B.E. (Mechatronics Engineering)

2026 Regulations, Curriculum & Syllabi

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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VISION OF THE DEPARTMENT

To prepare students to achieve academic excellence in the field of Mechatronics education, research and innovative product development.

MISSION OF THE DEPARTMENT

To provide pedagogical expertise and effectively disseminate technical knowledge.
To promote continuous learning and research by establishing state-of-the-art facilities.
To provide exposure to emerging technologies through industry–institute interaction.
To foster innovation through the development of interdisciplinary projects.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- To prepare graduates for successful careers in mechatronics, robotics, automation, and allied engineering domains by applying interdisciplinary engineering knowledge and professional skills to analyze, design, and implement innovative engineering solutions.
- To enable graduates to contribute effectively to the development, integration, and enhancement of mechatronic products, automated systems, and engineering processes through multidisciplinary approaches, contemporary engineering practices, and emerging technologies.
- To foster lifelong learning, higher education, research, entrepreneurship, and leadership among graduates while promoting professional ethics, sustainability, and social responsibility in their professional and societal endeavors.

PROGRAMME OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural sciences, computing, engineering fundamentals, and an engineering specialization, as specified, to develop solutions to complex engineering problems.

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

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

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

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

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

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

PO8: Individual and Collaborative Teamwork: Function effectively as an individual and as a member or leader of diverse and multidisciplinary teams.

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

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

PO11: Life-Long Learning: Recognize the need for, and demonstrate the preparation and ability for, (i) independent and life-long learning, (ii) adaptability to new and emerging technologies, and (iii) critical thinking in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

The Graduate will be able to

1. To design, analyze, and implement intelligent robotic systems by integrating sensors, actuators, control systems, embedded platforms, and artificial intelligence for automation and smart manufacturing applications.
2. To develop and implement intelligent, human-centric industrial automation solutions using modern control systems, PLC/SCADA, modeling and simulation, and Industry 5.0 technologies to address complex engineering challenges.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcomes(s)										
	1	2	3	4	5	6	7	8	9	10	11
I	X	X	X	X	X	-	-	-	X	-	X
II	X	X	X	X	X	-	-	-	X	X	X
III	-	X	-	X	X	X	X	X	X	X	X

DEPARTMENT OF MECHATRONICS ENGINEERING **Minimum Credits to be Earned: 162**										
I SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MA101	Linear Algebra and Calculus	3	1	0	4	4	40	60	100	BS
26PH102	Engineering Physics	3	0	0	3	3	40	60	100	BS
26CH103	Engineering Chemistry	2	0	0	2	2	40	60	100	BS
26GE003	Electronic Devices and Circuits	3	0	0	3	3	40	60	100	ES
26GE005	Problem Solving using C	3	0	0	3	3	40	60	100	ES
26HS001	Communicative English	1	0	2	2	3	60	40	100	HSS
26HS002	தமிழர் மரபு / Heritage of Tamils	1	0	0	1	1	40	60	100	HSS
26PS108	Physical Science Laboratory	0	0	4	2	4	60	40	100	BSC
26GE006	C Programming Laboratory	0	0	2	1	2	60	40	100	ES
26HS003	Induction Programme (AICTE, AU)	-	-	-	NC		-	-	-	HSS
Total					**21**	**25**				

II SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MA201	Differential Equations and Transforms	3	1	0	4	4	40	60	100	BS
26PH202	Materials Science	3	0	0	3	3	40	60	100	ES
26MC203	Engineering Mechanics	3	1	0	4	4	40	60	100	ES
26MC204	Electric Circuit Analysis	3	0	0	3	3	40	60	100	ES
26GE007	Python Programming	3	0	0	3	3	40	60	100	ES
26HS004	Professional Communication	1	0	2	2	3	50	50	100	HSS
26HS005	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	1	40	60	100	HSS
26GE008	Python Programming Laboratory	0	0	2	1	2	60	40	100	ES
26GE009	Engineering Drawing	1	0	2	2	2	60	40	100	ES
26HS006	Co-curricular / Extracurricular Activities	-	-	-	NC	-	-	-	-	HSS
Total					**23**	**25**				

III SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MC301	Probability and Statistics	3	1	0	4	4	40	60	100	BS
26MC302	Engineering Thermodynamics	3	0	0	3	3	40	60	100	PC
26MC303	Fluid Mechanics and Machinery	3	0	0	3	3	40	60	100	PC
26MC304	Digital System Design	2	1	0	3	3	40	60	100	PC
26MC305	Strength of Materials	3	0	0	3	3	40	60	100	PC
26MC306	Data Structure and OOPS	2	1	0	3	3	40	60	100	ES
26MC307	Modeling and Simulation Laboratory	0	0	4	2	4	60	40	100	PC
26MC308	Data Structure and OOPS Laboratory	0	0	2	1	2	60	40	100	ES
26MC309	Design Thinking and Innovation Laboratory	0	0	2	1	2	60	40	100	ES
Total					**23**	**27**				

IV SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MC401	Theory of Machines	3	1	0	4	4	40	60	100	PC
26MC402	Control Systems	3	0	0	3	3	40	60	100	PC
26MC403	Microprocessors and Microcontrollers	2	1	0	3	3	40	60	100	PC
26MC404	Fluid Power System	3	0	0	3	3	40	60	100	PC
26MC405	Manufacturing Technology	3	0	0	3	3	40	60	100	PC
26MC406	Electrical Machines	3	0	0	3	3	40	60	100	ES
26HS007	Environmental Sciences and Sustainability	0	0	4	2	2	60	40	100	HSS
26MC408	Microprocessors and Microcontrollers Laboratory	0	0	2	1	2	60	40	100	PC
26MC409	Manufacturing Technology Lab	0	0	4	2	4	60	40	100	PC
26MC410	Community Engagement Project	0	0	2	1	2	60	40	100	HSS
Total					**25**	**29**				

V SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MC501	Machine Design	3	1	0	4	4	40	60	100	PC
26MC502	CNC Technology	3	0	0	3	3	40	60	100	PC
26MC503	Sensors and Signal Conditioning	3	0	0	3	3	40	60	100	PC
26MC504	Power Electronics and Drives	3	0	0	3	3	40	60	100	PC
	Professional Elective I	3	0	0	3	3	40	60	100	PE
	Open Elective I	3	0	0	3	3	40	60	100	OE
26MC507	Standards in Mechatronics Engineering	1	0	0	1	1	40	60	100	ES
26MC508	Sensors and Signal Conditioning Laboratory	0	0	2	1	2	60	40	100	PC
26MC509	Drives and Motion Control Laboratory	0	0	2	1	2	60	40	100	PC
26HS008	Finance for Engineers	-	-	-	NC	-	60	40	100	HSS
Total					**22**	**24**				**-**
FOR HONOURS DEGREE										
	Honours Elective I	3	0	0	3	3	40	60	100	-
	Honours Elective II	3	0	0	3	3	40	60	100	-
FOR MINOR DEGREE										
	Minor Elective I	3	0	0	3	3	40	60	100	**-**
	Minor Elective II	3	0	0	3	3	40	60	100	**-**

VI SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MC601	Industrial Automation	3	0	0	3	3	40	60	100	PC
26MC602	Real Time Embedded System	3	0	0	3	3	40	60	100	PC
26MC603	Engineering Entrepreneurship Development	3	0	0	3	3	40	60	100	HSS
	Professional Elective II	3	0	0	3	3	40	60	100	PE
	Professional Elective III	3	0	0	3	3	40	60	100	PE
	Open Elective II	3	0	0	3	3	40	60	100	OE
26MC607	Industrial Automation Laboratory	0	0	2	1	2	60	40	100	PC
26MC608	Real Time Embedded System Laboratory	0	0	2	1	2	60	40	100	PC
26MC610	Innovation and Product Development Project / Industry Oriented Course / Summer Internship	0	0	2	1	2	60	40	100	EEC
Total					**21**	**24**				-
FOR HONOURS DEGREE										
	Honours Elective III	3	0	0	3	3	40	60	100	-
	Honours Elective IV	3	0	0	3	3	40	60	100	-
FOR MINOR DEGREE										
	Minor Elective III	3	0	0	3	3	40	60	100	-
	Minor Elective IV	3	0	0	3	3	40	60	100	-

VII SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MC701	Robotics and Machine Vision	3	0	0	3	3	40	60	100	PC
26MC702	Mechatronics System Design	3	0	0	3	3	40	60	100	PC
	Professional Elective IV	3	0	0	3	3	40	60	100	PE
	Professional Elective V	3	0	0	3	3	40	60	100	PE
	Professional Elective VI	3	0	0	3	3	40	60	100	PE
26MC706	Robotics Laboratory	0	0	2	1	2	60	40	100	PC
26MC707	Project Work I / Internship Project	0	0	6	3	3	60	40	100	EEC
Total					**19**	**20**				**-**
FOR HONOURS DEGREE										
	Honours Elective V	3	0	0	3	3	40	60	100	-
	Honours Elective VI	3	0	0	3	3	40	60	100	-
FOR MINOR DEGREE										
	Minor Elective V	3	0	0	3	3	40	60	100	**-**
	Minor Elective VI	3	0	0	3	3	40	60	100	**-**

VIII SEMESTER										
Course Code	**Course Name**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
26MC801	Project Work II / Internship Project / Startup Product	0	0	16	8	16	60	40	100	EEC
Total					**8**	**16**				**-**

26MA101	Linear Algebra and Calculus	L	T	P	C
		3	1	0	4

Prerequisite	Assessment Pattern		
	CIA	SEE	Total
Basic Integration and Differentiation	40	60	100

Course Objectives:

- Develop mathematical models using linear algebra and systems of linear equations to address engineering applications and real-world problems.
- Apply single-variable and multivariable differential calculus to analyze and solve engineering problems involving real-world phenomena and data.
- Evaluate multiple integrals and apply multivariable integration techniques to model and solve problems arising in physical and dynamical systems.

