JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
JALPAIGURI- 735102
(An Autonomous Government College)

COURSE STRUCTURE AND SYLLABUS / CURRICULLAM
FOR
B.TECH. IN CE/EE/ME/CSE/ECE/IT
(First year only)
(Implemented from the Academic Year 2026-27 for the new batch only)

www.jgec.ac.in
Phone:03561–255131(Principal), Fax:03561–256143

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
(an Autonomous Government College)
Jalpaiguri, West Bengal -735102
MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

DETAILED SYLLABUS

First Year — Semesters I and II

Common to all Bachelor of Technology programs of the College (JGEC)

Prepared against the NEP 2020 Compliant Curriculum Structure for the First Year as revised and adopted by the College (Effective from Academic Year 2026–27)

Outcome-Based · NEP 2020 · NAAC and NBA Aligned

Subjects cycle rotated across the two semesters in group: (Group-A: CE,EE,ME & Group-B: CSE,ECE,IT)

Part I — The Outcome-Based Framework

I.1 The eleven Programme Outcomes (NBA GAPC v4.0)

The National Board of Accreditation, under its updated GAPC v4.0 framework aligned with the Washington Accord, defines eleven Programme Outcomes for undergraduate engineering, consolidating the former twelve by merging the societal and environmental attributes into a single outcome. These eleven are adopted as the Programme Outcomes of every B.Tech. programme of the University and are used in the articulation matrices of this document.

PO	Attribute	What the graduate is expected to be able to do
PO1	Engineering Knowledge	Apply mathematics, science, computing and engineering fundamentals to solve complex engineering problems.
PO2	Problem Analysis	Identify, formulate and analyse complex engineering problems to reach substantiated conclusions.
PO3	Design / Development of Solutions	Design systems, components or processes that meet specified needs with due regard for public safety and cultural, societal and environmental factors.
PO4	Conduct Investigations of Complex Problems	Use research-based methods — design of experiment, analysis and interpretation of data — to reach valid conclusions.
PO5	Engineering Tool Usage	Select and apply modern engineering and information-technology tools to complex activities, with an understanding of their limitations.
PO6	The Engineer and the World	Assess the global, societal, health, safety, legal, cultural and environmental impacts of engineering practice (the former society and environment outcomes, merged).
PO7	Ethics	Apply professional ethics, human values, and the principles of diversity and inclusion.
PO8	Individual and Collaborative Team Work	Function effectively as an individual and as a member or leader of diverse teams.
PO9	Communication	Communicate clearly and inclusively with the engineering community and with society.
PO10	Project Management and Finance	Apply engineering-management and economic decision-making principles to projects.
PO11	Life-Long Learning	Recognise the need for, and have the ability to engage in, independent and life-long learning.

Programme Specific Outcomes are framed by each Department for its own programme; since these courses are common to all programmes, no PSO mapping is given here.

I.2 Mapping from the former twelve outcomes

For the reader familiar with the earlier twelve-outcome model, the correspondence is as follows, so that an existing mapping can be migrated without loss.

Former (12 PO) model	New (11 PO) model — GAPC v4.0
PO1 Engineering Knowledge	PO1 Engineering Knowledge
PO2 Problem Analysis	PO2 Problem Analysis
PO3 Design / Development of Solutions	PO3 Design / Development of Solutions
PO4 Conduct Investigations	PO4 Conduct Investigations of Complex Problems
PO5 Modern Tool Usage	PO5 Engineering Tool Usage
PO6 The Engineer and Society + PO7 Environment and Sustainability	PO6 The Engineer and the World (the two merged)
PO8 Ethics	PO7 Ethics (now including human values, diversity and inclusion)
PO9 Individual and Team Work	PO8 Individual and Collaborative Team Work
PO10 Communication	PO9 Communication
PO11 Project Management and Finance	PO10 Project Management and Finance
PO12 Life-Long Learning	PO11 Life-Long Learning

I.3 Levels of the revised Bloom taxonomy

Level	Verb family	What the student is asked to do in the first year
L1 – Remember	define, state, list, recall	Reproduce a definition, a law or a standard value. Group A of the paper and the online test.
L2 – Understand	explain, describe, classify	Explain a principle or interpret a diagram or curve. Groups A and B.
L3 – Apply	compute, solve, use	Work a problem or a procedure by an established method. Groups B and C, and the practical work.
L4 – Analyse	derive, compare, distinguish	Break a problem into parts, derive a result, or compare alternatives. Group C.
L5 – Evaluate	assess, justify, select	Choose between options against criteria and defend the choice. Group C and the case-based courses.
L6 – Create	design, formulate, construct	Reached in the first year chiefly in the design and modelling of Graphics and in later project work.

I.4 The articulation convention and the computation of attainment

The correlation between a Course Outcome and a Programme Outcome is recorded at three levels — 3 substantial, 2 moderate, 1 slight, and a dash for none — the mapping being at the level of the Course Outcome, so that attainment can be traced to an examination question or a laboratory task. A level of 3 is entered only where a question or task in this course could by itself furnish evidence of that outcome.

Attainment is computed for each Course Outcome from direct evidence (the marks on the questions and tasks mapped to it) and indirect evidence (an outcome-based student feedback instrument) in the ratio of eighty to twenty.

Attainment level	Criterion (direct)	Action required
Level 3 — attained	Not less than 70 % of the class secures 60 % or more of the marks mapped to the outcome	Record and maintain.
Level 2 — partly attained	Between 55 % and 70 % of the class does so	The teacher records a corrective action.
Level 1 — not attained	Fewer than 55 % of the class does so	The Department reviews delivery, prerequisite provision and question setting.

The thresholds are indicative and are placed before the Board for adoption; whichever are adopted must be applied uniformly, since the online end-semester continuous assessment is common to all colleges.

Part II — The Bridge from Class XII

The largest single cause of first-year failure is the discontinuity between what the school syllabus taught and what the first-year course assumes. This Part states the assumption course by course and provides for the gap.

Course	Assumed from the school syllabus	Board reference	Provision where absent
Mathematics I & II	Calculus, matrices, vectors, complex numbers, first-order ODEs	CBSE XII Units II–IV, IX; WBCHSE; ISC	Ten-hour non-credit bridge in the first three weeks, recorded in the WCA
Physics	Oscillations and waves; optics; electricity and magnetism; modern physics	CBSE XI–XII; WBCHSE; ISC	Module I begins from the differential equation of SHM; earlier material revised in two hours
Chemistry	Atomic structure and bonding; thermodynamics, equilibrium, electrochemistry; organic chemistry	CBSE XI–XII; WBCHSE; ISC	Three-hour bridge for students without Class XII Chemistry
Biology for Engineers	General science of Class X; Higher Secondary Biology where taken	WBBSE / CBSE / ICSE X; CBSE XII Biology	Module I is self-contained and supplies what a student without Class XII Biology requires
Basic Electrical & Electronics	Ohm's and Kirchhoff's laws; AC and the LCR circuit; diode, transistor and gates	CBSE XII Units II–IV, IX–XI; WBCHSE; ISC	Mesh and nodal methods taught from first principles; safety and wiring assume nothing
Programming & Introduction to AI	Computer Science / Informatics Practices where taken; otherwise nothing	CBSE XI–XII; WBCHSE Computer Application	No programming or AI assumed; Modules I–II compressed where the class has programmed
English / Language Lab	English of the Class XII course	WBCHSE / CBSE / ISC English	A first-week diagnostic places students in graded groups
Graphics & Workshop	Plane and solid geometry; 3-D coordinate geometry	WBBSE / CBSE / ICSE; CBSE XII Unit IV	No prior drawing or workshop experience assumed; each begins from the standard and the safety induction
Environmental Science; IKS; Constitution	General science, geography and civics of Class X	WBBSE / CBSE / ICSE	Self-contained; no prior study, and no Sanskrit, assumed

Three provisions apply across the first year. The Mathematics bridge is conducted for the whole class; the English diagnostic is used for placement and not for marks; and the Department is to identify the students at risk within the first three weeks and place them in the remedial and mentoring arrangement required under NAAC Criterion 2.2.

