to generate code blocks that algorithmically plot conic curves (ellipse, parabola, hyperbola) and compare with the manually drafted curve. Capture a hand-drawn geometric sketch and apply Computer Vision edge detection (Canny Edge/Hough Transform) to extract a clean vector shape.

Unit – 2 : Orthographic Projections of Points, Lines and Planes

1. Projection of Points in All Four Quadrants

Draw the orthographic projections (top view and front view) of points located in each of the four quadrants relative to the horizontal and vertical reference planes. Verify the position of each projection against the given point coordinates.

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2. Projection of Lines Inclined to Reference Planes

Determine the projections of a straight line inclined to one or both reference planes; find the true length and true inclination of the line using the rotation or auxiliary plane method. Cross-check results using trigonometric calculation.

3. Projection of Planes in Various Orientations

Draw projections of regular planes (triangle, square, pentagon, hexagon) positioned perpendicular to both reference planes, parallel to one reference plane, and inclined to both reference planes. Verify true shape recovery using the auxiliary view method.

4. 3D Coordinate Estimation Script from 2D Projections

Develop a transformation script where a user inputs 2D projection endpoints (top view and front view coordinates) and the script automatically computes the 3D line representation, true spatial length, and inclination angles. Validate the script output against a manually solved projection problem.

Unit 3 : Projection of Regular Solids

1. Projection of Solids with Axis Perpendicular to a Reference Plane

Draw the projections of a hexagonal prism and a cone with the axis perpendicular to the horizontal plane, and repeat with the axis perpendicular to the vertical plane. Verify true shape and hidden line conventions in each case.

2. Projection of Solids with Axis Inclined to a Reference Plane

Draw the projections of a square pyramid with its axis inclined to one reference plane and parallel to the other, using the change-of-position or auxiliary plane method. Verify the apparent and true lengths of the solid's edges.

3. Solid Classification Using a Machine Learning Notebook

Set up a classification notebook using scikit-learn or a simple convolutional model to automatically identify the type of solid (e.g., hexagonal prism vs. cone) present within a given orthographic engineering layout image. Test the classifier against five different solid images and document accuracy.

Unit 4 : Sections of Solids and Development of Surfaces

1. Sectional Views of Solids with Inclined Cutting Planes

Draw the sectional view and true shape of section for a pyramid and a cone cut by a section plane inclined to the base, for solids in simple position. Verify the true shape of the cut surface using the auxiliary projection method.

2. Development of Lateral Surfaces — Parallel Line Method

Develop the lateral surface of a cylinder and a prism using the parallel-line development method. Verify the unfolded pattern dimensions against the original solid's surface measurements.

3. Development of Lateral Surfaces — Radial Line Method

Develop the lateral surface of a cone and a pyramid using the radial-line development method. Verify the unfolded pattern by reconstructing a physical or digital model from the developed surface.

4. Sheet Nesting Optimization Using Heuristic Algorithms

Use a nesting optimization script (genetic algorithm or standard heuristic) to arrange multiple custom flat-surface solid developments onto a finite raw sheet grid, minimizing material margins and cut lines. Compare the optimized layout with a manually arranged layout in terms of material utilization.

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Unit 5: Isometric Projections and Computer Graphics

1. Isometric Projection of Simple and Compound Solids

Construct the isometric view of a simple solid (cube, prism, pyramid) using the isometric scale, and extend to a compound solid formed by combining two basic solids. Verify isometric axis angles and dimensional accuracy.

2. Conversion Between Orthographic and Isometric Views

Given a set of orthographic views (front, top, side) of an object, construct the corresponding isometric view; conversely, given an isometric view, derive the orthographic views. Cross-verify both conversions for dimensional consistency.

3. Computer-Aided Drafting Using AutoCAD

Create 2D drawings of simple machine components and a basic PCB layout using AutoCAD; apply transformation commands (move, rotate, scale, mirror) to manipulate the drawn entities. Export and document the final drawings (not for end examination).

4. 2D-to-3D Depth Reconstruction Using a Pretrained Model

Use a pretrained depth-estimation or pixel-to-voxel neural model to parse a set of front, top, and side drawings, compiling them into an interactive 3D point cloud or boundary surface rendering. Compare the AI-reconstructed 3D model with the manually constructed isometric drawing.

AI Tools Integration (Lab)

AI prompt engineering for generating geometric profiles and algorithmic conic curve code; Computer Vision (OpenCV — Canny Edge/Hough Transform) for parsing hand-drawn sketches into vector shapes. Machine learning pipelines (scikit-learn, simple CNNs) for 3D coordinate estimation and solid-type classification from orthographic images. Generative Adversarial Networks (GANs) and heuristic/genetic algorithms for flat-pattern nesting optimization. Neural Radiance Fields (NeRF) and pixel-to-voxel models for 2D-to-3D depth reconstruction from multi-view engineering sketches. AutoCAD for computer-aided 2D/3D drafting and transformations.

Text Books

1. Bhatt, N. D. (2016). Engineering Drawing. Charotar Publishing House.
2. Jolhe, D. (2017). Engineering Drawing with an Introduction to AutoCAD. Tata McGraw Hill.

Reference Books

1. Jain, P., Gautam, A. P., & Bhargava, A. (n.d.). Engineering Graphics and Design. Khanna Publishing.
2. Narayana, K. L., &Kannaiah, P. (2013). Engineering Drawing. Tata McGraw Hill.
3. Shah, M. B., & Rana, B. C. (2009). Engineering Drawing. Pearson Education.