Course Outcomes (COs)

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

1. Implement the concepts of systems of linear equations in engineering applications.
2. Formulate real-world problems as linear algebraic models.
3. Demonstrate real-world phenomena and data analysis using single-variable differential calculus.
4. Apply the concepts of multivariable calculus to solve engineering problems.
5. Develop the ability to identify and evaluate multiple integrals in physical and dynamical systems.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	1	3	-	-	-	-	-	-	-	-	-	2	1
CO 2	2	3	-	-	-	-	-	-	-	-	-	3	2
CO 3	2	3	-	-	-	-	-	-	-	-	-	2	1
CO 4	3	3	-	-	-	-	-	-	-	-	-	3	2
CO 5	1	3	-	-	-	-	-	-	-	-	-	2	2

Module 1

Linear Algebra **11 Hours**

Introduction to Vector Spaces – Examples – Subspaces – Linear Combinations – Span – Generating Sets – Linear Dependence and Independence – System of linear equations – Consistency of the system – Matrix representation of a linear transformation – Eigenvalues and Eigenvectors – Cayley – Hamilton theorem – Diagonalization – Reduction of quadratic form to canonical form – Nature of a Quadratic form.

Differential Calculus **11 Hours**

Functions and their graphs – Scaling and shifting graphs – Limits – Continuity-Derivatives – Maxima and Minima – Concavity – Curve sketching.

Functions of two variables – partial derivatives – Total derivative – Jacobian and its properties – Taylor's expansion for two variables – Maxima and minima – Constrained and Unconstrained maxima.

Module 2

Integral calculus **11 Hours**

Improper integrals of the first and second kind and their convergence – Differentiation under integrals – Evaluation of integrals involving a parameter by Leibniz rule – Beta and Gamma functions -Properties – Evaluation of integrals by using Beta and Gamma functions.

Multiple integral Calculus **12 Hours**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals.

Term Work Activity	
GATE Questions, Quiz, Assignments.	
Self-Learning Activity	
NPTEL Course: Linear Algebra **NPTEL link:** https://onlinecourses.nptel.ac.in/noc25_ma114/preview **NPTEL Course: Differential Calculus** **NPTEL link:** https://onlinecourses.nptel.ac.in/noc19_ma18/preview **NPTEL Course: Multiple integral Calculus** **NPTEL link:** https://onlinecourses.nptel.ac.in/noc23_ma27/preview	

Theory	**45 Hours**
Tutorial	**15 Hours**
Total	**60 Hours**

Text Books:

1. B.S Grewal, Higher Engineering Mathematics, Khanna Publisher, 45th Edition, 2024.
2. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017.

References:

1. Howard Anton, Chris Rorres, Elementary Linear Algebra with Supplementary Applications, Wiley, 11th edition, 2023.
2. Joel Hass, Christopher Heil, Przemyslaw Bogachi, Maurice D. Weir, Thomas' Calculus, 15th edition, Pearson, 2024.
3. Richard E., Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies Inc, 1997.
4. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018.
5. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 10th edition, 2015.

<table>
<tr><td rowspan="2">26PH102</td><td rowspan="2">Engineering Physics</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Prerequisite</td><td colspan="3">Assessment Pattern</td></tr>
<tr><td colspan="3" rowspan="2">Understand the structure of atoms, bonding and its influence on material properties, kinetic and potential energy, periodic and oscillatory motion.</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Course Objectives:</td></tr>
<tr><td colspan="6">● Understand the fundamental concepts of atomic structure, material interactions, thermal physics, forces, energy, and gravitation.
● Apply the principles of mechanics, heat transfer, oscillations, waves, and electromagnetic phenomena to understand physical systems and their properties.
● Analyze the interaction of matter with mechanical, thermal, acoustic, and electromagnetic phenomena and relate these concepts to practical applications.</td></tr>
<tr><td colspan="6">Course Outcomes (COs)</td></tr>
<tr><td colspan="6">At the end of the course, students will be able to
1. Apply the physical principles to describe the structure of matter from subatomic particles to atoms and elements.
2. Analyze the nature of ionic, covalent and metallic bonding and correlate the type of bonding with the mechanical, thermal and electrical properties of materials.
3. Interpret the relationship among heat, temperature and molecular motion to evaluate changes in physical states and material properties.
4. Apply and verify the fundamental laws of force, motion, and energy conservation to explain equilibrium, inertia, and gravitational effects in real-world systems.
5. Examine and model oscillations and wave phenomena including mechanical, sound and electromagnetic waves to interpret energy transmission and resonance behavior.
6. Integrate and relate atomic, thermal, and mechanical principles to justify the behavior of materials and their suitability for engineering applications.</td></tr>
</table>

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	2	-	-	-	-	1	-	-	-	-	2	-
CO 2	3	3	2	-	-	-	1	-	-	-	-	3	2
CO 3	3	3	-	2	-	-	1	-	-	-	-	2	1
CO 4	3	2	-	3	-	-	1	-	-	-	-	2	1
CO 5	3	2	3	2	-	-	1	-	-	-	-	2	2
CO 6	2	-	3	-	2	-	1	-	-	-	-	3	2

Module 1

Atomic Physics **8 Hours**

Origin of matter: Formation of atoms and elements (concept of nucleo synthesis). Sub-atomic particles and charge interactions: Coulomb's law. Atomic models: Thomson, Rutherford, Bohr, and QM concepts. Binding energy of an electron – ionization potential.

Atomic Interactions and Material Formation **8 Hours**

Origin and characteristics: Interactions of matter. Relationship of bond strength to mechanical, electrical, and thermal properties. Formation of molecules and compounds: representation and valency. Crystal parameters - defects and stability.

Heat, Temperature, and Phases of Matter **7 Hours**

Kinetic theory of gases: Ideal gas law and equation of state - Heat and temperature: thermal equilibrium – specific and latent heat capacity - temperature scales. Expansion of solids, liquids, and gases: Phase transitions. Modes of heat transfer: Conduction, convection and radiation.

Module 2

Forces, Energy and Gravity **7 Hours**

Concept of force-mass-weight-inertia. Newton's laws of motion: Linear and circular motion. Work-energy-power. Potential and kinetic energy- conservation of energy. Universal law of gravitation: gravitational field and potential energy. Density-mass-buoyancy-Archimedes' principle- stability in fluids.

Oscillations and Wave Mechanics **8 Hours**

Simple harmonic motion (SHM) – mathematical formulation-energy exchange. Damped and forced oscillations-resonance conditions. Mechanical waves: longitudinal and transverse wave-characteristics. Energy transport in waves: reflection-interference-diffraction. Sound waves: classification and application.

Introduction to Electromagnetic Waves and Matter Interaction **7 Hours**

Generation and propagation of electromagnetic waves-spectrum-dual nature of light-interaction of light with matter – absorption-transmission-reflection. Optical properties of materials: transparent-translucent-opaque. Luminescence: phosphorescence and fluorescence.

Term Work Activity	
GATE Questions, Quiz, Assignments, Presentations	
Self-Learning	
NPTEL Course **NPTEL link:** https://nptel.ac.in/courses **NPTEL link:** https://nptel.ac.in/courses/122103011	
Theory	**45 Hours**
Total	**45 Hours**

Text Books:

1. Halliday, D. & Resnick, R. Fundamentals of Physics, 12th Edition, John Wiley & Sons, Inc., New Delhi (2021).

References:

1. Verma, H. C. Concepts of Physics Vol. I, Bharati Bhawan Publishers, New Delhi (2022 reprint).
2. Young, H. D. & Freedman, R. A. University Physics with Modern Physics, Global Edition, 15th Edition, Pearson, New Delhi (2024).
3. Tipler, P. A. & Mosca, G. Physics for Scientists and Engineers, 6th Edition, W. H. Freeman & Company / Macmillan, New Delhi (2020).
4. Serway, R. A. & Jewett, J. W. Principles of Physics: A Calculus-Based Text, 5th Edition, Brooks/Cole / Cengage Learning India Pvt. Ltd., New Delhi (2012).
5. Feynman, R. P., Leighton, R. B. & Sands, M. The Feynman Lectures on Physics (Vol. I), New Millennium Edition, Basic Books / Perseus Group, New Delhi (2011).

26CH103	Engineering Chemistry	L	T	P	C
		2	0	0	2

Prerequisite	Assessment Pattern		
Formation of elements, Sub atomic particles	CIA	SEE	Total
	40	60	100

Course Objectives:

- Develop a strong foundation in atomic structure, periodicity, bonding, and their influence on material properties
- Examine energy conversion, electrochemical processes, corrosion, batteries, and fuel cells in engineering applications.
- Compare advanced materials, polymers, nanomaterials, and composites for sustainable engineering solutions.
- Correlate surface chemistry and computational modelling approaches with materials, reactions, and engineering applications.

Course Outcomes (COs)

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

1. Apply atomic structure, electronic configuration, periodic trends, bonding and intermolecular forces to interpret reactivity and properties of engineering materials.
2. Apply concepts of energy conversion, corrosion, batteries, fuel cells, polymers, nanomaterials and adsorption to evaluate material performance.
3. Analyze relationships among structure, bonding, surface interactions, electrochemical processes and advanced materials in sustainable engineering applications.
4. Analyze chemical reactions, energy systems, materials behavior and corrosion processes using surface chemistry principles and computational modelling approaches.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	2	1	-	-	-	-	-	-	-	-	1	2	1
CO 2	2	1	-	-	-	-	-	-	1	-	1	3	2
CO 3	3	2	-	-	-	1	-	-	1	-	1	3	2
CO 4	3	2	-	-	-	2	-	-	1	-	1	3	2

Module 1

Atomic structure, periodicity and bonding **7 Hours**

Quantum shells and orbitals – electronic configuration and stability – periodic table, trends and their influence on reactivity – types of chemical bonds – intermolecular forces and their influence on material properties.