Group-A: CSE/ECE/IT **Group-B: CE/EE/ME**

III.1 Semester I

3 Weeks Induction Program with Universal Human Values							
First Year First Semester							
Sl. No.	**Category**	**Course Code**	**Course Name**	**Total No. of contact hours**			**Credits**
				L	**T**	**P**	
Theory							
1	Basic Science course	BS-M101	Mathematics –I (All Branches)	3	0	0	3
2	Basic Science course	BS-PH101/ BS-CH101	Physics (CE/EE/ME) / Chemistry(CSE/ECE/IT)	3	0	0	3
3	Engineering Science Course	ES-CS101	Programming for Problem Solving (CE/EE/ME) /	3	0	0	3
		ES-EE101	Basic Electrical and Electronics Engineering (CSE/ECE/IT)	3	1	0	4
4	Ability Enhancement Course	AEC-101	English for Communication Skills (CE/EE/ME) /	2	0	0	2
	Basic Science course	BS-BI101	Biology for Engineers (CSE/ ECE/IT)	2	0	0	2
	Total Theory: CSE/ECE/IT			**11**	**1**	**0**	**12**
	CE/EE/ME			**11**	**0**	**0**	**11**
Practical/ Sessional							
1	Basic Science course	BS-PH191/ BS-CH191	Physics Lab(CE/EE/ME)/ Chemistry Lab (CSE/ECE/IT)	0	0	3	1.5
2	Engineering Science Courses	ES-ME191/ ES-ME192	Engineering Graphics & Design .(CSE/ECE/IT) / Workshop Practice(CE/EE/ME)	0	0	4	2
3	Engineering Science Course	ES-CS191	Programming for Problem Solving Lab.(CE/EE/ME) /	0	0	4	2
		ES-EE191	Basic Electrical and Electronics Engineering Lab.(CSE/ECE/IT)	0	0	3	1.5
4	Value Added Course	VAC-181	NCC / NSS / Yoga and Sports (All Branches)	0	0	4	2
5	Skill Enhancement Course	SEC-181	MOOCs (SWAYM Plus/ Future Skills Prime) or any other practical skills, hands on training, soft skills etc. offered by the Institute/ University (All Branches)	0	0	2	1
	Total Theory: CSE/ECE/IT			**0**	**0**	**17**	**8**
	CE/EE/ME			**0**	**0**	**18**	**8.5**
Mandatory courses (Non-credit)							
1	Value Added Course	MC-181/ MC-182	Indian Knowledge System (CE/EE/ME) /Indian Constitution.(CSE/ECE/IT)	**2**	**0**	**0**	**NC**
Total of First Semester: *CSE/ECE/IT*							**20**
CE/EE/ME							**19.5**
First Year Second Semester							

Sl. No.	Category	Course Code	Course Name	Total No. of contact hours			Credits
				L	T	P	
Theory							
1	Basic Science course	BS-M201	Mathematics –II (All Branches)	3	0	0	3
2	Ability Enhancement Course	AEC-201	English for Communication Skills(CSE/ ECE/IT) /	2	0	0	2
	Basic Science course	BS-BI201	Biology for Engineers (CE/EE/ME)	2	0	0	2
3	Basic Science course	BS-PH201/ BS-CH201	Physics (CSE/ECE/IT) / Chemistry(CE/EE/ME)	3	0	0	3
4	Engineering Science Courses	ES-CS201	Programming for Problem Solving(CSE/ECE/IT) /	3	0	0	3
		ES-EE201	Basic Electrical and Electronics Engineering (CE/EE/ME)	3	1	0	4
5	Value Added Course	VAC-201	Environmental Science (All Branches)	3	0	0	3
	Total Theory: CSE/ECE/IT			**14**	**0**	**0**	**14**
	CE/EE/ME			**14**	**1**	**0**	**15**
Practical/ Sessional							
1	Basic Science course	BS-PH291/ BS-CH291	Physics Lab(CSE/ECE/IT) Chemistry Lab. (CE/EE/ME)/	0	0	3	1.5
2	Engineering Science Courses	ES-CS291 /ES-EE291	Programming for Problem Solving Lab.(CSE/ECE/IT) /	0	0	4	2
			Basic Electrical and Electronics Engineering Lab(CE/EE/ME)	0	0	3	1.5
3	Engineering Science Courses	ES-ME291/ ES-ME292	Engineering Graphics & Design (CE/EE/ME) / Workshop Practice (CSE/ECE/IT)	0	0	4	2
4	Ability Enhancement Course	AEC-291	Language Lab. (All Branches)	0	0	2	1
5	Ability Enhancement Course	AEC-281	Essentials for Professional Skills (All Branches)	0	0	3	1.5
6	Skill Enhancement Course	SEC-282	MOOCs (SWAYM Plus/ Future Skills Prime) or any other practical skills, hands on training, soft skills etc. offered by the Institute/ University (All Branches)	0	0	4	2
	Total Theory: CSE/ECE/IT			**0**	**0**	**20**	**10**
	CE/EE/ME			**0**	**0**	**19**	**9.5**
Mandatory courses (Non-credit)							
1	Value Added Course	MC-281/ MC-282	Indian Knowledge System .(CSE/ECE/IT) / Indian Constitution (CE/EE/ME)	**2**	**0**	**0**	**NC**
(Optional) Mandatory for exit with UG certificate		Students exiting the program will be awarded a UG Certificate in the relevant Discipline /Subject provided they qualify all papers of 1st and 2nd semester and secure 4 credits in work-based vocational courses offered during the summer term or internship / Apprenticeship in addition to credits from skill-based courses earned during the first and second semester					4*
Total of Second Semester: *CSE/ECE/IT*							**24/28***
CE/EE/ME							**24.5/28.5***

Part IV — Detailed Syllabi: Theory Courses

The four theory courses follow, in the order in which they appear in the structure. Each carries a header block, prerequisites mapped to the school syllabus, objectives, Course Outcomes with Bloom levels, the eleven-column CO–PO matrix, the module-wise course plan with hours, cross-cutting notes, texts, suggested SWAYAM / NPTEL resources, the assessment map, and question-paper notes.

26-BS-M101 — Mathematics – I

Course Code	26-BS-M101	**Category**	Basic Science Course
Course Title	Mathematics – I	**L – T – P**	3 – 0 – 0
Credits	3	**Contact Hours**	36
Semester	First	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

The course builds on the Higher Secondary Mathematics of WBCHSE, CBSE or ISC. Being a first-semester course it is scoped a little lighter, since admission to the first year is habitually late and the effective teaching window is shorter than the calendar suggests. The following are assumed:

- Differentiation and integration of elementary functions; the idea of a limit and of continuity (CBSE XII Units III–IV; WBCHSE Class XII; ISC).
- Matrices and determinants to the third order and the solution of a linear system (CBSE XII Unit III).
- Vectors in two and three dimensions (CBSE XII Unit IV) and complex numbers in algebraic and polar form (CBSE XI).
- A ten-hour bridge is conducted for the whole class in the first three weeks, re-establishing differentiation, integration and the standard notation; it is recorded in the whole-semester component and is not separately credited.