Online Resources

- NPTEL Engineering Graphical Design Course – IIT Kharagpur
- OpenCV Official Python Bootcamps and Tutorials
- MIT 6.S192: Deep Generative Modeling Platforms

Video Links & Online Lectures

- **Classical Drafting Fundamentals**: NPTEL Engineering Graphical Design Course by IIT Kharagpur
- **Computer Vision and Processing**: OpenCV Official Python Bootcamps and Tutorials
- **Generative Design and Modeling Insights**: MIT 6.S192: Deep Generative Modeling Platforms

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

DATA STRUCTURES & EFFICIENT PROBLEM SOLVING

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
3	0	0	42	0	0	3	30	70	100

Course Objectives

- Introduce fundamental concepts of data structures and their applications using Python.
- Develop the ability to analyse time and space complexity of algorithms.
- Implement linear and non-linear data structures using Python.
- Apply appropriate data structures for efficient problem solving.
- Develop skills in algorithm design, recursion, and optimization techniques.

Course Outcomes (COs)

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

- **CO1** Apply basic data structure concepts and analyse algorithm complexity using Python.
- **CO2** Implement searching and sorting techniques for efficient data processing.
- **CO3** Develop programs using linear data structures — stacks, queues, and linked lists — in Python.
- **CO4** Design and implement non-linear data structures including trees and heaps using Python.
- **CO5** Apply graph traversal and hashing techniques to solve real-world computational problems.

Course Content

Unit I: Introduction, Algorithm Analysis, and Linear Structures

Core Content:

- Introduction to data structures; Abstract Data Types (ADTs); algorithm analysis — time and space complexity; Big-O, Big-Omega, Big-Theta notations.
- Lists in Python: operations on lists; static vs. dynamic memory allocation.
- Searching techniques: Linear Search, Binary Search, Interpolation Search — analysis and comparison.
- Sorting techniques: Bubble Sort, Selection Sort, Insertion Sort — algorithms, trace, and complexity analysis.

Source: TB1: Chapters 1–3 (Vasudevan et al.); TB2: Chapters 1, 5 (Goodrich et al.)

AI Integration: Use VisuAlgo and Algorithm Visualizer to animate sorting and searching; use ChatGPT to explain Big-O complexity with concrete examples; use Python Tutor to trace memory representation of data structures.

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Unit II: Stacks and Queues

Core Content:

- Stacks: LIFO principle, push, pop, peek; implementation using Python lists; applications — expression evaluation (infix to postfix, postfix evaluation), parenthesis checking.
- Queues: FIFO principle, enqueue, dequeue; types — Circular Queue, Priority Queue, Deque; implementation using Python lists and linked structures.
- Applications of queues: BFS simulation, scheduling, real-world analogies.

Source: TB1: Chapters 4–5 (Vasudevan et al.); TB2: Chapter 6 (Goodrich et al.)

AI Integration: Use VisuAlgo to animate stack and queue operations; use ChatGPT to generate edge cases (overflow, underflow, circular behaviour); use GitHub Copilot to implement expression evaluation.

Unit III: Linked Lists

Core Content:

- Singly Linked List: node structure, insertion at head/tail/position, deletion by value/position, traversal, reversal.
- Doubly Linked List: forward and backward traversal, insertion, deletion; Circular Linked List: traversal and operations.
- Applications: polynomial representation and addition, browser history simulation (doubly linked list), symbol table implementation.

Source: TB1: Chapter 6 (Vasudevan et al.); TB2: Chapter 7 (Goodrich et al.)

AI Integration: Use Python Tutor to trace pointer operations and node memory; use VisuAlgo to visualize insertion and deletion step by step; use ChatGPT to identify missing edge cases in AI-generated linked list explanations.

Unit IV: Trees and Heaps

Core Content:

- Trees: terminology, properties; Binary Trees — representation, traversals (inorder, preorder, postorder, level order).
- Binary Search Trees (BST): insertion, deletion, search; applications — autocomplete, range queries, dictionary lookup.
- Heaps: Min-Heap and Max-Heap, array representation, heapify, Build-Heap; Heap Sort — algorithm and complexity.

Source: TB1: Chapters 7–8 (Vasudevan et al.); TB2: Chapters 8, 9 (Goodrich et al.)

AI Integration: Use VisuAlgo and Algorithm Visualizer to animate tree traversals and BST operations; use ChatGPT to generate tricky tree cases (unbalanced, skewed); use GitHub Copilot to implement heap operations in Python.

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Unit V: Graphs and Hashing

Core Content:

- Graphs: terminology, types (directed, undirected, weighted); representation — adjacency matrix and adjacency list.
- Graph traversals: BFS (queue-based) and DFS (stack/recursion-based); applications — shortest path, cycle detection, social networks.
- Hashing: hash functions, properties of a good hash function; collision resolution — chaining (separate chaining), open addressing (linear probing, quadratic probing, double hashing); load factor.

Source: TB1: Chapters 9–10 (Vasudevan et al.); TB2: Chapters 14, 10 (Goodrich et al.)

AI Integration: Use NetworkX in Python and Gephi to build and traverse graphs; use VisuAlgo to animate BFS and DFS; use ChatGPT to explain real-world graph applications; use GitHub Copilot to implement hash tables with collision resolution.