Chemical Reactions and Energy Conversion **8 Hours**

Chemical reactions and stability – types of reactions – energy changes in reactions. Electrochemical cells – Electrode potential – corrosion as an electrochemical redox process: types, factors and prevention.

Primary and secondary batteries – fuel cells – performance factors – solid-state and Na-ion trends – safety, recycling and environmental aspects.

Module 2

Advanced materials for engineering **6 Hours**

Metals, ceramics and polymers – chemical perspective – Polymers: Thermoplastics – thermosets – conducting and biodegradable polymers – polymer composites. Nanomaterials: CNTs – graphene and quantum dots. Future directions in sustainable material design.

Surface Chemistry **5 Hours**

Adsorption: Physisorption and chemisorption, isotherms (Freundlich, Langmuir). Catalysis: homogeneous, heterogeneous and enzyme catalysis – Industrial examples.

Computational Chemistry and Molecular Modelling **4 Hours**

Need and scope in engineering. Basic quantum methods – molecular modelling software and visualization. Applications in chemical reactions, battery materials, corrosion and reaction pathways.

Term Work Activity	
Quiz, Assignments, Student seminar, case studies and models (Experimental /Computational)	
Self-Learning Activity	
NPTEL Course: Electrochemical Energy Systems (Prof. S. Mitra, IIT Madras) NPTEL link - https://nptel.ac.in/courses/113106028	

Corrosion (Prof. Kallol Mondal, IIT Kanpur) NPTEL link - https://nptel.ac.in/courses/112104088 Composite Materials (Dr. P.C. Pandey, IISc Bangalore) NPTEL link - https://nptel.ac.in/courses/105108124 Foundations of Computational Materials Modelling (Narasimhan Swaminathan, Indian Institute of Technology Madras) NPTEL Link – https://nptel.ac.in/courses/112106296 Heterogeneous Catalysis and Catalytic Processes Indian Institute of Technology Delhi (NPTEL) NPTEL Link – https://nptel.ac.in/courses/103102012	
Total	**30 Hours**

Textbooks:

1. Thomas Engel, Maheswaramma and Chugh, Engineering Chemistry, First Edition, Pearson, 2026.
2. Jain, P. C. and Jain M, Engineering Chemistry, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, 2015.
3. Puri, Sharma, and Pathania, Principles of Physical Chemistry, Vishal Publishing Co, 48th Edition, 2024.

References:

1. Frank Jensen, Introduction to Computational Chemistry, Wiley & sons, 3rd Edition, 2017.
2. S. Glasstone, An Introduction to Electrochemistry, 8th Edition, East-West Press, Reprint, 2006.
3. Young and Lovell, Introduction to Polymers, 3rd Edition, CRC Press (Taylor & Francis imprint), 2011.
4. Michael F. Ashby, Hugh Shercliff and David Cebon, Materials: Engineering, Science, Processing and Design, 4th Edition, Butterworth-Heinemann -an imprint of Elsevier, 2018.
5. https://avogadro.cc
6. https://orcaforum.kofo.mpg.de

26GE003	Electronic Devices and Circuits	L	T	P	C
		3	0	0	3

Prerequisite	Assessment Pattern		
Basic Electrical Engineering, Semiconductor Physics	CIA	SEE	Total
	40	60	100

Course Objectives:

- To understand the operating principles and characteristics of semiconductor devices, including diodes, BJTs, and FETs.
- To analyze and design basic electronic circuits such as rectifiers, amplifiers, feedback circuits, and voltage regulators.
- To apply electronic devices in practical applications involving signal amplification, regulation, sensing, and automation.

Course Outcomes (COs)

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

1. Analyze semiconductor energy bands, carrier transport, and PN-junction diode characteristics under different operating conditions.
2. Apply semiconductor diode principles to design and evaluate rectifier, filter, and Zener voltage-regulator circuits.
3. Examine BJT characteristics, configurations, biasing circuits, load lines, and thermal stability for reliable operation.
4. Assess the performance of BJT and FET amplifier configurations using appropriate small-signal models to assess gain and frequency response.
5. Evaluate coupling techniques, power-amplifier classes, feedback circuits, and oscillators based on specified performance requirements.
6. Design voltage-regulator and optoelectronic circuits for sensing, isolation, automation, and energy-efficient applications.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	2	-	1	-	-	-	-	-	-	-	1	1
CO 2	3	3	3	2	2	-	-	-	-	-	-	3	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	2	2
CO 4	3	3	2	3	2	-	-	-	-	-	-	3	2
CO 5	3	3	2	3	2	-	-	-	-	-	-	3	2
CO 6	3	3	3	2	3	2	-	-	-	-	-	3	3

Module 1

Semiconductor Basics and PN Junction Diode **8 Hours**

Atomic structure and energy bands in solids, Carrier concentration, Mass Action Law, intrinsic and extrinsic semiconductors, Variation of properties with temperature Carrier drift and diffusion, current density equation, PN junction theory and diode characteristics – forward and reverse bias.

Special function Semiconductor Diodes and applications **7 Hours**

Zener Diode- Zener breakdown and Zener diode as voltage regulator, PN Junction diode-rectifiers (half-wave, full-wave and bridge), filter circuits (capacitor, inductor and π-type)

Transistor Fundamentals **7 Hours**

Bipolar Junction Transistor (BJT): construction, operation, and configurations (CE, CB, CC), Input/output characteristics and transistor parameters (β, re, gm), Gain and frequency response Biasing methods: fixed, voltage divider. Load-line analysis and operating point stability, Thermal runaway.

Module 2

FET Fundamentals **8 Hours**

JFET – construction working, characteristics, parameters, MOSFET and MOS capacitor Depletion and enhancement modes, nMOS and pMOS, threshold voltage, Transfer and output characteristics CMOS – introduction and basic operation.

Transistor and FET Applications **8 Hours**

Concept of feedback – types, advantages and disadvantages, Analysis of CE, CB, CC amplifiers- Gain and frequency response, MOSFET small signal model – Analysis of CS, CG and Source follower – Gain and frequency response.

Voltage Regulators and Optoelectronic Devices **7 Hours**

Voltage regulation: series and shunt regulators, IC voltage regulators (78XX, 79XX, LM317). Optoelectronic devices: LED, phototransistor, LDR, optocoupler, light sensing and isolation circuits.

Term Work Activity	
GATE Questions, Quiz, Assignments, Presentations, Seminars, Micro Projects, Electronics P-skill Level 3A.	
Self-Learning Activity	
NPTEL Course https://nptel.ac.in/courses/108101091 NPTEL link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee168	
Theory	**45 Hours**
Total	**45 Hours**

Text Books:

1. V.K. Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics, S. Chand Publishing, 12th Edition, 2019.

References:

1. Boylestad R.L. and Nashelsky L., Electronic Devices and Circuit Theory, Pearson, 12th Ed., 2013.
2. Millman J. and Halkias C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2015.
3. Sedra A.S. and Smith K.C., Microelectronic Circuits, Oxford University Press, 7th Ed., 2017.
4. A.P. Malvino, D.J. Bates, Patrick E. Hoppe., Electronic Principles, Tata McGraw Hill, 2021.
5. Salivahanan S. and Kumar N.S., Electronic Devices and Circuits, Tata McGraw Hill, 2022. NPTEL – Electronic Devices and Circuits, IIT Guwahati / IIT Bombay.

26GE005	Problem Solving Using C	L	T	P	C
		3	0	0	3

Prerequisite	Assessment Pattern		
Basic Mathematics	CIA	SEE	Total
	40	60	100

Course Objectives

- To understand the basics of algorithmic problem solving using flowcharts and pseudocode.
- To learn the structure of a C program, its data types, operators, and expressions.
- To solve problems using control structures, arrays, and string handling functions.
- To use functions, recursion, and pointers for modular and efficient programming.
- To do file operations in C using structures, unions, and streams.

Course Outcomes (COs)

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

- Apply algorithmic problem-solving principles to formulate computational solutions using flowcharts and pseudocode.
- Develop C programs using fundamental syntax, operators and control structures to solve real-world problems.
- Develop modular C programs using arrays, strings, functions and recursion to process and manipulate data.
- Implement C programs using pointers and dynamic memory allocation techniques to manage memory effectively.
- Construct C programs using structures, unions, and file operations to handle structured and persistent data.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2									3	
CO2	2	2	1		2							2	1
CO3	2	2	2		3		-		1			3	1
CO4	2	2	1		3		-					2	1
CO5	3	2	2	-	3		-		1			3	1

Module 1

Problem Solving and Algorithms **8 Hours**

Problem solving and algorithmic thinking- Algorithms-Definition, Characteristics and examples, flowcharts-symbols, conventions, and illustrations, Pseudocode and structured representation, Steps in program development, Overview of compilers and the C programming environment (edit → compile → execute).

C Programming Basics **7 Hours**

Structure of a C program, Tokens, keywords, identifiers, data types, variables, and constants, Operators and expressions, Input/output functions: printf(), scanf(), Type conversion and precedence rules, Debugging techniques and handling syntax errors.

Control Structures, Arrays and Strings **8 Hours**

Decision making: if, if–else, nested if, switch – Looping: while, for, do–while – Loop control statements: break, continue – Nested loops and example programs – One-dimensional and two-dimensional arrays: declaration, initialization, traversal – Concept of multi-dimensional arrays – Character arrays – Strings and string library functions – String processing applications.

Module 2

Functions and Modular Programming **8 Hours**

Concept of functions and modular programming, Function definition, declaration, prototypes, Parameter passing: call by value and call by reference, Recursion, Storage classes (auto, static, extern, register)

Pointers and Dynamic Memory **7 Hours**

Pointers and pointer arithmetic, Relationship between arrays and pointers, Pointers to functions, Pointers - function arguments, Dynamic memory allocation: malloc, calloc, free, realloc.

Structures, Unions and File Handling **7 Hours**

Structures: definition, initialization, arrays of structures, nested structures, Pointers to structures, Unions: definition, initialization, and difference from structures, Enumerated data types (enum), File handling: concept of files and streams, file operations, reading/writing text and binary files, error handling.