Course Objectives

- To establish the differential and integral calculus of one and several variables as the working language of engineering analysis.
- To develop competence in the matrix and eigenvalue methods that underlie later courses across every branch.
- To introduce the convergence of sequences and series as the basis of approximation.
- To do so on a common, branch-neutral footing, leaving discipline-specific mathematics to Semester III.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply the differential calculus of one and several variables, including partial differentiation, to engineering functions.	L3 – Apply
CO2	Evaluate definite, improper and multiple integrals and use them to compute area, volume and average value.	L3 – Apply
CO3	Apply matrix methods — rank, the solution of linear systems, eigenvalues and eigenvectors — to engineering problems.	L3 – Apply
CO4	Test an infinite series for convergence and construct elementary power-series approximations.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1	–	–	–	–	–	1
CO2	3	2	1	1	1	–	–	–	–	–	1
CO3	3	3	2	1	2	–	–	–	–	–	1
CO4	3	2	1	1	1	–	–	–	–	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Calculus of a Single Variable	Review in brief of limits, continuity and differentiation; successive differentiation and Leibnitz's theorem; Rolle's and the mean-value theorems; Taylor's and Maclaurin's series with elementary applications; maxima and minima of a function of one variable; definite and improper integrals and the reduction formulae in outline.	9
II	Calculus of Several Variables	Functions of two and more variables; partial derivatives; the total differential and its use in error estimation; the chain rule; Euler's theorem on homogeneous functions; maxima and minima of a function of two variables and the method of Lagrange multipliers in outline.	9
III	Multiple Integrals	Double integrals in Cartesian and polar coordinates; change of order of integration; computation of area and volume; the idea of the triple integral.	8
IV	Matrices and Linear Algebra	Rank of a matrix by elementary transformation; consistency and solution of a linear system; eigenvalues and eigenvectors; the Cayley–Hamilton theorem and its use; diagonalisation in outline. The linear-algebra content is generic; discipline-specific extensions are left to Mathematics-III.	10

Cross-cutting notes. This is a generic mathematics course, common to every branch of the University; it deliberately carries no discipline-specific material. Where a programme requires mathematics particular to it — discrete structures and graph theory for the computing branches, additional transforms and complex analysis for the electronics and electrical branches, additional statistics and numerical methods for the others — that requirement is to be met either in Mathematics-III in Semester III, which each Department frames for its own programme, or in Module I of the relevant discipline course where it is small enough to be carried there. The first-year mathematics is thus kept uniform, so that the common first-year examination and inter-branch mobility are preserved.

Text and Reference Books

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- Erwin Kreyszig, Advanced Engineering Mathematics, Wiley.
- G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Pearson.
- N. P. Bali and M. Goyal, A Textbook of Engineering Mathematics, Laxmi Publications.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Engineering Mathematics I (Prof. Jitendra Kumar, IIT Kharagpur), 12 weeks.
- NPTEL — Multivariable Calculus, 12 weeks.
- NPTEL — Matrix Analysis with Applications / Linear Algebra, 12 weeks.
- SWAYAM — Mathematics I (AICTE / SWAYAM), as offered.

Question-paper note. The paper is predominantly a problem paper: at least two-thirds of the marks of Groups B and C are for the working of problems, not for statement of theory. No question draws on discipline-specific material, since the class is common to all branches.

26-BS-PH101 /201— Physics

Course Code	26-BS-PH101		Basic Science Course
Course Title	Physics	**L – T – P**	3 – 0 – 0
Credits	3	**Contact Hours**	36
Semester	First or Second (by group)	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

Builds on the Higher Secondary Physics of WBCHSE, CBSE or ISC. Under the group rotation it is taken in one semester by one group and in the other by the second; the syllabus is identical. Assumed:

- Oscillations, waves and the elements of optics (CBSE XI Units VII, X; WBCHSE; ISC).
- Electrostatics, current electricity and magnetism (CBSE XII Units I–IV).
- The elements of modern physics — the photoelectric effect and the Bohr atom (CBSE XII Units VIII–IX).
- Calculus to the level of Mathematics-I, taken concurrently.

Course Objectives

- To establish the physics of oscillations and waves as the basis of much of engineering.
- To develop the electromagnetic theory and the wave picture of light used across the branches.
- To introduce quantum and solid-state physics as the foundation of modern devices.
- To connect each principle to an engineering application and to laboratory measurement.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply the theory of simple harmonic, damped and forced oscillations and of waves to physical systems.	L3 – Apply
CO2	Apply the principles of interference, diffraction and polarisation to optical phenomena and instruments.	L3 – Apply
CO3	Apply the laws of electromagnetism, including Maxwell's equations in outline, to fields and waves.	L3 – Apply
CO4	Apply the elements of quantum and solid-state physics to the behaviour of materials and devices.	L4 – Analyse
CO5	Relate the theory to measurement, estimating the uncertainty of a physical quantity determined in the laboratory.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1	–	–	–	–	–	1
CO2	3	2	1	2	1	–	–	–	–	–	1
CO3	3	3	2	2	2	1	1	–	–	–	1
CO4	3	2	2	2	2	1	1	–	–	–	2
CO5	3	2	1	3	2	–	–	1	1	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Oscillations and Waves	Simple harmonic motion from the differential equation; damped and forced oscillations, resonance and the quality factor; coupled oscillators in outline; the wave equation, travelling and standing waves; superposition, beats and the Doppler effect.	8
II	Wave Optics	Interference — Young's experiment, thin films, Newton's rings; diffraction — single slit, the grating and its resolving power; polarisation — Malus' law, double refraction, the quarter- and half-wave plate; the elements of the laser and of optical fibre.	8
III	Electromagnetism	Electrostatics and magnetostatics in review; the laws of Gauss, Faraday and Ampère; the displacement current; Maxwell's equations in integral and differential form (statement and meaning); the electromagnetic wave in vacuum in outline.	8
IV	Quantum Physics	The failure of classical physics; the photoelectric and Compton effects; the de Broglie hypothesis and wave–particle duality; the uncertainty principle; the Schrödinger equation and the particle in a box; the quantum numbers in outline.	7
V	Solid-State and Modern Physics	Free-electron theory of metals in outline; the band theory of solids and the distinction of conductor, semiconductor and insulator; intrinsic and extrinsic semiconductors; superconductivity in brief; an introduction to nanomaterials and their engineering use.	5

Cross-cutting notes. The physics laboratory (BS-PH191/291) is taken concurrently and is assessed separately; the theory is to be sequenced so that the relevant principle precedes the experiment. Module V connects forward to the Basic Electrical and Electronics course and to the materials content of the disciplines.

Text and Reference Books

- A. Beiser, Concepts of Modern Physics, McGraw-Hill.
- D. J. Griffiths, Introduction to Electrodynamics, Pearson.
- Halliday, Resnick and Walker, Fundamentals of Physics, Wiley.
- B. B. Laud, Electromagnetics, New Age.
- A. Ghatak, Optics, McGraw-Hill.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Engineering Physics I / II (IITs), 12 weeks.
- NPTEL — Waves and Oscillations, 8 / 12 weeks.
- NPTEL — Semiconductor Physics and Devices, 12 weeks.
- Virtual Labs (Ministry of Education) — Optics, Modern Physics and Electricity & Magnetism laboratories.

Question-paper note. At least one question in Group C is to be a numerical problem — a resonance, interference-fringe, field or quantum calculation — with units and significant figures required. Standard constants are printed with the paper.

26-BS-CH101 /201— Chemistry

Course Code	26-BS-CH101	**Category**	Basic Science Course
Course Title	Chemistry	**L – T – P**	3 – 0 – 0
Credits	3	**Contact Hours**	36
Semester	First or Second (by group)	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

Builds on the Higher Secondary Chemistry of WBCHSE, CBSE or ISC. Under the group rotation it is taken in one semester by one group and in the other by the second; the syllabus is identical. Assumed:

- Atomic structure, the quantum numbers and electronic configuration; the periodic table (CBSE XI Units II–III; WBCHSE).
- Chemical bonding — ionic, covalent and coordinate bonds, VSEPR and hybridisation (CBSE XI Unit IV).
- Thermodynamics, equilibrium, electrochemistry and kinetics (CBSE XI Unit VI; XII Units III–IV).
- A three-hour bridge on atomic structure, bonding and the mole concept is provided for students without Class XII Chemistry.