Suggested Tools: NetworkX, Gephi, VisuAlgo, ChatGPT, GitHub Copilot

Textbooks

1. Shriram K. Vasudevan, Abhishek S. Nagarajan & Karthick Nanmaran, Data Structures Using Python, Wiley India.

2. Michael T. Goodrich, Roberto Tamassia & Michael H. Goldwasser, Data Structures and Algorithms in Python (Indian Adaptation), Wiley India.

Reference Books

1. Brad Miller & David Ranum, Problem Solving with Algorithms and Data Structures Using Python, Franklin Beedle.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.

Online Resources

- NPTEL — Data Structures and Algorithms — nptel.ac.in
- VisuAlgo — visualgo.net
- Python Tutor — pythontutor.com
- NetworkX — networkx.org
- GeeksforGeeks — geeksforgeeks.org
- Algorithm Visualizer — algorithm-visualizer.org

Recommended Free & Open-Source Data Structures / AI Tools

Language & Environment: Python, Jupyter Notebook — implementation and tracing.

Visualization: VisuAlgo, Algorithm Visualizer, Python Tutor — animate sorting, traversal and memory operations.

Graph Tools: NetworkX, Gephi — graph build and traversal.

AI Assistants: ChatGPT, GitHub Copilot — complexity explanation, edge-case generation and implementation.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

DESIGN THINKING

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	Pr	L	T	Pr	C	CIE	SEE	Total
1	0	4	14	0	56	3	30	70	100

Course Objectives

- Introduce the philosophy, principles, and five-stage model of Design Thinking as a human-centred innovation methodology.
- Develop empathy-driven research skills including interviews, observation, and persona creation to understand user needs.
- Apply structured ideation techniques and AI-assisted tools to generate and prioritise creative solutions.
- Build low-fidelity and digital prototypes incorporating AI-assisted design tools.
- Conduct user testing, iterate based on feedback, and present design solutions effectively.

Course Outcomes (COs)

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

- **CO1** Recall and understand the philosophy, principles, and stages of the Design Thinking process and its relevance to human-centred problem solving.
- **CO2** Apply empathy tools (interviews, observation, personas) and problem-framing techniques to real-world engineering scenarios.
- **CO3** Analyse user needs and problem statements using the 'How Might We' framework and AI-powered insight generation tools.
- **CO4** Evaluate and select the most viable prototype solution through structured testing, user feedback, and AI-assisted evaluation rubrics.
- **CO5** Create innovative prototypes and pitch solutions to identified problems using AI ideation tools and digital prototyping platforms.

Course Content

Unit 1: Introduction to Design Thinking

Core Content:

- Design Thinking: Definition, origin (Stanford d.school, IDEO), and relevance to engineering.
- The 5-Stage Model: Empathise – Define – Ideate – Prototype – Test.
- Human-centred design principles: Desirability, Feasibility, Viability.
- Systems Thinking vs. Linear Thinking: Understanding complexity.
- Case Studies: Successful design thinking applications (IDEO shopping cart, Stanford Mobile Clinic).

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AI Integration: AI Tool: ChatGPT/Copilot — use AI to explain design thinking in different domains (healthcare, education, agriculture). Activity: MindMeister (free, open-source alternative: FreeMind) to create a mindmap of the 5-stage process. AI Video Analysis: summarise key DT principles from documentary case studies.

Unit 2: Empathise and Define Stages

Core Content:

- Empathy Methods: Interviews, Observation, Immersion, Shadowing.
- Creating User Personas: Demographic, psychographic, goals and pain points.
- Empathy Mapping: Says, Thinks, Does, Feels.
- Point of View (POV) Statement: User + Need + Insight formula.
- How Might We (HMW) Questions: Reframing problems as opportunities.

AI Integration: AI Tool: Miro (free plan) for digital empathy maps and POV statements. AI Tool: ChatGPT for generating diverse user persona profiles. Activity: interview peers about a campus problem and use AI to analyse transcripts and extract themes. AI Tool: Dovetail (free plan) for affinity mapping of qualitative research data.

Unit 3: Ideation Stage

Core Content:

- Creative Thinking Techniques: Brainstorming, Brainwriting, SCAMPER, Random Word Association.
- Lateral Thinking: Edward de Bono's Six Thinking Hats.
- Affinity Diagramming: Grouping ideas by themes.
- Prioritisation Matrix: Impact vs. Effort, Dot Voting.
- Concept Selection: Morphological charts and Pugh Matrix.

AI Integration: AI Tool: ChatGPT — use 'expand my idea' prompts to generate variations of a concept. AI Tool: IdeaFlip (free)/Miro for digital brainstorming and affinity diagramming. AI Tool: Midjourney (free trial)/DALL-E (free credits) for visual concept sketches. Activity: run an AI-augmented brainstorming session and compare idea quality with pure human brainstorming.

Unit 4: Prototyping

Core Content:

- Principles of Prototyping: Low-fidelity vs. High-fidelity prototypes.
- Paper Prototyping: Sketching UI and physical models.
- Digital Wireframing: Introduction to wireframes and mockups.
- 3D Prototyping Concepts: Introduction to 3D printing and rapid prototyping.
- Role Plays and Experience Prototyping: Service design scenarios.

AI Integration: AI Tool: Figma AI for converting sketches to digital wireframes. AI Tool: Tinkercad (free, web-based) for simple 3D models for physical prototyping. Activity: build a paper prototype for a chosen problem and photograph for digital documentation.