Term Work Activity	
Micro projects, PS Assessment and Programming Assignments	
Self-Learning Activity	
SWAYAM / NPTEL: Prof. AnupamBasu, Problem solving through Programming in C, IIT Kharagpur,2025, https://nptel.ac.in/courses/106105171. Prof. SatyadevNandakumar, Introduction to Programming in C, NPTEL Online Course, Indian Institute of Technology Khanpur, 2025, https://onlinecourses.nptel.ac.in/noc25_cs119/preview.	
Theory	**45 Hours**
Total	**45 Hours**

Text Books:

1. Kernighan, B. W. and Ritchie, D. M., The C Programming Language, Prentice Hall, 2nd Edition, USA, 2023.
2. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.

References:

1. Schildt, H., C: The Complete Reference, McGraw Hill, Latest Edition, USA, 2018.
2. Kanetkar, Y. P., Let Us C, BPB Publications, Latest Edition, India, 2025.
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.
4. PradipDey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.

26HS001	COMMUNICATIVE ENGLISH	L	T	P	C
		1	0	2	2

Prerequisite	Assessment Pattern		
Basic Communication & Writing skill	CIA	SEE	Total
	60	40	100

Course Objectives:

- Develop students' ability to communicate effectively and professionally using accurate and appropriate English.
- Enhance students' skills in descriptive and narrative forms of communication.
- Develop active reading and comprehension skills through exposure to authentic English texts.

Course Outcomes (COs)

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

1. Express themselves clearly and accurately using appropriate English language structures.
2. Develop and express ideas effectively through descriptive and narrative forms.
3. Understand and make effective use of the English language in real-world contexts.
4. Read and interpret authentic texts for effective understanding.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1									2	3	2		
CO 2									2	3	2		
CO 3									2	3	2		
CO 4									2	3	2		

Module 1

Communication Process **8 Hours**

Listening –formal & informal conversations, Motivational speeches - **Speaking** –Self introduction– speaking on given topics & situations – recording speeches and strategies to improve, - impromptu speeches, Debates and discussion - **Reading** - Reading comprehension – skimming/ scanning/ predicting – question & answers – objective and descriptive answers, articles – magazines - **Writing** – paragraph writing, personal notes, review writing, - **Language Development**- single word substitutes, compound words- conditionals, 21st century vocabulary.

Module 2

Language Mechanics **7 Hours**

Listening –Interviews – Extensive speech on current affairs, TED talks - popular speeches and presentations- **Speaking** – Role plays- describing a simple process – asking and answering questions - **Reading** – critical reading – finding key information in a given text – ideation, mind mapping - **Writing** - dialogue, instructions, process description, channel conversion – bar diagram/ table, poster/ picture interpretation - **Language Development** – writing single sentence definitions, sequence words, synonyms & antonyms, modal verbs, Collocations.

Practical	30 Hours
Listening – Speaking – Reading – Writing - Language Development	

Term Work Activity	
Technical Article Analysis, Mind Maping, Interview Script, TED Talk review	
Self-Learning	
1. **MOOC**: NPTEL "Developing Soft Skills and Personality" or equivalent. **NPTEL link**: https://nptel.ac.in/courses/109104107 2. **Online Module**: Complete an NPTEL or Spoken Tutorial and submit the certificate or a 150–200 word summary. **NPTEL link**: https://onlinecourses.nptel.ac.in/noc26_hs74/preview 3. **MOOCs**: Complete an Nptel online module; submit certificate or summary. **NPTEL link:** https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_hs08 4. **Online Module:** Coursera / Swayam / FutureLearn on Communication Skills. **NPTEL link**: https://onlinecourses.swayam2.ac.in/e-learning/preview/aic21_ge24 5. **Spoken Tutorial**: IIT Bombay English Communication. 6. **TED Talk**: 200-word reflection on strategies learned.	

Theory	**15 Hours**
Practical	**30 Hours**
Total	**45 Hours**

Textbooks:

1. A Course in Technical English, D. Praveen Sam and K.N. Shoba, Cambridge University Press, 2020
2. *Anderson, Paul V*. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.

References:

1. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
3. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

26HS002	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

Prerequisite	Assessment Pattern		
Understanding of Indian and Regional History/Culture	CIA	SEE	Total
	40	60	100

Course Objectives

- To understand the history, culture, and traditions of Tamils.
- To learn about the achievements and contributions of Tamils.
- To develop pride in and preserve Tamil heritage.

Course Outcomes (COs)

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

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features.
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures.
- Examine the role of sports and games in promoting cultural values and community bonding.
- Discuss the education and literacy systems during the Sangam Age and their impact.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1						3	3	2		2				
CO 2						3	3	2		2				
CO 3						3	3	2		2				
CO 4						3	3	2		2				
CO 5						3	3	2		2				

Module 1

Language And Literature **3 Hours**

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

Rock Art Paintings To Modern Art Sculpture **3 Hours**

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

Folk And Martial Arts **3 Hours**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

Module 2

Thinai Concept of Tamils **3 Hours**

Thinai Concept in Tamil Culture – Flora and Fauna associated with the five landscapes of Tamils Aham and Puram concepts from Tholkappiyam and Sangam Literature – Aram concept of Tamils and its ethical values – Education and literacy during the Sangam Age – Ancient cities and ports of the Sangam period – Export and import trade during Sangam Age – Overseas conquest and maritime expansion of the Cholas.

Contribution of Tamils to Indian National Movement and Indian Culture **3 Hours**

Contribution of Tamils to the Indian Freedom Struggle – Participation of Tamil leaders and revolutionaries – Cultural influence of Tamils over other regions of India – Self-Respect Movement and its social impact – Role of Siddha medicine in indigenous medical systems – Importance of inscriptions and manuscripts in preserving Tamil history – Development of Tamil print culture and history of Tamil books.

Term Work Activity	
Assignments, Case Study	
Theory	**15 Hours**
Total	**15 Hours**

Textbooks:

1. TAMILAR MARABU-Dr.A.Boobalan VRB PUBLISHERS PVT LTD,6/50,Venkatesa Nagar 1 st street,Virukambakkam, Chennai-600 092.

References:

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

<table>
<tr><td rowspan="2">26PS108</td><td rowspan="2">PHYSICAL SCIENCE LABORATORY - PHYSICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="3">Prerequisite</td><td colspan="3">Assessment Pattern</td></tr>
<tr><td colspan="3" rowspan="2">Principles of interference and diffraction of light.
Characteristics of laser light.
Skills in data observation, measurement, and error calculation.</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>60</td><td>40</td><td>100</td></tr>
<tr><td colspan="6">Course Objectives:
● Develop proficiency in using precision instruments to accurately measure dimensions of engineering materials.
● Determine mechanical and optical properties of materials through systematic experimental methods and analysis.
● Characterize semiconductor and solar cell performance using electrical measurements and graphical analysis techniques.</td></tr>
<tr><td colspan="6">Course Outcomes (COs)
At the end of the course, students will be able to
1. Demonstrate the ability to measure and record physical parameters such as radius, diameter, thickness, and refractive index.
2. Determine and analyze mechanical properties like Young’s modulus, rigidity modulus, and moment of inertia.
3. Investigate optical phenomena to measure thickness, wavelength, and particle size using interference and diffraction methods
4. Analyze I–V characteristics and energy band gap to evaluate performance parameters of solar cells and PN junction diodes.
5. Interpret and apply experimental data to understand material behavior and solve engineering problems.</td></tr>
</table>

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	2	1	-	-	-	-	1	-	1	-	1	-	1
CO 2	2	1	-	-	-	-	1	-	1	-	1	-	1
CO 3	2	1	-	-	-	-	1	-	1	-	1	1	1
CO 4	2	1	-	-	-	-	1	-	1	-	1	1	2
CO 5	2	1	-	-	-	-	1	-	1	-	1	1	2

Module 1 (Any three experiments)

9 Hours

Experiment 1

Assess the physical parameters (radius, diameter, and thickness) of various engineering materials using precision instruments like the screw gauge, vernier caliper, and travelling microscope.

Experiment 2

Determine the moment of inertia of a given disc by torsional oscillations and evaluate the rigidity modulus of the material of the suspension wire.

Experiment 3

Apply the non-uniform bending method to determine the Young's modulus of a uniform bar and analyze its mechanical properties for engineering applications.

Experiment 4

Analyze the thickness of a thin sheet or wire by observing the interference pattern in an air-wedge arrangement.

Module 2 (Any two experiments)

6 Hours

Experiment 5

Evaluate the wavelength of a laser source and assess the size of the given micro-particles (Lycopodium powder) using appropriate experimental techniques.

Experiment 6

Determine the efficiency of a solar cell by experimentally plotting its current-voltage (I–V) characteristics curve.

Experiment 7	
Measure the characteristics of a PN junction diode to determine the energy band gap of the semiconductor material.	
Experiment 8	
Investigate the refractive indices of a glass slab and water by measuring their apparent thickness using a travelling microscope.	
Self-Learning Activity	
NPTEL Course: NOC: Experimental Physics I, Prof. Amal Kumar Das NPTEL link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ph16 **NPTEL Course: NOC:** Experimental Physics II, Prof. Amal Kumar Das NPTEL link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ph06	
Practical	**15 Hours**
Total	**15 Hours**

Text Book:

1. Knight, R. D., "Physics for Scientists and Engineers: A Strategic Approach with Modern Physics," 4th Edition, Pearson, 2017.

Reference:

1. Prakash, I., Ramakrishna, "A Textbook of Practical Physics," 11th Edition, Kitab Mahal, 2011.

26PS108	Physical Science Laboratory - Chemistry	L	T	P	C
		0	0	2	1

Prerequisite	Assessment Pattern		
	CIA	SEE	Total
Atomic structure, Redox reactions	60	40	100

Course Objectives

- Apply suitable instruments and techniques to determine chemical properties of water, metals, and effluents.
- Analyze experimental data to determine concentrations, hardness, acidity, corrosion, adsorption, and electrochemical properties.
- Analyze experimental results using calculations and software to identify chemical behavior and stable structures.