Course Objectives

- To establish the quantum-mechanical picture of the atom and the molecule as the basis of the properties of materials.
- To develop the thermodynamic, kinetic and electrochemical reasoning used to predict whether and how fast a process occurs.
- To connect the structure of materials and of water to their engineering behaviour and treatment.
- To introduce the instrumental methods by which composition and structure are determined.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply the quantum-mechanical and molecular-orbital picture to the structure and properties of molecules and materials.	L3 – Apply
CO2	Apply thermodynamics, chemical and phase equilibrium and reaction kinetics to engineering processes and compute the quantities.	L3 – Apply
CO3	Apply the principles of electrochemistry to cells, batteries and fuel cells, and explain and control corrosion.	L3 – Apply
CO4	Relate the structure of engineering materials and the chemistry of water to their engineering use and treatment.	L4 – Analyse
CO5	Select an appropriate spectroscopic or instrumental method for an analytical problem and interpret its output.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	1	–	–	–	–	–	1
CO2	3	3	2	2	1	–	–	–	–	–	1
CO3	3	2	2	2	2	1	2	–	–	–	2
CO4	3	2	2	2	2	2	2	–	–	–	2
CO5	3	2	1	3	2	–	–	–	–	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Atomic and Molecular Structure	The Schrödinger equation and the particle in a box as a model; atomic and molecular orbitals; molecular-orbital theory of diatomic molecules, bond order and magnetic behaviour; π-molecular orbitals of conjugated systems; band theory of solids in outline; crystal-field splitting and the colour of transition-metal complexes.	8
II	Thermodynamics, Equilibrium and Kinetics	The laws of thermodynamics in review; entropy, free energy and the criteria of spontaneity; chemical potential; chemical and phase equilibrium, the phase rule and simple phase diagrams; chemical kinetics — order, molecularity, the rate law, the Arrhenius equation and catalysis.	8
III	Electrochemistry and Corrosion	Electrode potential and the electrochemical series; the Nernst equation; galvanic and concentration cells; conductance; batteries — primary, secondary and the lithium-ion cell — and fuel cells; corrosion — mechanism, factors, and protection by coatings, cathodic protection and inhibitors.	7
IV	Engineering Materials and Water	Polymers — addition and condensation polymerisation, thermoplastics and thermosets, elastomers, conducting and biodegradable polymers; composites and nanomaterials in outline. Water — hardness and its determination, boiler troubles, softening by lime–soda, zeolite and ion-exchange methods, and municipal treatment.	8
V	Instrumental Methods of Analysis	The basis of spectroscopy and the Beer–Lambert law; ultraviolet–visible, infrared and, in outline, nuclear magnetic resonance spectroscopy; elementary chromatography; the accuracy and precision of a measurement and the reporting of a result with its uncertainty.	5

Cross-cutting notes. Module III (corrosion) and Module IV (materials and water) are the points at which the course serves the materials, durability and water concerns of the Civil, Mechanical, Electrical and Leather disciplines and connects to Environmental Science. The concurrent Chemistry Laboratory (BS-CH191/291) reduces at least one result with its uncertainty.

Text and Reference Books

- P. C. Jain and M. Jain, Engineering Chemistry, Dhanpat Rai.
- P. W. Atkins, Physical Chemistry, Oxford University Press.
- B. R. Puri, L. R. Sharma and M. S. Pathania, Principles of Physical Chemistry, Vishal.
- S. S. Dara and S. S. Umare, A Textbook of Engineering Chemistry, S. Chand.
- Shashi Chawla, A Textbook of Engineering Chemistry, Dhanpat Rai.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Chemistry: Principles and Applications / Engineering Chemistry, 12 weeks.
- NPTEL — Electrochemical Energy Systems / Corrosion Engineering, 12 weeks.
- Virtual Labs (Ministry of Education) — Physical, Inorganic and Analytical Chemistry laboratories.

Question-paper note. At least one Group C question is a numerical problem — a free-energy or equilibrium computation, a Nernst potential, a rate or activation-energy calculation, or a hardness determination. Structure-and-reasoning questions require explanation from the underlying bonding or thermodynamics.

26-ES-EE101 /201— Basic Electrical and Electronics Engineering

Course Code	26-ES-EE101	**Category**	Engineering Science Course
Course Title	Basic Electrical and Electronics Engineering	**L – T – P**	3 – 1 – 0
Credits	4	**Contact Hours**	44
Semester	First	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

A four-credit course (3-1-0), the tutorial hour serving the problem-working that a combined electrical-and-electronics paper needs. Scoped at about forty-four hours. Assumed:

- Ohm's and Kirchhoff's laws and simple resistive circuits (CBSE XII Unit II; WBCHSE).
- Alternating current and the LCR circuit in outline (CBSE XII Unit IV).
- The p–n junction diode and the elements of the transistor and logic gates (CBSE XII Units IX–XI).
- The calculus of Mathematics-I, taken concurrently.

Course Objectives

- To establish the analysis of direct- and alternating-current circuits by the network theorems.
- To introduce electrical machines and their engineering use.
- To establish the physics and characteristics of the semiconductor devices — diode, transistor, field-effect transistor and operational amplifier.
- To ground the student in electrical safety and the Indian wiring practice.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply electrical safety and wiring practice and analyse direct-current circuits using the network theorems.	L3 – Apply
CO2	Analyse single-phase and balanced three-phase alternating-current circuits and compute power and power factor.	L3 – Apply
CO3	Explain the construction and characteristics of transformers and rotating machines and their engineering use.	L2 – Understand
CO4	Explain the physics and characteristics of the semiconductor diode and its applications in rectification and regulation.	L3 – Apply
CO5	Calculate the voltage gain of the operational amplifier in the inverting and non-inverting configuration and study its applications.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	1	1	1	–	–	1
CO2	3	3	2	2	2	–	–	–	–	–	1
CO3	3	2	2	1	2	1	1	–	–	–	1
CO4	3	3	2	2	2	–	–	–	–	–	2
CO5	3	3	3	2	3	–	–	1	–	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Basics of Electrical Wiring and Safety	Electrical safety — the effect of current on the body; earthing; the residual-current device; the Switch-Fuse Unit (SFU), MCB, ELCB and MCCB; types of wires and cables; the elements of the Indian wiring practice; types of batteries and their important characteristics.	3
II	Direct-Current Circuits	Circuit elements and their voltage–current relations; independent and dependent sources; Kirchhoff's voltage and current laws; mesh and nodal analysis; star–delta transformation; superposition, Thevenin, Norton and maximum-power-transfer theorems; transient response of RL and RC circuits in outline.	9
III	Alternating-Current Circuits	Generation of alternating voltage; average and root-mean-square values, form and peak factors; phasor representation; analysis of R, L, C and series and parallel RLC circuits; impedance and admittance; real, reactive and apparent power, power factor and its improvement; series and parallel resonance; balanced three-phase systems, star and delta connection, and three-phase power measurement in outline.	8
IV	Transformers and Rotating Machines	Single-phase transformer — construction, principle, equivalent circuit, losses, efficiency and regulation; the auto-transformer in outline. Direct-current machines — construction, e.m.f. and torque equations, types of excitation, characteristics and starting. Introduction to alternating-current motors (three-phase and single-phase), with the stepper motor and the brushless direct-current motor and a note on their use in automation.	6
V	Semiconductor Fundamentals and Diode Applications	Energy bands in solids; valence and conduction bands; insulators, semiconductors and conductors; intrinsic and extrinsic semiconductors; current in semiconductors by diffusion and drift; the p–n junction diode under forward and reverse bias and its current–voltage characteristic; breakdown — Zener and avalanche; rectifiers — half-wave and full-wave with filters; the Zener diode as a voltage regulator; the light-emitting diode and the photodiode.	7
VI	Transistors and Operational Amplifiers	Bipolar junction transistor — structure and symbol, operation, modes, the CB, CE and CC characteristics and current-gain expressions, the Early effect, and the hybrid (h-parameter) model in outline. Field-effect transistor — the junction FET: circuit, symbol, drain and transfer characteristics, and the saturation drain current; the MOSFET — construction, operation and drain characteristics. The operational amplifier — the ideal op-amp, open-loop characteristics and parameters; the inverting, non-inverting, summing and difference amplifier.	11

Note on scope and delivery. The course carries four credits as 3-1-0 — three lectures and a tutorial — in recognition that it combines two subjects within one paper. The tutorial hour is for the working of circuit and device problems and is not a fourth lecture. The safety-and-wiring Module I and the semiconductor and operational-amplifier content of Modules V and VI are the parts strengthened at the Board's instance, so that the electronics half is given its due.