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Unit 5: Testing, Iteration and AI in Design

Core Content:

- User Testing Methods: Think-aloud protocol, A/B testing, Usability testing.
- Feedback Analysis: Affinity mapping of test feedback.
- Iteration Cycle: Incorporating feedback and pivoting.
- Design Presentation: Pitching to stakeholders (elevator pitch, demo day format).
- AI in Design: Overview of AI-assisted design (generative design, co-creation with AI).

AI Integration: AI Tool: Maze (free plan) — conduct remote usability tests on Figma prototypes. AI Tool: ChatGPT — analyse collected user feedback and generate insights and improvement suggestions. Activity: present final prototype to a panel; use AI to prepare pitch slides in Canva. Reflection: Design Thinking journal documenting each stage with AI tool usage notes.

Text Books

1. T1. Brown, Tim. (2019). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, New York.
2. T2. Lewrick, Michael, Link, Patrick & Leifer, Larry. (2018). The Design Thinking Playbook. Wiley, New Jersey.

Reference Books

1. R1. IDEO.org. (2015). The Field Guide to Human-Centered Design. IDEO.org, San Francisco.
2. R2. Kelley, Tom & Kelley, David. (2013). Creative Confidence: Unleashing the Creative Potential Within Us All. Crown Business.

3. R3. Liedtka, Jeanne & Ogilvie, Tim. (2011). Designing for Growth: A Design Thinking Tool Kit for Managers. Columbia Business School Press.

4. R4. Plattner, Hasso, Meinel, Christoph & Leifer, Larry (Eds.). (2018). Design Thinking Research. Springer.

5. R5. Kumar, Vijay. (2012). 101 Design Methods: A Structured Approach for Driving Innovation. Wiley.

6. R6. Stickdorn, Marc & Schneider, Jakob. (2021). This Is Service Design Thinking (Expanded ed.). BIS Publishers.

Web Resources

- Stanford d.school Resources: dschool.stanford.edu/resources
- IDEO Design Kit: www.designkit.org/methods
- MIT OpenCourseWare — Design Thinking: ocw.mit.edu
- Interaction Design Foundation: www.interaction-design.org
- NPTEL Design Thinking: swayam.gov.in

YouTube / Video Resources

- YouTube: Stanford d.school — Design Thinking Bootcamp — www.youtube.com/@stanforddschool
- YouTube: IDEO U — www.youtube.com/@ideou
- YouTube: Crash Course — Design Thinking Series — www.youtube.com/@crashcourse
- YouTube: AJ&Smart — Design Sprint tutorials — www.youtube.com/@AJSmart
- YouTube: NPTEL Design Thinking — www.youtube.com/c/nptel

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

ENGINEERING WORKSHOP

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	3	0	0	42	1.5	0	100	100

Lab Course Outcomes

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

- **CO1** Recognize the importance of safety precautions while working in the workshop.
- **CO2** Identify different measuring, marking, cutting tools used in the workshop and their operational capabilities.
- **CO3** Fabricate precision wood and metal fitting joints within standard specifications.
- **CO4** Understand wiring standards, safe residential switches, lighting circuits, and basic appliances.
- **CO5** Identify different tools used in foundry and welding sections.

List of Experiments

Unit 1: Safety Practices, Carpentry and Fitting Trades

1. Workshop Safety Orientation and PPE Demonstration

Demonstrate proper use of Personal Protective Equipment (helmet, safety glasses, gloves, apron) and identify common workshop hazards. Practise emergency protocols including fire extinguisher use and first-aid station location, using computer vision-based safety compliance monitoring as a demonstration.

2. Carpentry — Half-Lap and Mortise & Tenon Joints

Prepare a half-lap joint and a mortise-and-tenon joint using basic carpentry tools (saw, chisel, mallet, marking gauge) on a wooden workpiece. Verify joint fit and dimensional accuracy against the given drawing specification.

3. Carpentry — Corner Dovetail or Bridle Joint

Prepare a corner dovetail joint or bridle joint following standard carpentry marking and cutting procedures. Inspect the finished joint for fit, squareness, and surface finish.

4. Fitting — V-Fit and Dovetail Fit

Perform a V-fit and a dovetail fit exercise on mild steel workpieces using fitting tools (files, scriber, try square, vernier caliper). Verify dimensional accuracy and fit tolerance against the drawing.

5. Fitting — Semi-Circular Fit

Perform a semi-circular fit exercise combining male and female workpieces to standard tolerance. Inspect for fit accuracy using feeler gauges and visual inspection.

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Unit 2: Sheet Metal, Plumbing and Welding Trades

1. Sheet Metal Working — Tapered Tray and Conical Funnel

Develop and fabricate a tapered tray and a conical funnel from GI sheet using sheet metal tools (snips, mallet, stakes); apply development of surfaces principles for accurate pattern marking. Verify dimensional accuracy of the finished components.

2. Sheet Metal Working — Elbow Pipe and Brazing

Develop and fabricate an elbow pipe joint from GI sheet, and perform a brazing exercise to join two metal pieces. Inspect the joint strength and surface finish of the brazed connection.

3. Electrical Wiring — Series, Parallel and Two-Way Switch Circuits

Make electrical connections for a parallel and series lighting circuit, and wire a two-way switch circuit for staircase lighting control. Test each circuit for correct operation and safety compliance using a multimeter.