Course Outcomes (COs)

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

1. Apply electrochemical techniques to determine cell EMF, conductivity and concentration of iron present in the given water samples
2. Apply analytical technique to identify the chromium concentration in industrial and environmental samples
3. Apply the principles of surface chemistry and adsorption to assess the adsorption ability of activated charcoal in the removal of heavy metals (such as chromium or nickel) from aqueous solutions
4. Analyze the quality of given water sample by measuring hardness/pH and interpret their suitability for domestic use.
5. Analyze the corrosion in concrete TMT bars and determine Fe^{2+} content in mild steel alloys to evaluate material degradation

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	2	1	-	-	-	2	-	-	1	-	1	-	1
CO 2	2	1	-	-	-	1	-	-	1	-	1	-	1
CO 3	1	2	-	-	-	2	-	-	-	-	1	-	1
CO 4	2	2	-	-	-	1	-	-	1	-	1	-	1
CO 5	2	1	-	-	-	1	-	-	-	-	1	-	2

Module 1 (Any three experiments)
9 Hours
Experiment 1
Construction of a simple electrochemical cell (Cu–Zn) and measurement of its potential.
Experiment 2
Assess the adsorption ability of activated charcoal in heavy metal (chromium/nickel) removal
Experiment 3
Determine the amount of electrolyte present in the industrial effluent by conductometric titration
Experiment 4
Redox titration: Potentiometric Analysis of iron (Fe^{2+}) present in the given water sample using $KMnO_4$
Module 2 (Any two experiments)
Experiment 5
Estimation of Hardness in water sample by EDTA method.
Experiment 6
Determination of acid content by measuring pH (Use pH Meter)
Experiment 7
Evaluate the corrosion percentage in concrete TMT bars.
Experiment 8
Investigate the amount of Iron (Fe^{2+}) in a mild steel alloy sample using a spectrophotometer.
Experiment 9
Visualize the geometry of the given molecule and identify the stable structure using software tools.

Self-Learning	
NPTEL Course: NOC: Water Quality Management Practices, Prof. Gourav Dhar Bhowmick IIT Kharagpur NPTEL link: https://nptel.ac.in/courses/126105335 NPTEL Course: Elementary Electrochemistry, Prof. Angshuman Roy Choudhur, IISER Mohali NPTEL link: https://onlinecourses.nptel.ac.in/noc23_cy19/preview	
Practical	**15 Hours**
Total	**15 Hours**

Textbook:

1. Vogel, A. I., Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson,2009

References:

1. Skoog, West and Holler, Fundamentals of Analytical Chemistry, 10th Edition, 2022
2. Fontana, M. G., Corrosion Engineering, 4th Edition, 2017.

26GE006	C Programming Laboratory	L	T	P	C
		0	0	2	1

Prerequisite	Assessment Pattern		
Fundamental mathematics	CIA	SEE	Total
	60	40	100

Course Objectives

To understand problem solving through flowcharts, pseudocode, and the C compilation process.
To learn to write programs using operators, decision-making, and looping constructs.
To implement programs using arrays, matrices, and string library functions.
To use functions, recursion, pointers, and dynamic memory allocation in programs.
To do file operations in C using structures and unions for real-world applications.

Course Outcomes (COs)

At the end of the course, students will be able to
Apply algorithmic problem-solving techniques and fundamental C programming constructs to develop programs using operators, decision-making and looping constructs.
Develop C programs using arrays, matrices and string processing techniques to manipulate and process data.
Implement modular C programs using functions, recursion, pointers and dynamic memory allocation techniques.
Construct C programs using structures, unions and file handling techniques to manage structured and persistent data.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2			3				1			3	2
CO2	2	2			3				1			3	2
CO3	2	2			3				1			3	2
CO4	2	2			3				1			3	2

Module 1

Experiment 1	**3 Hours**
Problem-solving using flowcharts and pseudocode	
Experiment 2	**3 Hours**
Simple programs using arithmetic, logical, and relational operators.	
Experiment 3	**3 Hours**
Programs using decision-making and looping constructs.	
Experiment 4	**3 Hours**
Programs using arrays and matrices	
Experiment 5	**3 Hours**
String manipulation programs using library functions	

Module 2

Experiment 6	**3 Hours**
Programs with user-defined functions and recursion	
Experiment 7	**3 Hours**
Implementation of pointer-based programs (arrays and functions).	
Experiment 8	**3 Hours**
Dynamic memory allocation programs	
Experiment 9	**3 Hours**
Programs using structures and unions.	
Experiment 10	**3 Hours**
File handling – reading, writing, and updating text/binary files.	
Practical	**30 Hours**
Total	**30 Hours**

References:

Kernighan, B. W. and Ritchie, D. M., The C Programming Language, Prentice Hall, 2nd Edition, USA, 2023.
Schildt, H., C: The Complete Reference, McGraw Hill, Latest Edition, USA, 2018.
Kanetkar, Y. P., Let Us C, BPB Publications, Latest Edition, India, 2025.
Thareja, R., Programming in C, Oxford University Press, Latest Edition, India, 2024.

26MA201	Differential Equations and Transforms	L	T	P	C
		3	1	0	4

Prerequisite	Assessment Pattern		
Linear Algebra and Vectors, Complex Numbers and Basic Algebra, Calculus	CIA	SEE	Total
	40	60	100

Course Objectives:

- Develop proficiency in solving higher-order linear differential equations and applying Fourier and Laplace transforms to engineering problems.
- Understand the fundamental concepts and properties of Fourier, Laplace, and Z-transforms for analyzing continuous and discrete systems.
- Apply transform techniques, particularly Laplace and Z-transforms, to solve ordinary differential equations, initial value problems, and difference equations in practical applications.

Course Outcomes (COs)

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

1. Analyze and solve higher-order linear differential equations with constant coefficients in engineering applications.
2. Apply Fourier Transforms to analyze non-periodic functions in practical applications.
3. Use Laplace Transforms to solve ordinary differential equations and initial value problems.
4. Explain the concept of Z–Transform and its fundamental properties.
5. Determine the solutions of difference equations through Z transforms.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	1	3										2	1
CO 2	2	3										2	1
CO 3	2	3										1	2
CO 4	3	3										2	2
CO 5	1	3										2	2

Module 1

Linear Differential Equations **12 Hours**

Homogeneous linear ordinary differential equations of second order, linearity principle, general solution- Particular integral – Operator method – Solution by variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler–Cauchy and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

Fourier Transforms **10 Hours**

Fourier integral theorem- Fourier transform and inverse Fourier transform- Sine and cosine transforms - Properties - Transforms of simple functions - Convolution theorem – Parseval's identity

Module 2

Laplace Transforms **12 Hours**

Laplace transform: Existence of Laplace transform- Properties of Laplace transform-Laplace transform of periodic function. Inverse Laplace transform: Properties of inverse Laplace transform-Partial fraction method – Initial and final value theorems- Convolution- Application of Laplace transform to solve ordinary differential equations with constant coefficients- Solutions of simultaneous differential equations by Laplace transforms techniques.

Z- Transforms **10 Hours**

Z-Transform - Properties - Inverse Z-transform - Convolution method- Partial fraction method - Initial and final value theorems - Solution of difference equations using Z-transform.

Term Work Activity	
GATE Questions, Quiz, Assignments.	
Self-Learning Activity	
NPTEL Course Linear Differential Equations NPTEL link: https://onlinecourses.nptel.ac.in/noc22_ma72/preview NPTEL Course Transforms NPTEL link: https://nptel.ac.in/courses/111106111	
Theory	**45 Hours**
Tutorial	**15 Hours**
Total	**60 Hours**

Text Books:

1. B.S Grewal, Higher Engineering Mathematics, Khanna Publisher, 45th Edition, 2024.
2. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th edition, 2015.
2. Richard E., Williamson Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies Inc, 1997.
3. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018.
4. George B.Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013.

<table>
<tr><td rowspan="2">26PH202</td><td rowspan="2">Materials Science</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Prerequisite</td><td colspan="3">Assessment Pattern</td></tr>
<tr><td colspan="3" rowspan="2">Understand the concepts of electric charge, current, magnetism, radiation-matter interaction, charged particle behavior and atomic structure of materials.</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Course Objectives:
● Understand the principles of electrostatics, electricity, magnetism, optics, quantum mechanics and solid-state physics.
● Apply the laws of electromagnetism, optics and quantum mechanics to solve basic engineering problems.
● Analyze the electrical, optical, magnetic, and quantum properties of materials and their applications in modern technology.</td></tr>
<tr><td colspan="6">Course Outcomes (COs)
At the end of the course, students will be able to
1. Apply electrostatic principles to determine electric field, potential, and energy in simple charge configurations.
2. Explain the behavior of magnetic materials and apply laws of electromagnetic induction to real-world systems.
3. Analyze and interpret optical phenomena including interference, diffraction and polarization for engineering applications.
4. Interpret and apply quantum principles to explain the microscopic behavior of particles and energy quantization.
5. Relate the electronic and structural properties of semiconductors and modern materials to their technological applications.</td></tr>
</table>

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	2	-	-	-	-	1	-	-	-	-	1	2
CO 2	3	3	-	2	-	-	1	-	-	-	-	2	3
CO 3	3	2	3	2	-	-	1	-	-	-	-	2	2
CO 4	3	3	-	-	2	-	1	-	-	-	-	1	2
CO 5	2	-	3	-	3	-	1	-	-	-	3	3	3

Module 1

Electrostatics **8 Hours**

Electric charge-field-potential. Gauss's law and its applications. Electric flux-field due to charge distributions-line, plane, and sphere. Capacitance and energy storage: parallel plate and spherical capacitors. Dielectric constant-polarization-displacement current.