Text and Reference Books

- D. P. Kothari and I. J. Nagrath, Basic Electrical and Electronics Engineering, McGraw-Hill.
- D. C. Kulshreshtha, Basic Electrical Engineering, McGraw-Hill.
- Boylestad and Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- V. K. Mehta and Rohit Mehta, Principles of Electronics, S. Chand.
- Millman, Halkias and Jit, Electronic Devices and Circuits, McGraw-Hill.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Basic Electrical Circuits / Basic Electrical Engineering (IITs), 12 weeks.
- NPTEL — Electronic Devices and Circuits, 12 weeks.
- NPTEL — Analog Electronic Circuits / Operational Amplifiers, 12 weeks.
- Virtual Labs (Ministry of Education) — Basic Electrical and Analog Electronics laboratories.

Question-paper note. The paper is a problem-and-reasoning paper. At least one Group C question requires network analysis by a stated theorem, one requires an op-amp gain calculation (CO5), and one requires interpretation of a device characteristic. Circuit diagrams are to be drawn to standard symbols.

26-AEC-101 /201— English for Communication Skills

Course Code	26-AEC-101	**Category**	Ability Enhancement Course
Course Title	English for Communication Skills	**L – T – P**	2 – 0 – 0
Credits	2	**Contact Hours**	26
Semester	First	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

A two-credit first-semester course scoped at about twenty-six hours, and lightened for the shorter first-semester window. A first-week diagnostic places students in graded groups. Assumed:

- The English of the Higher Secondary course (WBCHSE / CBSE / ISC).
- No uniform standard is assumed; the diagnostic test is used for placement and not for marks..

Course Objectives

- To strengthen the grammar and vocabulary of technical English.
- To develop reading, comprehension and the conventions of technical writing.
- To build the listening and speaking competence the workplace requires.
- To prepare the student for the communication demands of employability.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply the grammar and vocabulary of technical English accurately in writing and speech.	L3 – Apply
CO2	Read and comprehend a technical text and summarise it accurately.	L3 – Apply
CO3	Write clear technical prose — the paragraph, the letter, the report and the e-mail.	L3 – Apply
CO4	Listen and speak effectively in professional and group settings.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	–	–	1	1	1	2	3	–	2
CO2	1	1	–	1	1	1	–	1	3	–	2
CO3	1	1	1	1	2	1	1	2	3	1	2
CO4	1	–	–	–	1	2	1	3	3	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	The Grammar and Vocabulary of Technical English	Parts of speech and sentence structure in review; common errors and their correction; tense, voice and concord; the vocabulary of technical English — word-formation, technical and sub-technical vocabulary, and precision of usage.	6
II	Reading and Comprehension	Reading strategies — skimming, scanning and intensive reading; comprehension of a technical passage; note-making and summarising; interpreting data presented in a table or figure. (May be carried partly by guided assignment in a short session.)	6
III	Technical Writing	The technical paragraph and its coherence; the formal letter and the e-mail; the memorandum; the structure of the technical report; the description of a process and of an object; the abstract.	8
IV	Listening, Speaking and Employability	Listening comprehension; pronunciation and stress in outline; the group discussion and the interview; the presentation; the résumé and the covering letter; communication for the workplace.	6

Cross-cutting notes. The course is paired with the Language Laboratory (AEC-291) and with Essentials for Professional Skills (AEC-281), which carry the practice; this course supplies the frame. It serves PO9 (Communication) directly and is the principal first-year vehicle for it.

Text and Reference Books

- Meenakshi Raman and Sangeeta Sharma, Technical Communication, Oxford University Press.
- Board of Editors, English for Engineers and Technologists, Orient BlackSwan.
- F. T. Wood, Remedial English Grammar for Foreign Students, Macmillan.
- Ashraf Rizvi, Effective Technical Communication, McGraw-Hill.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Technical English for Engineers / English Language for Competitive Examinations, 8 / 12 weeks.
- NPTEL — Effective Writing / Speaking Effectively, as offered.
- SWAYAM — Soft Skills and Communication, as offered.

Question-paper note. The paper tests use rather than the naming of rules: grammar is examined through correction and transformation, writing through a short composition, and reading through comprehension of an unseen technical passage.

Part V — Detailed Syllabi: Laboratory and Practical Courses

The three laboratory and practical courses follow. Each carries its list of experiments or exercises mapped to the Course Outcomes, and is assessed under the practical scheme of Part III.

26-BS-PH191 /291— Physics Laboratory

Course Code	26-BS-PH191	**Category**	Basic Science Course
Course Title	Physics Laboratory	**L – T – P**	0 – 0 – 3
Credits	1.5	**Contact Hours**	36
Semester	First or Second (by group)	**Assessment**	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with Physics and sequenced so the relevant theory precedes the experiment. Assumed: the laboratory safety induction (first session); elementary measurement, significant figures and the reporting of a result with its uncertainty.

- The laboratory safety and measurement induction, conducted in the first session.
- Elementary use of the vernier, screw gauge and travelling microscope (Class XI–XII practical).
- The idea of least count, error and the reporting of a result with its uncertainty.

Course Objectives

- To connect the principles of the Physics course to measurement.
- To develop competence and safe practice in physical measurement.
- To establish the estimation of uncertainty as routine.
- To establish the discipline of the laboratory record.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Work safely and take physical measurements to their rated precision using standard instruments.	L3 – Apply
CO2	Determine physical quantities — g, wavelength, refractive index, resistance, and the like — from measured data.	L3 – Apply
CO3	Plot and interpret an experimental graph and extract a physical quantity from its slope or intercept.	L4 – Analyse
CO4	Estimate the uncertainty in a measured result and maintain a reproducible laboratory record.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	3	2	–	–	2	1	–	2
CO2	3	3	2	3	2	–	–	2	1	–	2
CO3	3	3	1	3	3	–	–	2	2	–	2
CO4	2	2	1	3	2	–	–	3	2	–	2

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Determination of the acceleration due to gravity by the bar or Kater's pendulum.	CO1, CO2
2	Determination of the spring constant and the acceleration due to gravity by a helical spring.	CO2, CO3
3	Determination of the wavelength of light by Newton's rings.	CO2, CO3
4	Determination of the wavelength of the spectral lines by a diffraction grating and the spectrometer.	CO2, CO3
5	Determination of the refractive index of the material of a prism by the spectrometer.	CO1, CO2
6	Determination of an unknown resistance by the Carey Foster bridge.	CO2, CO3
7	Study of the characteristics of a p–n junction diode / the variation of a thermistor resistance with temperature.	CO2, CO3
8	Determination of the specific resistance of a wire by the metre bridge.	CO2, CO4
9	Determination of the numerical aperture of an optical fibre / the wavelength of a laser by a grating.	CO2, CO3
10	Determination of the Planck constant using light-emitting diodes.	CO2, CO3, CO4

A student is to perform not fewer than eight experiments. Every result is to be reported with its estimated uncertainty; a result reported without one is incomplete. At least one experiment is to be recorded and reduced using a spreadsheet or a short script.

Text and Reference Books

- C. L. Arora, Practical Physics, S. Chand.
- B. L. Worsnop and H. T. Flint, Advanced Practical Physics for Students, Methuen.
- J. R. Taylor, An Introduction to Error Analysis, University Science Books — for the uncertainty component.

Suggested SWAYAM / NPTEL and Online Resources

- Virtual Labs (Ministry of Education) — Optics, Mechanics and Electricity & Magnetism laboratories, for pre-laboratory preparation.

Indicative Assessment Map

Component	Coverage	Outcomes
Practical CA – I (PCA1, 40)	First cycle — conduct and safe working 10, observation and data 10, computation and result with uncertainty 10, viva 10	CO1, CO2
Practical CA – II (PCA2, 40)	Second cycle, assessed on the same rubric	CO3, CO4
End-Semester Practical Examination (60)	Record, performance and viva-voce before an external examiner	All COs

26-BS-CH191 /291— Chemistry Laboratory

Course Code	26-BS-CH191	**Category**	Basic Science Course
Course Title	Chemistry Laboratory	**L – T – P**	0 – 0 – 3
Credits	1.5	**Contact Hours**	36
Semester	First or Second (by group)	**Assessment**	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with Chemistry, sequenced so the relevant module precedes the experiment. Assumed: the laboratory safety induction (first session); elementary volumetric practice; significant figures and uncertainty.

- The laboratory safety induction, in the first session; no reagent is handled without it.
- Elementary use of the burette, pipette and volumetric flask (Class XI–XII practical).
- The reporting of a result with its unit and uncertainty.