4. Electrical Wiring — Godown Lighting, Tube Light and Soldering

Wire a godown lighting circuit and a tube light circuit (including choke and starter connections); practise soldering of wire joints. Test all connections for continuity and correct functioning.

5. Plumbing — Pipe Joint Preparation

Prepare a simple PVC pipe joint with coupling for same-diameter pipes and with a reducer for different-diameter pipes, using thread cutting and pipe-fitting tools. Test the joint for leak-tightness using a pressure or water test.

6. Welding Shop — Lap Joint and Butt Joint

Demonstrate and practise Arc Welding and Gas Welding techniques to prepare a simple lap joint and a butt joint on mild steel plates. Inspect the welded joint for uniformity, penetration, and visual defects.

Unit 3: Foundry, Computer Hardware and Smart Systems

1. Foundry Trade — Green Sand Mould Preparation

Demonstrate and practise moulding tools and processes to prepare a green sand mould for a simple pattern. Inspect the mould cavity for surface finish and dimensional accuracy before pouring simulation.

2. Introduction to 3D Printing

Demonstrate the core concepts of 3D printing including hardware components, software workflow, digital file preparation (STL/G-code), and printing materials. Observe the 3D printing process for a simple complex-geometry object and document the print quality.

3. Computer Hardware Disassembly and Reassembly

Disassemble and reassemble a desktop computer to understand the role of each component (CPU, motherboard, RAM, HDD/SSD, GPU). Document the function and interconnection of each component and verify successful reassembly through a boot test.

4. Hardware Troubleshooting and Peripheral Installation

Simulate common hardware issues (RAM failure, CPU overheating) and identify the procedures for resolving each. Install and configure peripheral devices such as a printer, scanner, or external hard drive, and verify successful operation.

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5. Network Setup and Configuration

Set up a small LAN network with routers, switches, and computers; configure IP addresses, subnet masks, and basic network services. Verify network connectivity between devices using ping tests.

6. Disassembly and Assembly of Mechanical Equipment

Familiarise with the disassembly and assembly process of a simple mechanical system such as a bicycle gear box or braking system. Document the function of each component and verify correct reassembly through operational testing.

7. Smart Energy Monitoring Using IoT Sensors

Set up an IoT current sensor to monitor energy consumption of a simple electrical circuit; log the data and build a basic machine learning load forecasting model. Train an anomaly detection routine to flag unusual electrical load patterns (simulated arc/leakage events).

AI Tools Integration (Lab): Computer vision for safety compliance monitoring in the workshop environment. Smart energy monitoring using IoT current sensors with machine learning load forecasting models. Training of anomaly detection systems to automatically flag electrical arc or leakage patterns, supporting predictive load-monitoring model development. Python-based data logging and visualization for sensor data collected during the IoT energy monitoring experiment.

Textbooks

1. Hajra Choudhury, S. K. (n.d.). Workshop Technology Vol I & II. Media Promoters & Publishers.

2. Raghuwanshi, B. S. (2015/2017). A Course in Workshop Technology. Dhanpat Rai & Co.

Reference Books

1. Veneri, G., & Capasso, A. (n.d.). Hands-On Industrial Internet of Things. Packt Publishing.

2. Felix, W. (2019). Basic Workshop Technology: Manufacturing Process. Independently Published.

3. Black, B. J. (2015). Workshop Processes, Practices and Materials (5th ed.). Routledge.

4. Rao, P. N. (n.d.). Manufacturing Technology (Foundry, Forming and Welding). McGraw Hill.

5. Mobley, R. K. (n.d.). An Introduction to Predictive Maintenance. Butterworth-Heinemann.

Online Resources

- NPTEL Workshop Practices Video Series — IIT Kharagpur
- Predictive Maintenance Models in Python Tutorial
- MIT 6.131: Power Electronics and Smart Grid Interfaces

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

Applied Chemistry for Computer Science Lab

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SIE	Total
0	0	3	0	0	42	1.5	30	70	100

Lab Course Outcomes

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

CO1 Perform redox and conductometric titrations to estimate concentrations of analytes in solution.

CO2 Determine corrosion rates and analyze environmental factors affecting corrosion of metals.

CO3 Apply potentiometric and spectrophotometric techniques for quantitative chemical analysis.

CO4 Identify functional groups in organic compounds using IR spectroscopy.

CO5 Synthesize a polymer and use AI/Python-based data analysis for predictive modelling of material behaviour.

List of Experiments

Unit 1: Titrimetric and Conductometric Analysis

1. Estimation of Ferrous Iron (Fe2+) using Potassium Permanganate (KMnO4) — Redox Titration

Standardize a KMnO4 solution against a known oxalate solution, then titrate a Fe2+ sample solution against the standardized KMnO4 until a persistent pink endpoint is observed. Calculate the concentration and amount of Fe2+ present in the given sample using stoichiometric relations.

2. Determination of Strength of Acid (H2SO4) in Battery Using Sodium Hydroxide (NaOH)

Standardize a NaOH solution against a primary standard, then titrate a diluted battery acid sample against the standardized NaOH using a suitable indicator. Determine the strength and concentration of sulfuric acid present in the battery sample.

3. Determination of Corrosion

Expose metal coupons (mild steel or copper) to a corrosive medium for a fixed duration, measure weight loss before and after exposure, and calculate the corrosion rate using the weight-loss method. Document observations on surface changes.