Current Electricity **8 Hours**

Electric current-drift velocity-mobility-current density. Ohm's law-resistivity temperature dependence of resistance. Kirchhoff's laws and applications in resistive networks. RC circuit – charging and discharging of capacitors-time constant.

Magnetism and Electromagnetic Induction **7 Hours**

Magnetic field: Biot–Savart law-Ampere's circuital law. Classification of magnetic materials-magnetic domains: B–H curve and hysteresis. Faraday's and Lenz's law: Eddy currents and applications. Inductance – self and mutual-transformers and energy in magnetic fields

Module 2

Optics **7 Hours**

Interference: Air wedge-Newton's ring-Michelson interferometer. Diffraction: Single slit-diffraction grating-resolving power. Polarization: Plane-circular-elliptical-applications. Optical fibers: Principle-numerical aperture-applications in communication.

Quantum Mechanics **8 Hours**

Blackbody radiation-photoelectric effect-Compton effect. De-Broglie hypothesis-Davisson–Germer experiment. Schrödinger wave equation – physical interpretation-particle in a one dimensional-box. Quantum tunneling-application in electronic devices.

Solid State and Modern Materials	**7 Hours**
Band theory of solids: Conductors-semiconductors-insulators. Semiconductor: Types-Fermi level and conductivity. Superconductor: Types-properties-applications. Nanomaterials – properties and applications.	
Term Work Activity	
GATE Questions, Quiz, Assignments, Presentations	
Self-Learning	
NPTEL Course: https://nptel.ac.in/courses **NPTEL link:** https://nptel.ac.in/courses/113107078	
Theory	**45 Hours**
Total	**45 Hours**

Text Books:

1. William D. Callister Materials Science and Engineering: An Introduction, 6th Edition, John Wiley & Sons, 2003.

References:

1. Halliday, D. & Resnick, R. Fundamentals of Physics, 12th Edition, John Wiley & Sons, Inc., New Delhi (2021).
2. Verma, H. C. Concepts of Physics Vol. I, Bharati Bhawan Publishers, New Delhi (2022 reprint).
3. Young, H. D. & Freedman, R. A. University Physics with Modern Physics, Global Edition, 15th Edition, Pearson, New Delhi (2024).
4. Tipler, P. A. & Mosca, G. Physics for Scientists and Engineers, 6th Edition, W. H. Freeman & Company / Macmillan, New Delhi (2020).
5. Serway, R. A. & Jewett, J. W. Principles of Physics: A Calculus-Based Text, 5th Edition, Brooks/Cole / Cengage Learning India Pvt. Ltd., New Delhi (2012).
6. Feynman, R. P., Leighton, R. B. & Sands, M. The Feynman Lectures on Physics (Vol. I), New Millennium Edition, Basic Books / Perseus Group, New Delhi (2011).

26ME203 / 26MC203	Engineering Mechanics	L	T	P	C
		3	1	0	4

Prerequisite	Assessment Pattern		
Trigonometry & Linear Algebra	CIA	SEE	Total
Physics Laws	40	60	100

Course Objectives

To provide a comprehensive understanding of engineering mechanics principles for analyzing structures, machines, and mechanical systems.
To solve engineering problems using analytical, energy, and momentum methods.

Course Outcomes (COs)

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

- Apply fundamental principles of mechanics to solve engineering problems involving forces, moments, equilibrium, motion, and energy of physical objects.
- analyze the behaviour of particles, rigid bodies, and structural elements under different loading and motion conditions to arrive at logical and validated conclusions.
- Solve engineering mechanics problems by applying appropriate principles and procedures for analyzing forces, motion, and related properties of particles, rigid bodies, and simple structures.
- Demonstrate professional and ethical responsibility by evaluating real-world engineering incidents where improper application of mechanics principles led to failures, and suggest preventive measures.
- Communicate mechanics-based engineering analyses effectively through diagrams, calculations, and presentations

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1	3											2		
CO 2		3										2		
CO 3			2									2		
CO 4						2	2					2		
CO 5									2		2	2		

Module 1

Force Systems and Equilibrium **6 Hours**

Laws of mechanics - system of forces - resultant of a force system – Lami’s theorem - moment of a force – Varignon’s theorem - resolution of a force into force and couple - force in space - equilibrium of a particle in space.

Support Reactions and Internal Forces **4 Hours**

Beams and types of beams - Simple Trusses - Method of Joints - Method of Sections.

Section Properties **6 Hours**

Centroids - determination by integration - moment of inertia - product of inertia - principal moment of inertia of plane areas - radius of gyration - Mass moment inertia of simple solids.

Friction **7 Hours**

Friction resistance - classification of friction - laws of friction - angle of repose - cone of friction - free body diagram - equilibrium of a body on a rough inclined plane - non concurrent force system - ladder friction - rope friction - wedge friction - virtual work method.	
Module 2	
Kinematics **10 Hours** Equations of motion. Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration. Curvilinear motion of particles - projectiles - angle of projection - range - time of flight and maximum height. Kinematics of rigid bodies. **Kinetics** **12 Hours** Newton's second law of motion – D'Alembert's principle, dynamics equilibrium. Principle of work and energy - work energy equation of particles - law of conservation of energy. Principles of impulse and momentum - equations of momentum - laws of conservation of momentum. Impact - time of compression, restitution, collision - co-efficient of restitution - collision of elastic bodies by direct central impact and oblique impact - collision of a small body with a massive body. Kinetics of rigid body rotation.	
Term Work Activity	
Quiz, GATE Questions, Assignments	
Self-Learning	
Resultant of force - https://javalab.org/en/addition_of_force_en/, Lami's Theorem - https://www.geogebra.org/m/dprezdz6 ,Truss Simulator - https://ei.jhu.edu/truss-simulator/, Beam Analysis - https://beamguru.com/online/beam-calculator/ Centre of Mass - https://www.physicsclassroom.com/interactive/rotation-and-balance/center-of-mass-builder/launch Moment of Inertia - https://javalab.org/en/moment_of_inertia_2_en/ Mass Moment of Inertia - https://javalab.org/en/moment_of_inertia_en/ Friction - https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_all.html Rectilinear Motion - https://phet.colorado.edu/en/simulations/moving-man Projectile Motion - https://phet.colorado.edu/en/simulations/projectile-motion. Newton's Second Law - https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_all.html Work - Energy Principle - https://www.physicsclassroom.com/interactive/work-and-energy/roller-coaster-model/launch Collision - https://phet.colorado.edu/sims/html/collision-lab/latest/collision-lab_all.html	
Theory	**45 Hours**
Tutorial	**15 Hours**
Total	**60 Hours**

Textbooks:

2. Beer F.P and Johnston Jr. E.R, Vector Mechanics for Engineers (In SI Units): Statics and Dynamics, 11th Edition, Tata McGraw Hill Publishing company, New Delhi, 2017.
3. Dubey N. H, Engineering Mechanics: Statics and Dynamics, McGraw Hill Education, 2020.

References:

1. Hibbeller, R.C and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Edition, Pearson Education 2010.
2. Meriam J. L. and Kraige L. G, Engineering Mechanics- Statics - Volume 1, Dynamics Volume 2, 5th Edition, John Wiley & Sons,2006.
3. NPTEL - Engineering Mechanics - https://onlinecourses.nptel.ac.in/noc21_me70/preview
4. Virtual Lab - Mechanics Virtual Lab - https://mech-amrt.vlabs.ac.in/

<table>
<tr><td rowspan="2">26MC204</td><td rowspan="2">Electric Circuit Analysis</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="3">Prerequisite</td><td colspan="3">Assessment Pattern</td></tr>
<tr><td colspan="3" rowspan="2">● Differential equations, complex variables and Laplace transforms
● Physics Laws</td><td>CIA</td><td>SEE</td><td>Total</td></tr>
<tr><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Course Objectives:</td></tr>
<tr><td colspan="6">● To impart the fundamentals of electrical measurements, measuring instruments, calibration techniques, and bridge circuits for accurate parameter measurement.
● To develop the ability to analyze and apply analog, digital, and electronic instruments for industrial electrical measurements and monitoring.
● To provide knowledge of transducers, sensors, oscilloscopes, and data acquisition systems for modern industrial automation applications.</td></tr>
<tr><td colspan="6">Course Outcomes (COs)</td></tr>
<tr><td colspan="6">At the end of the course, students will be able to
1. Apply KCL, KVL, mesh and nodal analysis, and source transformation techniques to solve DC circuits.
2. Analyze the sinusoidal AC circuits using phasor, impedance concepts and determine real, reactive power and power factor correction.
3. Utilize Superposition, Thevenin, Norton, and Maximum Power Transfer theorems to solve DC and AC networks.
4. Evaluate power in single-phase and three-phase balanced AC circuits using wattmeter and two-wattmeter methods.
5. Analyze transient responses and damping behaviors of RL, RC, and RLC circuits using analytical and Laplace techniques.
6. Examine series and parallel resonance, compute Q-factor and bandwidth, and analyze coupled circuit behavior and mutual inductance.</td></tr>
</table>

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	1	1	1
2	2	3	-	-	-	-	-	-	-	-	1	1	2
3	2	3	2	-	-	-	-	-	-	-	2	1	2
4	2	3	2	-	-	-	-	-	-	-	2	2	2
5	2	3	3	-	-	-	-	-	-	-	3	2	2
6	3	3	3	-	-	-	-	-	-	-	3	2	3

Module 1

DC Circuit Fundamentals **9 Hours**

Electrical quantities: Charge, current, voltage, power, energy, Circuit elements: R, L, C, independent and dependent sources, Ohm's Law – Kirchhoff's Laws, Series and Parallel circuits – Equivalent resistance, Mesh and Nodal analysis for DC circuits, Network reduction: Source transformation, Star–Delta conversion.