Course Objectives

- To develop competence and safe practice in quantitative chemical measurement.
- To connect the thermodynamic, kinetic, electrochemical and analytical principles of the theory to observation.
- To introduce instrumental measurement and the estimation of uncertainty as routine.
- To establish the discipline of the laboratory record.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Work safely in a chemical laboratory and carry out volumetric determinations to their rated precision.	L3 – Apply
CO2	Determine physicochemical quantities — hardness, rate constant, cell potential, viscosity — from measured data.	L3 – Apply
CO3	Operate elementary instruments — pH meter, conductivity meter, colorimeter — and interpret their output.	L3 – Apply
CO4	Estimate the uncertainty in a measured result and maintain a reproducible laboratory record.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	3	2	1	2	2	1	–	2
CO2	3	3	2	3	2	–	1	2	1	–	2
CO3	3	2	1	3	3	–	–	2	1	–	2
CO4	2	2	1	3	2	–	–	3	2	–	2

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Laboratory safety, the handling of reagents and glassware, measurement, significant figures and uncertainty; preparation of a standard solution.	CO1, CO4
2	Determination of the total, permanent and temporary hardness of water by the EDTA method.	CO1, CO2
3	Estimation of a carbonate–bicarbonate mixture by double-indicator titration.	CO1, CO2
4	Determination of iron in a sample by a redox titration (permanganometry or dichromatometry).	CO1, CO2
5	Determination of the rate constant of the acid-catalysed hydrolysis of an ester.	CO2, CO4
6	Determination of the strength of an acid by conductometric titration.	CO2, CO3
7	Determination of the strength or dissociation constant of a weak acid by pH-metric titration.	CO2, CO3
8	Verification of the Beer–Lambert law and colorimetric determination of a coloured species.	CO2, CO3
9	Determination of the viscosity of a liquid and its variation with concentration.	CO2
10	Determination of the cell constant and equivalent conductance of a strong electrolyte.	CO2, CO3
11	Preparation of a simple polymer (phenol–formaldehyde or urea–formaldehyde) or of a metal complex.	CO1

A student is to perform not fewer than eight experiments. At least one experiment per cycle is recorded and reduced using a spreadsheet or short script, and every result is reported with its estimated uncertainty.

Text and Reference Books

- B. Viswanathan and P. S. Raghavan, Practical Physical Chemistry, Viva Books.
- A. I. Vogel, A Textbook of Quantitative Chemical Analysis, Pearson.
- Sunita Rattan, Experiments in Applied / Engineering Chemistry, S. K. Kataria.

Suggested SWAYAM / NPTEL and Online Resources

- Virtual Labs (Ministry of Education) — Physical, Analytical and Inorganic Chemistry laboratories.

Indicative Assessment Map

Component	Coverage	Outcomes
Practical CA – I (PCA1, 40)	First cycle — conduct and safe working 10, observation and data 10, computation and result with uncertainty 10, viva 10	CO1, CO2
Practical CA – II (PCA2, 40)	Second cycle, assessed on the same rubric	CO2, CO3, CO4
End-Semester Practical Examination (60)	Record, performance and viva-voce before an external examiner	All COs

26-ES-EE191 /291— Basic Electrical and Electronics Engineering Laboratory

Course Code	26-ES-EE191	**Category**	Engineering Science Course
Course Title	Basic Electrical and Electronics Engineering Laboratory	**L – T – P**	0 – 0 – 3
Credits	1.5	**Contact Hours**	36
Semester	First	**Assessment**	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with Basic Electrical and Electronics Engineering (ES-EE101). Assumed: the electrical-safety induction (first session); the use of the multimeter, the cathode-ray oscilloscope and the function generator, taught in the first two sessions.

- The electrical-safety induction, in the first session.
- The use of the multimeter, oscilloscope, function generator and regulated power supply, taught at the outset.
- The circuit and device theory of ES-EE101, taken concurrently.

Course Objectives

- To verify the network theorems and the behaviour of alternating-current circuits by measurement.
- To study the characteristics of electrical machines.
- To obtain and interpret the characteristics of the semiconductor devices and to test rectifier and regulator circuits.
- To study the operational amplifier in its basic configurations.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Use electrical measuring instruments safely and verify the network theorems by measurement.	L3 – Apply
CO2	Measure the parameters of an alternating-current circuit and study resonance and power-factor improvement.	L3 – Apply
CO3	Obtain and interpret the characteristics of the diode, the Zener diode, the bipolar junction transistor and the JFET, and test rectifier and regulator circuits.	L4 – Analyse
CO4	Study the characteristics of an electrical machine or transformer.	L3 – Apply
CO5	Calculate the voltage gain of the operational amplifier in the inverting and non-inverting configuration.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	3	3	1	1	2	1	–	2
CO2	3	3	2	3	3	–	–	2	1	–	2
CO3	3	3	2	3	3	–	–	2	1	–	2
CO4	3	2	2	3	3	1	1	2	1	–	2
CO5	3	3	3	3	3	–	–	2	1	–	2

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Familiarisation with electrical safety, the multimeter, the oscilloscope, the function generator and the regulated power supply.	CO1
2	Verification of Kirchhoff's voltage and current laws.	CO1
3	Verification of the superposition theorem.	CO1
4	Verification of the Thevenin and Norton theorems / the maximum-power-transfer theorem.	CO1
5	Study of the series RLC circuit — resonance, the resonant frequency and the quality factor.	CO2
6	Measurement of power and power factor in a single-phase circuit and improvement of the power factor by a capacitor.	CO2
7	Open-circuit and short-circuit test on a single-phase transformer / study of a DC machine.	CO4
8	Study of the characteristics of the p–n junction diode and the Zener diode.	CO3
9	Study of the half-wave and full-wave rectifier with and without a filter, and the Zener voltage regulator.	CO3
10	Study of the input and output characteristics of a bipolar junction transistor in the CE configuration.	CO3
11	Study of the JFET characteristics.	CO3
12	Study of the inverting and non-inverting mode of the operational amplifier.	CO5

A student is to perform not fewer than ten experiments covering all five outcomes, including at least the diode/transistor/JFET characteristics (CO3) and the operational-amplifier experiment (CO5). Every observation is to be recorded against the theory and the measured value compared with the expected.

Text and Reference Books

- Laboratory manual, Basic Electrical and Electronics Engineering, MAKAUT (to be issued).
- D. P. Kothari and I. J. Nagrath, Basic Electrical and Electronics Engineering, McGraw-Hill.
- Boylestad and Nashelsky, Electronic Devices and Circuit Theory, Pearson.

Suggested SWAYAM / NPTEL and Online Resources

- Virtual Labs (Ministry of Education) — Basic Electrical, Electrical Machines and Analog Electronics laboratories.

Indicative Assessment Map

Component	Coverage	Outcomes
Practical CA – I (PCA1, 40)	First cycle — electrical circuits, AC and machines: conduct 10, observation and data 10, result and interpretation 10, viva 10	CO1, CO2, CO4
Practical CA – II (PCA2, 40)	Second cycle — semiconductor devices and the operational amplifier, on the same rubric	CO3, CO5
End-Semester Practical Examination (60)	Record, performance and viva-voce before an external examiner	All COs

26-ES-ME191/291— Engineering Graphics and Design

Course Code	26-ES-ME191	**Category**	Engineering Science Course
Course Title	Engineering Graphics and Design	**L – T – P**	0 – 0 – 4
Credits	2	**Contact Hours**	48
Semester	First or Second (by group)	**Assessment**	Practical: PCA 40 + ESE 60

Prerequisites

A two-credit graphics course of about forty-eight hours, rotating with Workshop Practice across the two semesters by group. It assumes only school geometry and begins from the drawing standard. Assumed:

- Plane and solid geometry and coordinate geometry in three dimensions (WBBSE / CBSE / ICSE; CBSE XII Unit IV).
- No prior drawing experience; the course begins from the standard (BIS SP 46) and the instruments.
- The safety and housekeeping induction of the drawing hall / CAD laboratory.