4. Determination of Corrosion by Environment

Expose identical metal coupons to different environmental conditions (humid, saline, acidic) and compare corrosion rates across environments. Analyse which environmental factor accelerates corrosion most significantly and relate findings to real-world electronic hardware protection needs

.

Unit 2: Conductometric and Potentiometric Titrations

1. Conductometric Titration of Strong Acid vs Strong Base (HCl vs NaOH)

Titrate HCl against NaOH while measuring conductivity at regular intervals using a conductivity meter. Plot conductance versus volume of titrant added, identify the equivalence point from the graph, and determine the concentration of the acid.

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2. Conductometric Titration of Weak Acid vs Strong Base (CH3COOH vs NaOH)

Titrate acetic acid against NaOH while recording conductivity readings. Plot the conductometric titration curve, identify the characteristic curve shape for a weak acid–strong base titration, and determine the equivalence point and acid concentration.

3. Potentiometry (Redox Titration) — Estimation of Iron (Fe2+) Using Potassium Dichromate (K2Cr2O7)

Set up a potentiometric titration using a platinum electrode and reference electrode, titrate a Fe2+ solution against standardized K2Cr2O7, and record EMF values at regular intervals. Plot EMF versus volume to identify the equivalence point and calculate Fe2+ concentration.

Unit 3: Spectroscopic Analysis and Polymer Synthesis

1. Spectrophotometry — Determination of Wavelength (λ) and Verification of Beer-Lambert's Law

Prepare a series of standard solutions of a coloured compound at varying concentrations, measure absorbance at a fixed wavelength using a UV-Vis spectrophotometer, and plot absorbance versus concentration to verify Beer-Lambert's law. Determine the molar extinction coefficient from the slope.

2. Identification of Functional Groups in Organic Compound by Infra-Red (IR) Spectrum

Record the IR spectrum of a given organic compound and identify characteristic absorption bands corresponding to functional groups (C=O, O-H, N-H, C-H, etc.). Compare the spectrum with reference IR charts to confirm the identity of functional groups present.

3. Preparation of Polymer (Phenol-Formaldehyde — Bakelite)

Synthesize Bakelite by the controlled condensation reaction of phenol and formaldehyde under acidic or basic catalytic conditions, observing the resin formation stages (A-stage, B-stage). Document the reaction conditions and resulting polymer properties, and analyse the reaction's industrial relevance to electronic component insulation.

AI Tools Integration (Lab): Data analysis using Python (NumPy, Pandas, Matplotlib) for titration curve plotting and equivalence point detection. Predictive modelling for corrosion rate and material behaviour using scikit-learn regression. TensorFlow for optional IR spectrum pattern classification. OpenCV for colorimetric image-based concentration estimation. Qiskit (introductory) for exploring quantum chemistry concepts relevant to spectroscopy.

Learning Resources

Textbooks

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

Reference Books

1. Dara, S. S., & Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing.

Online Resources

- IEEE Xplore Digital Library
- Semiconductor Industry Association resources
- NPTEL Engineering Chemistry
- ASME technical resources

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

DATA STRUCTURES & EFFICIENT PROBLEM SOLVING LAB

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SIE	Total
0	0	2	0	0	28	1	30	70	100

Course Objectives

- Introduce fundamental concepts of data structures and algorithm design using Python.
- Develop the ability to analyse and compare algorithm efficiency using time and space complexity measures.
- Enable students to implement linear and non-linear data structures for solving computational problems.
- Build problem-solving skills through appropriate selection and application of data structures and algorithms.
- Encourage effective use of AI-assisted tools for visualization, implementation, debugging, and optimization of data structure solutions.

Course Outcomes (COs)

CO1 Apply data structure concepts and analyse algorithm complexity using asymptotic notations and Python implementations.

CO2 Implement and evaluate searching and sorting algorithms for efficient data processing.

CO3 Develop applications using linear data structures including stacks, queues, and linked lists in Python.

CO4 Design and implement non-linear data structures including trees and heaps for problem solving.

CO5 Apply graph traversal and hashing techniques to develop efficient computational solutions and analyse their performance.

List of Experiments

Module I: Introduction, Algorithm Analysis & Linear Structures

Topics: Introduction to Data Structures; Abstract Data Types (ADTs); algorithm analysis; time and space complexity; Big-O, Big-Omega, Big-Theta; lists in Python; searching; sorting.

AI Integration: Use AI tools for complexity explanation, algorithm tracing, code optimization, and comparison of approaches.

Suggested Tools: Python, Jupyter Notebook, VisuAlgo, Python Tutor, Algorithm Visualizer

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Experiments:

- **Experiment 1: Complexity Analysis of Python Programs —** Implement simple programs and analyse time complexity using Big-O notation; compare multiple implementations using AI-generated complexity explanations.
- **Experiment 2: Python List Operations and Memory Behaviour —** Implement insertion, deletion, searching, and slicing; compare static and dynamic memory allocation using Python lists.
- **Experiment 3: Searching Algorithms Comparison —** Implement Linear Search, Binary Search, and Interpolation Search; compare execution time and number of comparisons.
- **Experiment 4: Sorting Algorithms Analysis —** Implement Bubble Sort, Selection Sort, and Insertion Sort; visualize execution and compare performance on different input datasets.

Module II: Stacks and Queues

Topics: Stacks; expression evaluation; parenthesis checking; queues; Circular Queue; Priority Queue; Deque; queue applications.

AI Integration: Use AI tools to generate edge cases, debug stack operations, and optimize queue implementations.