AC Circuit Analysis **9 Hours**

Sinusoidal source – RMS & Average values, Phasor representation – Impedance & Admittance concepts, R,L,C circuits under sinusoidal excitation, Power triangle: real, reactive, apparent power, Power factor improvement using capacitors. Network Theorems for both AC and DC- Superposition theorem – Thevenin's theorem – Norton's theorem – applications in both the networks.

Network Theorems for DC and AC Circuits **4 Hours**

Maximum power transfer theorem - Reciprocity theorem, Application of theorems to both DC and AC networks - Verification through numerical and simulation-based analysis.

Module 2

Measurement and Interpretation of Power in AC Circuits **5 Hours**

Single-phase and three-phase balanced AC circuits, including star and delta configurations with line and phase relationships. Measurement of electrical power using single wattmeter and two-wattmeter methods under different load and power factor conditions.

Transient Analysis of RL, RC and RLC Circuits **9 Hours**

Initial and final conditions of energy elements - Transient response of RL, RC circuits to DC step input - RLC series circuit: overdamped, underdamped, and critically damped cases - Time constant, natural frequency, and damping factor - Introduction to Laplace Transform for transient response evaluation - Comparison of analytical and simulation-based transient results.

Resonance & Coupled Circuits **9 Hours**

Series Resonance – Resonant frequency, Q factor, Bandwidth, Parallel Resonance – Selectivity, current magnification, dynamic resistance - Voltage and Current magnification, Coupled circuits: Mutual inductance, dot convention, Coefficient of coupling – Equivalent circuits representation of coupled coils - Real-world examples: transformers, inductive sensors, and filters.

Term Work Activity	
GATE Questions, Quiz, Assignments, Presentations, Seminars, Mini Projects, Case-study, Electrical PSkills Level 1 and Level 2.	
Self-Learning Activity	
NPTEL Course: https://nptel.ac.in/courses/117106108 NPTEL link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_ee36	
Theory	**45 Hours**
Total	**45 Hours**

Text Books:

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, 19th edition, Dhanpat Rai and Co, 2022.

References:

1. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press, 2013.
2. Alan Morris, Reza Langari, Measurement and Instrumentation Theory and Application, Elsevier Publications, 2020.
3. H. S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, 3rd edition, 2018.
4. Sergey Yurish, Advances in Measurement and Instrumentation Reviews, IFSA Publishing, 2019.
5. Robert B Northrop, Instrumentation and measurements, Taylor and Francis,2014.
6. D.V.S. Murty, Transducers and Instrumentation, Prentice Hall of India, 2010.

7. Ernest O. Doebelin, Dhanesh N. Manik, Measurement Systems: Application and Design, McGraw-Hill Education, 2017.

26GE007	Python Programming	L	T	P	C
		3	0	0	3

Prerequisite	Assessment Pattern		
Basic understanding of programming paradigms Basic mathematical concepts	CIA	SEE	Total
	40	60	100

Course Objectives

- To understand Python syntax, data types, operators, and control structures for problem solving.
- To learn to use strings and built-in data structures — lists, tuples, sets, dictionaries.
- To define Python functions and apply recursion and modular programming principles.
- To use modules, file operations, exception handling, and object-oriented programming.
- To do data analysis and visualization using NumPy, Pandas, and Matplotlib.

Course Outcomes (COs)

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

1. Apply Python syntax, data types and control structures to develop programs for problem solving.
2. Develop modular Python programs using strings, built-in data structures, functions, and recursion to process and manipulate data.
3. Implement Python programs using modules, file operations, and exception handling to manage data and handle program execution errors.
4. Construct object-oriented Python programs using classes, objects, inheritance, polymorphism, encapsulation, and abstraction to model application entities.
5. Apply NumPy, Pandas, and Matplotlib to perform data processing, analysis, and visualization.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2			3							3	2
CO2	2	2	1		3							3	2
CO3	2	2	1		3							3	2
CO4	2	2	2		3					1		3	2
CO5	3	2	2	2	3					1	1	3	2

Module 1

Python Fundamentals **8 Hours**

Introduction to Python: features, versions, IDEs, interpreter and script mode – Syntax, indentation, identifiers and comments – Variables, constants and basic data types – Type conversions – Expressions and operators – Evaluation order – Input and output operations.

Control Structures and Strings **6 Hours**

Conditional statements: if, if–else, elif, nested conditions – Looping constructs: for, while, nested loops – Loop control statements: break, continue, pass – String creation, indexing, slicing and formatting – Common string methods.

Data Structures and Functions **9 Hours**

Lists, tuples, sets, and dictionaries – creation, indexing, slicing, and operations - Built-in methods and comprehensions (list, set, dictionary) Functions: Function definition, parameters, return values- Function

Arguments: Default and keyword arguments Scope and Lifetime of Variables- Recursion and Modular Programming Principles.

Module 2

File Handling and Exception Management **7 Hours**

Modules and packages – creation and import of built-in and user-defined modules – File operations (open, read, write, append) – Working with text and CSV files – Context managers (with statement) – Exception handling using try, except, else, finally, raise – User-defined exceptions.

Object-Oriented Programming **7 Hours**

Classes and objects – attributes and methods – Constructors (__init__) and destructors – Instance and class variables – Basics of inheritance and polymorphism – Encapsulation and abstraction – Simple OOP applications.

Numerical and Data Analysis with Visualization **8 Hours**

Introduction to NumPy arrays and operations – Introduction to Pandas (Series and DataFrame) – Data import/export (CSV, Excel) – Data selection, filtering, cleaning, and aggregation – Data visualization using Matplotlib (line, bar, scatter plots) with chart customization – Integration of NumPy and Pandas for analysis and visualization.

Term Work Activity	
Micro projects, PS Assessment, Programming Assignments.	
Self-Learning Activity	
SWAYAM / NPTEL: Dr. RizwanRehman, Programming in Python, Dibrugarh University, https://onlinecourses.swayam2.ac.in/cec22_cs20/preview	
Theory	**45 Hours**
Total	**45 Hours**

Text Book:

1. Thareja, R., Python Programming using Problem Solving Approach, Oxford University Press, 2nd Edition, New Delhi, 2019.

References:

1. McKinney, W., Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, O'Reilly Media, 3rd Edition, Sebastopol, 2022.
2. Lutz, M., Learning Python, O'Reilly Media, 5th Edition, Sebastopol, 2013.
3. Matthes, E., Python Crash Course: A Hands-On, Project-Based Introduction to Programming, No Starch Press, 2nd Edition, San Francisco, 2019.
4. Vasiliev, Y., Python for Data Science: A Hands-On Introduction, No Starch Press, 1st Edition, San Francisco, 2022.
5. VanderPlas, J., Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, 1st Edition, Sebastopol, 2016.
6. Severance, C., Python for Everybody: Exploring Data Using Python 3, CreateSpace Independent Publishing, 1st Edition, Michigan, 2016.
7. Chen, D.Y., Pandas for Everyone: Python Data Analysis, Addison-Wesley Professional, 1st Edition, Boston, 2018.
8. Arora, S. and Deore, P., Hands-On Data Analysis with NumPy and Pandas, Packt Publishing, 1st

Edition, Birmingham, 2019.

26HS004	PROFESSIONAL COMMUNICATION	L	T	P	C
		1	0	2	2

Prerequisite	Assessment Pattern		
Basic Communication & Writing skill	CIA	SEE	Total
	50	50	100

Course Objectives

1. Develop students' professional communication skills using clear, accurate, and error-free English.
2. Enhance students' ability to communicate effectively through descriptive and narrative forms.
3. Develop students' ability to use English appropriately in business and professional contexts.

Course Outcomes (COs)

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

1.Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1									2	3	2		
CO 2									2	3	2		
CO 3									2	3	2		
CO 4									2	3	2		

Articulation Matrix

Module 1

Effective Communication **5 Hours**

Listening – conversations, advertisements, expert talks – Speaking – real-life conversations, greetings, telephonic communication – Reading – short stories, articles, autobiographies – Writing – autobiographical writing, blogs, summaries, checklists – Language Development – subject-verb agreement, commonly confused words, reported speech, idiomatic expressions.

Module 2

Formal and Technical Expression **5 Hours**

Listening – podcasts, documentaries – Speaking – oral presentation with visuals, expressing opinions, debates, group discussions – Reading – biographies, travelogues, innovations – Writing – reports, agenda and minutes, formal letters, proposals, job application and resume – Language Development – cause & effect expressions, degrees of comparison, acronyms and abbreviations.

Career Competencies **5 Hours**

Listening – expert and technical talks, recommendations and solutions – Speaking – debates, GDs, professional presentations – Reading – analytical reading of reports and articles – Writing – proposals.

Practical	30 Hours
Listening Listen to real-life talks, ads, or expert speeches and summarize key ideas, tone, and purpose. Summarize podcasts or documentaries on innovation and social issues, focusing on theme and tone. Summarize expert talks, webinars, or panel discussions highlighting key insights and practical takeaways. **Speaking** Practice greetings, introductions, and telephonic role plays using correct etiquette and clarity. Deliver presentations and join debates or discussions using formal communication. Deliver professional presentations and participate in debates or GDs on industry or ethical topics. Reading Read short stories or articles to identify main ideas, tone, and writer's perspective. Analyze biographies or articles for key ideas, tone, and cause–effect links. Analyze technical reports or journal articles for key arguments, data, and recommendations. **Writing** Compose short autobiographies, blog posts, summaries, or checklists based on given topics. Draft reports, proposals, and job applications with clarity and structure. Prepare proposals, technical reports, formal emails, resumes, and cover letters. **Language Development** Reinforce grammar, vocabulary and idiomatic usage through quizzes and practice exercises. Practice grammar, connectors, comparisons, and workplace vocabulary Practice verbal analogies, phrasal verbs, and vocabulary through quizzes and games	
Term Work Activity	
Role Play, Mind Maping, Data Conversion, Poster Interpretation, JAM (Just a Minute)	
Self-Learning Activity	
MOOCs: Online NPTEL English or communication course. **NPTEL link**: https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed67 **MOOC**: NPTEL course on Business Communication or English; submit certificate	

or 150-word summary. **NPTEL link:** https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg128 **MOOC**: NPTELcourse on Professional Communication or Workplace English; submit certificate or 150-word reflection. **NPTEL link: https://onlinecourses.nptel.ac.in/noc26_hs25/preview** **TED Talk Analysis:** Summarize key lessons from a biography or travelogue. **Review:** Draft a report or business letter with proper tone and format. **Review**: Summarize a career-related article or success story (150 words). **Writing**: Draft a formal email, proposal, or report using workplace tone. **Career Task**: Update your LinkedIn profile with skills and certifications; share reflections in class.	
Theory	**15 Hours**
Practical	**30 Hours**
Total	**45 Hours**

Textbooks:

1. Raman, Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford University Press.
2. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.