Course Objectives

- To establish engineering drawing as the graphical language of engineering to the Bureau of Indian Standards code.
- To develop competence in orthographic and isometric projection.
- To introduce sectioning, dimensioning and the drawing of simple machine and civil elements.
- To introduce computer-aided drafting as the modern medium.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply the conventions of engineering drawing and construct the standard geometrical and engineering curves.	L3 – Apply
CO2	Draw the orthographic projection of a point, line, plane and solid.	L3 – Apply
CO3	Construct isometric and sectional views and dimension a drawing to the standard.	L4 – Analyse
CO4	Produce a drawing using a computer-aided drafting package.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	1	3	–	–	1	2	–	2
CO2	3	2	3	1	2	–	–	1	2	–	2
CO3	3	3	3	1	3	–	–	1	2	–	2
CO4	2	2	3	1	3	–	–	2	2	–	2

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Introduction to engineering drawing — instruments, the BIS code (SP 46), lettering, lines and dimensioning; scales.	CO1
2	Conic sections — the ellipse, parabola and hyperbola; the cycloid and the involute.	CO1
3	Orthographic projection — projection of points and of straight lines.	CO2
4	Projection of planes.	CO2
5	Projection of solids — prism, pyramid, cylinder and cone in simple position.	CO2
6	Section of solids and the true shape of the section.	CO3
7	Development of surfaces of simple solids.	CO3
8	Isometric projection and isometric view of simple solids and their combinations.	CO3
9	Conversion of a pictorial view to orthographic views and vice versa.	CO3
10	Introduction to a CAD package — the drawing environment, drawing and editing commands.	CO4
11	Two-dimensional drawing of a simple engineering component in CAD, with dimensioning.	CO4
12	Introduction to three-dimensional modelling of a simple part in CAD.	CO4

The plates are drawn on the board for the projection modules and in the CAD laboratory for the last three. A student is to complete not fewer than ten plates. The end-semester examination has a board component and a CAD component.

Text and Reference Books

- N. D. Bhatt, Engineering Drawing, Charotar Publishing.
- K. Venugopal, Engineering Drawing and Graphics, New Age.
- Bureau of Indian Standards, SP 46 — Engineering Drawing Practice.
- Sham Tickoo, AutoCAD / Fusion 360 for Engineers (as adopted), CADCIM.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Engineering Drawing and Computer Graphics (IITs), 12 weeks.
- NPTEL — Engineering Graphics, as offered.
- SWAYAM — CAD-based courses, as approved.

Indicative Assessment Map

Component	Coverage	Outcomes
Practical CA – I (PCA1, 40)	First cycle — geometrical constructions and orthographic projection: plates and board work	CO1, CO2
Practical CA – II (PCA2, 40)	Second cycle — isometric, sections, development and CAD	CO3, CO4
End-Semester Practical Examination (60)	Record, performance and viva-voce before an external examiner	All COs

26-ES-ME192 /292— Workshop Practice

Course Code	26-ES-ME192	**Category**	Engineering Science Course
Course Title	Workshop Practice	**L – T – P**	0 – 0 – 4
Credits	2	**Contact Hours**	48
Semester	First or Second (by group)	**Assessment**	Practical: PCA 40 + ESE 60

Prerequisites

A two-credit workshop of about forty-eight hours, rotating with Engineering Graphics across the two semesters by group. It assumes no prior experience and begins from the safety induction. Assumed:

- The workshop safety induction, in the first session; no machine is operated without it.
- No prior workshop experience.
- General science of Class X for the properties of the common materials.

Course Objectives

- To give hands-on experience of the basic manufacturing and fabrication processes.
- To develop safe practice and the correct use of hand tools and machines.
- To connect the process to the material and to the product.
- To introduce measurement and the reading of a job against a drawing.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Work safely in the workshop and select the correct tool and process for a job.	L3 – Apply
CO2	Make a job to a given drawing in fitting, carpentry and sheet metal.	L3 – Apply
CO3	Perform the elementary welding, machining and casting / smithy operations.	L3 – Apply
CO4	Measure a job and compare it with the specification on the drawing.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	2	1	1	2	1	–	2
CO2	3	2	3	1	2	–	–	2	1	–	2
CO3	3	2	2	1	2	1	1	2	1	–	2
CO4	2	3	2	2	2	–	–	2	1	–	2

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Workshop safety, the layout of the shops, and the common engineering materials and their uses.	CO1
2	Fitting — marking, filing, sawing, drilling and tapping to make a job to a drawing.	CO2, CO4
3	Carpentry — planing, marking and making a simple joint (lap or mortise-and-tenon).	CO2, CO4
4	Sheet-metal work — development, cutting, bending and making a simple article.	CO2, CO4
5	Welding — arc and gas welding; making a simple butt or lap joint.	CO3
6	Machining — introduction to the lathe; plain and step turning of a job.	CO3, CO4
7	Foundry / smithy — mould-making, or the forging of a simple shape.	CO3
8	Introduction to modern manufacturing — a demonstration of 3D printing / CNC.	CO1, CO3

A student is to complete a job in each of the fitting, carpentry, sheet-metal and welding sections and at least one of the machining, foundry or smithy sections. Each job is measured against its drawing (CO4).

Text and Reference Books

- Hajra Choudhury, Elements of Workshop Technology, Vol. I, Media Promoters.
- B. S. Raghuwanshi, A Course in Workshop Technology, Dhanpat Rai.
- W. A. J. Chapman, Workshop Technology, CBS.
- Workshop practice manual, MAKAUT (to be issued).

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Manufacturing Process Technology / Introduction to Manufacturing, 8 / 12 weeks.
- Virtual Labs (Ministry of Education) — Workshop and Manufacturing laboratories.

Indicative Assessment Map

Component	Coverage	Outcomes
Practical CA – I (PCA1, 40)	First cycle — fitting, carpentry and sheet metal: jobs, finish and dimensional accuracy	CO1, CO2, CO4
Practical CA – II (PCA2, 40)	Second cycle — welding, machining and foundry / smithy	CO3, CO4
End-Semester Practical Examination (60)	Record, performance and viva-voce before an external examiner	All COs

Part VI — Detailed Syllabi: Sessional and Non-Credit Mandatory Courses

The sessional courses (NCC / NSS / Yoga and Sports, and the Skill Enhancement Course) and the two mandatory non-credit courses (the Indian Knowledge System and the Indian Constitution) follow.

A. What a sessional course is, and which courses this document covers

A sessional course is assessed wholly by internal, continuous evaluation across the semester, against published rubrics, rather than by a single end-of-semester written theory paper. In the first-year structure the courses below are assessed on a sessional or continuous basis, and are covered here. Marks are out of 100 unless the course is non-credit, in which case it is graded Satisfactory or Unsatisfactory.

Code	Course	Credits / L-T-P	Assessment basis
26-VAC-181	NCC / NSS / Yoga and Sports	2 (0-0-4)	Pure sessional — 100 marks, wholly internal continuous evaluation
26-SEC-181	Skill Enhancement Course — MOOCs / Skills	1 (0-0-2)	Sessional / MOOC — 100 marks; MOOC score + applied task + reflection, or institutional skill assessment
26-MC-182/282			
26-MC-181/281	Indian Constitution	Non-credit (2-0-0)	Sessional, non-credit — graded Satisfactory / Unsatisfactory

B. General principles governing every sessional assessment

Principle	What it means
Continuous, not terminal	Assessment is distributed across the whole semester in at least two cycles; no sessional course is settled by a single end-point exercise.
Rubric published in advance	Every qualitative component is marked against a written rubric (the Rubric Bank at the end of this document) given to the student before the task is set.
Assessor and moderation	The subject teacher or stream in-charge assesses; a sessional committee of the department moderates. An external examiner is associated with the final evaluation of every credit-bearing sessional course, but not the non-credit courses.
Minimum conditions	Attendance of not less than 75% is a necessary but not sufficient condition of a pass; the student must also secure at least 40% of the sessional marks, or, for a non-credit course, a Satisfactory grade.
Outcome attainment	Course-Outcome attainment is computed as in Part I of the syllabus — 80% from the direct marks mapped to each outcome and 20% from an outcome-based student feedback instrument.
Records for NBA / NAAC	Attendance registers, rubric sheets, log books, artefacts, certificates and the assessment sheet are retained for not fewer than three assessment years, as the NBA continuous-improvement criterion requires.
Uniformity across colleges	The scheme, the components and the rubrics are uniform across every affiliated college; a college may not vary the marks distribution.