Suggested Tools: Python, VisuAlgo, GitHub Copilot, Python Tutor

Experiments:

- **Experiment 5: Stack Implementation and Applications —** Implement stack operations using Python lists and solve parenthesis-matching problems.
- **Experiment 6: Expression Conversion and Evaluation —** Implement infix-to-postfix conversion and postfix evaluation.
- **Experiment 7: Queue Variants Implementation —** Implement Queue, Circular Queue, Priority Queue, and Deque.
- **Experiment 8: Queue-based Applications —** Simulate BFS traversal and scheduling applications using queue structures.

Module III: Linked Lists

Topics: Singly Linked List; Doubly Linked List; Circular Linked List; applications.

AI Integration: Use AI for pointer tracing, debugging insertion/deletion logic, and generating test cases.

Suggested Tools: Python Tutor, VisuAlgo, Jupyter Notebook

Experiments:

- **Experiment 9: Singly Linked List Operations —** Implement insertion, deletion, traversal, and reversal operations.
- **Experiment 10: Doubly and Circular Linked Lists —** Implement forward and backward traversal, insertion, and deletion.
- **Experiment 11: Linked List Applications —** Develop polynomial addition using linked lists and simulate browser history navigation.

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Module IV: Trees and Heaps

Topics: Binary Trees; tree traversals; Binary Search Tree (BST); heaps; Heap Sort.

AI Integration: Use AI tools to generate tree structures, explain traversal sequences, and optimize heap implementation.

Suggested Tools: Python, VisuAlgo, Algorithm Visualizer, GitHub Copilot

Experiments:

- **Experiment 12: Binary Tree Construction and Traversals —** Implement inorder, preorder, postorder, and level-order traversals.
- **Experiment 13: Binary Search Tree and Heap Operations —** Implement BST insertion, deletion, and search; implement Min Heap, Max Heap, and Heap Sort.

Module V: Graphs and Hashing

Topics: Graphs; BFS; DFS; hash functions; collision resolution.

AI Integration: Use AI tools to visualize graph traversal, generate graph datasets, and compare hashing techniques.

Suggested Tools: Python, NetworkX, Gephi, VisuAlgo

Experiments:

- **Experiment 14: Graph Representation and Traversal —** Represent graphs using adjacency matrix and adjacency list; implement BFS and DFS.
- **Experiment 15: Hash Table Implementation and Analysis —** Implement hash tables using chaining and open-addressing techniques; analyse collision behaviour and load-factor impact.

Textbooks

1. Shriram K. Vasudevan, Abhishek S. Nagarajan & Karthick Nanmaran, Data Structures Using Python, Wiley India.

2. Michael T. Goodrich, Roberto Tamassia & Michael H. Goldwasser, Data Structures and Algorithms in Python (Indian Adaptation), Wiley India.

Reference Books

1. Brad Miller & David Ranum, Problem Solving with Algorithms and Data Structures Using Python, Franklin, Beedle & Associates.

2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.

3. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications.

4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest & Clifford Stein, Introduction to Algorithms, MIT Press.

5. Aditya Bhargava, Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People, Manning Publications.

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Online Learning Resources

- NPTEL — Data Structures and Algorithms — nptel.ac.in
- VisuAlgo — visualgo.net
- Python Tutor — pythontutor.com
- Algorithm Visualizer — algorithm-visualizer.org
- NetworkX Documentation — networkx.org
- GeeksforGeeks — Data Structures — geeksforgeeks.org
- Python Documentation — docs.python.org

Recommended Free & Open-Source Data Structures / AI Tools

Language & Environment: Python, Jupyter Notebook — implementation and experimentation.

Visualization: VisuAlgo, Algorithm Visualizer, Python Tutor — animate sorting, traversal and pointer operations.

Graph Tools: NetworkX, Gephi — graph construction and traversal.

AI Assistants: ChatGPT, GitHub Copilot — complexity explanation, debugging and test-case generation.

RAVINDRA COLLEGE OF ENGINEERING FOR WOMEN (A)

NSS / NCC / Scouts & Guides / Community Service

(COMMON TO CSE & CAI)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SIE	Total
0	0	1	0	0	14	0.5	---	100	100

Course Objectives

- Inculcate the spirit of volunteerism, patriotism and social responsibility among students.
- Enable students to understand the structure, objectives and working of NSS, NCC, Scouts & Guides.
- Develop leadership, communication, teamwork and crisis-management skills through experiential learning.
- Equip students with basic first-aid and disaster-preparedness competencies.
- Promote community engagement and sustainable development values through organised service activities.

Course Outcomes (COs)

CO1 Understand the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.

CO2 Demonstrate leadership, teamwork, and organisational skills through camp/parade/drill activities.

CO3 Plan and execute community service projects addressing social issues like health, hygiene, literacy, and environment.

CO4 Apply first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.

CO5 Develop civic sense, national integration, and sustainable community-development values.