References:

1. Raman, Meenakshi, Sharma, Sangeeta. Technical Communication. Principles and Practice. Oxford University Press, New Delhi, 2014.
2. Muralikrishnan & Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamil Nadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
3. Vesilind Aarne P., Public Speaking and Writing Skills for Engineering Students (2nd Ed), Lakeshore press, 2007
4. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

26HS005	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

Prerequisite	Assessment Pattern		
Understanding of Indian and Regional History/Culture	CIA	SEE	Total
	40	60	100

Course Objectives

Analyze digital preservation: Evaluate how Tamil computing, digital archives, and language tools preserve cultural heritage.
Examine modern tech adoption: Investigate how Tamil communities worldwide use social media, software, and AI to collaborate.

Course Outcomes (COs)

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

1. Analyze the techniques and significance of weaving and ceramic technologies (like Black and Red Ware) of the Sangam Age, including the interpretation of graffiti on potteries.
2. Describe and differentiate the design and construction technologies used in ancient Tamil Nadu, ranging from Sangam-era houses and hero stones to the structural details of temples (e.g., Mamallapuram, Chola, Nayaka) and their evolution through various periods (including Chettinadu and Indo-Saracenic architecture).
3. Explain the manufacturing processes related to key industries, specifically the art of ship building, various metallurgical practices (iron smelting, steel, copper/gold minting), and the diverse technologies used in bead-making (stone, glass, terracotta, shell).
4. Evaluate archaeological and literary evidence (like *Silappathikaram*) as primary sources for reconstructing and understanding the technological, trade, and economic landscape of ancient and medieval Tamil society.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1	3		2				2			2				
CO 2	3	2	2	3	3	3	2			2				
CO 3	3	2	2							2	3			
CO 4	3	2	2							2				
CO 5	3	2			3	3	2			2	3			

Module 1

Weaving and Ceramic Technology **3 Hours**

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

DESIGN AND CONSTRUCTION TECHNOLOGY **3 Hours**

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

MANUFACTURING TECHNOLOGY **3 Hours**

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

Module 2

AGRICULTURE AND IRRIGATION TECHNOLOGY **3 Hours**

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

SCIENTIFIC TAMIL & TAMIL COMPUTING **3 Hours**

Development of Tamil language in the fields of science and technology – Emergence of scientific terminology in Tamil – Contributions of scholars and institutions in promoting Scientific Tamil – Tamil computing and digital evolution – Unicode development, Tamil typing systems, and digital archives – Government and institutional initiatives such as Sorkuvai for preserving and promoting Tamil in the digital era.

Term Work Activity	
Assignments, Case Study	
Theory	**15 Hours**
Total	**15 Hours**

Textbooks:

1. TAMILS AND TECHNOLOGY-Dr.A.Boobalan VRB PUBLISHERS PVT LTD,6/50,Venkatesa Nagar 1 st street,Virukambakkam, Chennai-600 092.

References:

- Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

- Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
- Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
- The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
- Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporate Tamil Nadu)
  Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

26GE008	Python Programming Laboratory	L	T	P	C
		0	0	2	1

Prerequisite	Assessment Pattern		
Fundamental mathematics	CIA	SEE	Total
	60	40	100

Course Objectives:

- To understand Python syntax, operators, and control statements for problem solving.
- To learn to use strings, lists, tuples, sets, and dictionaries to represent data.
- To define Python functions and build modular programs using classes and inheritance.
- To use file handling and exception handling for structured program development.
- To do numerical analysis and visualization using NumPy, Pandas, and Matplotlib.

Course Outcomes (COs)

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

1. Apply Python syntax, operators, control structures, and input/output constructs to develop programs for solving computational problems.
2. Develop Python programs using strings and built-in data structures such as lists, tuples, sets, and dictionaries to store and manipulate data.
3. Implement modular and robust Python programs using functions, recursion, file handling, and exception handling techniques.
4. Construct Python programs using classes, objects, and inheritance to implement object-oriented solutions.
5. Apply NumPy, Pandas, and Matplotlib to perform numerical computation, data processing, and visualization.

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2			3				1		1	3	2
CO2	2	2			3				1		1	3	2
CO3	2	2			3				1		1	3	2
CO4	2	2	1		3				1		1	3	2
CO5	3	2	1	1	3				1		2	3	2

Module 1

Experiment 1	**3 Hours**
Writing and executing Python programs using expressions, operators, and control statements.	
Experiment 2	**3 Hours**
Programs involving loops, conditional statements, and user input.	
Experiment 3	**3 Hours**
String operations and formatted output programs.	
Experiment 4	**3 Hours**
Programs using lists, tuples, sets, and dictionaries.	
Experiment 5	**3 Hours**

Function-based programs – recursion, modular code, and argument passing.	
Module 2	
Experiment 6	**3 Hours**
File operations – reading, writing, and processing text and CSV files.	
Experiment 7	**3 Hours**
Exception handling programs with user-defined exceptions.	
Experiment 8	**3 Hours**
Programs using classes, objects, and inheritance.	
Experiment 9	**3 Hours**
Numerical computation and data analysis using NumPy and Pandas.	
Experiment 10	**3 Hours**
Visualization of data using Matplotlib (line, bar, scatter plots).	
Practical	**30 Hours**
Total	**30 Hours**

References:

1. McKinney, W., Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter, O'Reilly Media, 3rd Edition, Sebastopol, 2022.
2. Thareja, R., Python Programming using Problem Solving Approach, Oxford University Press, 2nd Edition, New Delhi, 2021.
3. Lutz, M., *Learning Python*, O'Reilly Media, 5th Edition, Sebastopol, 2013.
4. Matthes, E., *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*, No Starch Press, 2nd Edition, San Francisco, 2019.
5. Vasiliev, Y., Python for Data Science: A Hands-On Introduction, No Starch Press, 1st Edition, San Francisco, 2022.
6. VanderPlas, J., Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, 1st Edition, Sebastopol, 2016. Severance, C., Python for Everybody: Exploring Data Using Python 3, CreateSpace Independent Publishing, 1st Edition, Michigan, 2016.
7. Chen, D.Y., Pandas for Everyone: Python Data Analysis, Addison-Wesley Professional, 1st Edition, Boston, 2018.
8. Arora, S. and Deore, P., Hands-On Data Analysis with NumPy and Pandas, Packt Publishing, 1st Edition, Birmingham, 2019

26GE009	Engineering Drawing	L	T	P	C
		1	0	2	2

Prerequisite	Assessment Pattern		
Algebra; Geometry Construction	CIA	SEE	Total
	60	40	100

Course Objectives

- To impart knowledge on dimensions and drawing standards.
- To explore the orthographic projection of lines and solids.
- To provide the understanding of orthographic, isometric and perspective views

Course Outcomes (COs)

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

- Understand the standards and conventions used in Engineering drawing
- Apply the concepts of projections in formulating various solid parts in engineering systems.
- Analyze the various view and interpret the engineering drawings.
- Demonstrate lifelong learning and adaptability by utilizing modern techniques and digital tools to improve engineering drawing skills

Articulation Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1												2		
CO 2	3											2		
CO 3		3										2		
CO 4					2						2	2		

Module 1

Fundamentals **6 Hours**

Engineering Drawing standards (SP 46), usage of drawing instruments, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings

Construction of Curves **8 Hours**

Regular Polygons. Conic curves with their tangent and normal – ellipse, parabola, and hyperbola by eccentricity method.

Projections of Points, Lines and Solids **8 Hours**

Principles and conventions of Orthographic Projections. Projections of Points and lines inclined to both planes. Projections of Regular Solids - Parallel, perpendicular, inclined to one plane using change of position method and inclined to both the planes.

Module 2

Section of Solids **8 Hours**

Simple and hollow solids with true shape of section – Prisms, Pyramids and Axisymmetric solids. Cutting plane parallel, perpendicular and inclined to one plane

Development of Surfaces **8 Hours**

Regular and Truncated Solids - Prism, Pyramid, Cylinder and Cone

Orthographic and Isometric Projections **7 Hours**

Orthographic projections and isometric view of components used in engineering applications.	
Term Work Activity	
Quiz on Drawing Standards, Drawing Assignments, Product Drawing Recreation, Assembly Drawing.	
Self-Learning	
Virtual Labs - https://eg-nitk.vlabs.ac.in/ and https://eg-dei.vlabs.ac.in/	
Theory	**15 Hours**
Practical	**30 Hours**
Total	**45 Hours**

Text Books:

- N.D. Bhatt and V.M. Panchal, Engineering Drawing, 55th Edition, Charotar Publishing house Pvt. Ltd, Gujarat, 2024
- K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2023.

References:

1. Frederick E. Giesecke et al., Technical Drawing with Engineering Graphics, 16th Edition, Peachpit Press, 2023.
2. K. Venugopal, Engineering Drawing and Graphics, 5th Edition, New Age International Pvt Ltd, 2024.
3. Virtual Labs - https://eg-nitk.vlabs.ac.in/ and https://eg-dei.vlabs.ac.in/
4. NPTEL Course - Engineering Drawing and Engineering Graphics and Design