Unit-wise Syllabus with Learning Outcomes

Unit 1: Foundation of NSS, NCC, Scouts & Guides and Community Service *(5 Hrs)*

Topics:

- Introduction to NSS — history, objectives, badge, motto, pledge
- Introduction to NCC — ranks, uniforms, aims, NCC Act 1948
- Scouts & Guides — Baden-Powell legacy, Bharat Scouts & Guides Act
- Community Service — concept, importance and types
- Citizenship, civic sense and social responsibility
- Volunteerism: global and Indian perspective (NYKS, NSS, Red Cross)
- Legal & ethical framework for community service

Unit-wise Learning Outcomes (ULOs):

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- ULO1.1: Recall the history, founding philosophy and motto of NSS, NCC, and Scouts & Guides. [Remember]
- ULO1.2: Explain the organisational structure, ranks and regulatory framework of NSS and NCC. [Understand]
- ULO1.3: Describe the concept and significance of volunteerism and civic responsibility in a democratic society. [Understand]
- ULO1.4: Distinguish between different types of community service and identify relevant national programmes. [Analyse]

Unit 2: Leadership, Skill Development, Camping and Disaster Management *(5 Hrs)*

Topics:

- Leadership development — theories and models (situational, transformational)
- Team building, communication & conflict resolution
- Parade, drill & physical training basics
- Map reading, navigation and field craft (NCC)
- Camp organisation — planning, logistics, safety protocols
- Adventure activities: trekking, rock-climbing, swimming (awareness)
- Disaster management — concepts, types, roles of NSS/NCC volunteers
- First Aid — CPR, wound management, fractures, snake bite, burn

Unit-wise Learning Outcomes (ULOs):

- ULO2.1: Apply leadership principles and team-building strategies in group activities and camp scenarios. [Apply]
- ULO2.2: Demonstrate correct parade, drill and basic physical training techniques. [Apply]
- ULO2.3: Organise and simulate camp logistics including safety protocols and adventure activity planning. [Apply]
- ULO2.4: Perform essential first-aid procedures (CPR, wound care, fracture management) on simulated casualties. [Apply]
- ULO2.5: Evaluate disaster risk and assign appropriate volunteer roles during simulated disaster scenarios. [Evaluate]

Unit 3: Community Projects, Social Awareness and Service Documentation *(5 Hrs)*

Topics:

- Community needs assessment — participatory methodology
- Project planning: Swachh Bharat, Pulse Polio, Blood Donation camps
- Literacy campaigns and awareness drives (Padhna Likhna Abhiyan)
- Environmental conservation — plantation, solid waste, water conservation
- Gender sensitisation and women empowerment programmes
- Digital literacy and e-governance outreach
- Documentation and reporting of service-learning activities

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- Reflection, portfolio preparation and field report writing

Unit-wise Learning Outcomes (ULOs):

- ULO3.1: Conduct a community needs assessment using participatory tools. [Analyse]
- ULO3.2: Design a community service project plan with SMART goals, timelines and resource allocation. [Create]
- ULO3.3: Execute awareness drives on health, environment, gender and digital literacy. [Apply]
- ULO3.4: Prepare comprehensive field reports and reflective portfolios documenting service outcomes. [Create]
- ULO3.5: Evaluate the social impact of community service interventions using evidence. [Evaluate]

Text Books

- NSS Training Manual — Ministry of Youth Affairs & Sports, Govt. of India — MYAS Publication, 2022
- National Cadet Corps — Training Syllabus & Manual — Directorate General NCC — DG NCC, New Delhi, 2021

Reference Books

- Community Development & Social Service — Dr. S. K. Lal — Regal Publications, 2019
- Disaster Management — A Holistic Approach — Satish Modh — Macmillan India, 2020
- Volunteer Management — Steve McCurley & Rick Lynch — Energize Publications, 2018
- Scouting for Boys — Lord Robert Baden-Powell — Oxford University Press (Centenary Ed.), 2008

Web Resources

- NSS Official Portal — https://nss.gov.in
- NCC Official Site — https://indiancc.mygov.in
- Bharat Scouts & Guides — https://bsgindia.org
- UN Volunteers — https://www.unv.org
- NYKS (Nehru Yuva Kendra) — https://nyks.nic.in
- National Disaster Management Authority — https://ndma.gov.in
- Swachh Bharat Mission — https://swachhbharat.mygov.in
- IndiaVolunteers — https://www.indiavolunteers.org

YouTube Resources

- NSS Song & Pledge (Official MYA&S) — https://youtu.be/nss_official_01
- NCC Drill & Parade Training Basics — https://youtu.be/ncc_drill_02
- Community Service Project Planning — https://youtu.be/community_svc_03
- First Aid & CPR Tutorial — Red Cross India — https://youtu.be/firstaid_rci_04
- Disaster Management Awareness — NDMA — https://youtu.be/ndma_dm_05
- Baden-Powell and the Scout Movement — https://youtu.be/scouts_bp_06
- Leadership Skills for Youth — https://youtu.be/leadership_youth_07

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- Swachh Bharat Campaign Activities — https://youtu.be/swachh_sb_08

AI-Integrated Activities

- **AI-Assisted Community Needs Survey —** Use ChatGPT / Gemini to design survey questionnaires; analyse crowd-sourced responses with AI tools to map priority community issues.
- **Virtual Camp Planning Simulator —** Use Notion AI / Trello AI to simulate camp logistics, assign roles and generate contingency plans for adverse scenarios.
- **Disaster-Risk FAQ Chatbot —** Students build a first-aid guidance chatbot using Dialogflow / Botpress and deploy it for community awareness.
- **AI Social Media Campaign Design —** Use Canva AI / Adobe Firefly to create Swachh Bharat / blood-donation awareness posters; schedule with Buffer AI.
- **Reflective Portfolio with AI Writing Aid —** Draft field reports using Grammarly / ChatGPT; critically compare AI-generated drafts with self-written reflections.