26-VAC-181 — NCC / NSS / Yoga and Sports

Course Code	26-VAC-181	**Category**	Value-Added Course
Course Title	NCC / NSS / Yoga and Sports	**L – T – P**	0 – 0 – 4
Credits	2	**Contact Hours**	52
Semester	First	**Assessment**	Sessional: wholly internal continuous evaluation (100)

Prerequisites

A two-credit activity-based value-added course. The student chooses one stream — the National Cadet Corps, the National Service Scheme, or Yoga and Sports — and is assessed on participation and a record of activity. Assumed: none beyond the medical fitness the activity requires.

- No academic prerequisite.
- A declaration of medical fitness for the physical activity of the chosen stream.
- Enrolment in one stream at the start of the semester.

Course Objectives

- To develop physical fitness, discipline and the habit of regular activity.
- To develop service, citizenship and community engagement.
- To develop teamwork, leadership and resilience.
- To contribute to the holistic development the National Education Policy seeks.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Participate regularly and safely in the physical or service activity of the chosen stream.	L3 – Apply
CO2	Demonstrate discipline, teamwork and responsibility in the activity.	L3 – Apply
CO3	Reflect on the value of service, fitness or citizenship through a record of activity.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	–	–	–	–	2	2	3	2	1	2
CO2	–	–	–	–	–	2	2	3	2	1	2
CO3	1	–	–	–	–	3	2	2	2	1	3

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	NCC stream — drill, discipline, national-security awareness, and camp / social-service activity, per the NCC syllabus.	CO1, CO2
2	NSS stream — orientation, regular activity, and a special camp of community service, per the NSS framework.	CO1, CO3
3	Yoga and Sports stream — yoga practice (āsana, prāṇāyāma) and its documented basis, and participation in a chosen sport.	CO1, CO2
4	A record / log of activity across the semester, and a short reflective report.	CO3

Each student follows one stream for the whole semester. Assessment is wholly internal and continuous — attendance and regularity, participation and conduct, camp or event participation, and the activity record and reflective report. A minimum attendance and participation is a necessary condition of a pass.

Text and Reference Books

- NCC Cadet Handbook, Directorate General of NCC (for the NCC stream).
- National Service Scheme Manual, Ministry of Youth Affairs and Sports (for the NSS stream).
- A textbook of Yoga and the Common Yoga Protocol, Ministry of AYUSH (for the Yoga stream).

Suggested SWAYAM / NPTEL and Online Resources

- SWAYAM / NPTEL — Science of Yoga / Yoga and Wellness, as offered.
- Fit India and MY Bharat resources, for activity and reporting.

26-VAC-181 — NCC / NSS / Yoga and Sports (2 credits, 0-0-4, Semester I)

A pure sessional course of 100 marks, wholly internal and continuous. The student follows one stream for the whole semester; the components are the same across the three streams, the stream-specific activity differing only in kind. An external examiner is associated with the final evaluation.

Course Outcomes assessed

CO	Statement
CO1	Participate regularly and safely in the physical or service activity of the chosen stream.
CO2	Demonstrate discipline, teamwork and responsibility in the activity.
CO3	Reflect on the value of service, fitness or citizenship through a record of activity.

Assessment components and marks

Sl.	Component	Marks	Weight	How it is assessed (rubric / evidence)
1	Attendance and regularity	20	20%	From the attendance register across the semester; 75% attendance is the qualifying floor, marks scaled above it. (CO1)
2	Participation and conduct	20	20%	Continuous observation of engagement, discipline and responsibility, on the four-band rubric. (CO2)
3	Activity / skill performance	30	30%	Stream-specific: NCC — drill and turnout; NSS — service-activity performance; Yoga & Sports — āsana / prāṇāyāma practice and sport skill, on the rubric. (CO1, CO2)
4	Camp / event / field participation	15	15%	NCC camp / NSS special camp / a sports meet or yoga demonstration, evidenced by a certificate or supervisor report. (CO1)
5	Activity log and reflective report	15	15%	A maintained log of activity and a short reflective report, on the reflection rubric. (CO3)
	Total	100	100%	

Minimum requirements to pass

- Attendance not less than 75% (a necessary condition).
- At least 40% in the aggregate (40 of 100).
- Participation in at least one camp, event or field activity of the chosen stream.
- Submission of the activity log and reflective report.

Assessor, moderation and records

Assessed and moderated by	Evidence retained (NBA / NAAC)
The NCC Associate NCC Officer, the NSS Programme Officer, or the Physical Education / Yoga instructor as the stream in-charge, internally; moderated by the departmental sessional committee; external examiner associated with the final evaluation.	Attendance register; participation and conduct observation sheet; activity / skill rubric sheet; camp or event certificate or supervisor report; the activity log; the reflective report; and the consolidated assessment sheet.

26-SEC-181 (0-0-2, 1)— Skill Enhancement Course — MOOCs / Skills

Course Code	26-SEC-181 (0-0-2, 1)	**Category**	Skill Enhancement Course
Course Title	Skill Enhancement Course — MOOCs / Skills	**L – T – P**	See note
Credits	1	**Contact Hours**	As per the credit of the chosen course
Semester	First and Second	**Assessment**	Sessional: as per the mode of the chosen course

Prerequisites

A skill course taken from a specified, published basket — through SWAYAM Plus, Future Skills Prime, an approved MOOC, or a practical / hands-on / soft-skill course offered by the institution or University. SEC-181 in Semester I carries one credit; SEC-282 in Semester II carries two credits. The Department publishes the basket, with the outcomes, mode, effort, assessment and fallback of each entry, before registration each session; the student chooses from the basket, not from the whole of a platform.

- The prerequisite of the specific course chosen, as stated in the published basket.
- Registration on the platform, and mentor allocation by the Department.
- For a credit-bearing MOOC, the proctored examination the platform requires.

Course Objectives

- To bring an employable practical skill to the student from the first year.
- To place at least part of the first year on a national digital-learning platform, on the University's early-mover credit-transfer policy.
- To let the student begin to shape the degree towards an interest or a specialisation.
- To do so under a specified and quality-assured basket rather than an open choice.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Complete an approved skill or MOOC course and demonstrate the skill it certifies.	L3 – Apply
CO2	Apply the skill to a small task, problem or artefact.	L3 – Apply
CO3	Reflect on the learning and relate it to the programme and to employability.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	1	3	–	–	1	1	–	3
CO2	2	2	2	1	3	–	–	1	1	–	3
CO3	1	1	1	1	2	1	1	1	1	–	3

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	An indicative basket — digital productivity and office tools; an introduction to Python; computer-aided drafting; an introduction to the Internet of Things; a communication, entrepreneurship or financial-literacy skill.	CO1
2	Completion of the chosen course with its certificate or the institutional assessment.	CO1
3	A small applied task, artefact or portfolio demonstrating the skill.	CO2
4	A short reflective note relating the skill to the programme.	CO3

The credit is awarded on completion of the chosen course and the associated applied task, verified by the mentor. For a SWAYAM course the platform's proctored score is used; for an institutional course the internal assessment is used. The specified basket, with outcomes and a named fallback against each entry, is a matter for the Board (Part X) and is to be published before registration.

Text and Reference Books

- As prescribed by the specific course chosen from the published basket.

Suggested SWAYAM / NPTEL and Online Resources

- SWAYAM Plus and SWAYAM — the approved credit-bearing courses of the published basket.
- Future Skills Prime (NASSCOM – MeitY) — approved digital-skill courses.
- NPTEL — short (4 / 8-week) skill courses aligned to the basket, as approved.

26-SEC-181 (1 cr, 0-0-2, Sem I) — Skill Enhancement Course (MOOCs / Skills)

A sessional course taken from the specified, published basket, in one of two modes — an approved SWAYAM / NPTEL MOOC, or an institutional skill course. It carries 100 marks in either mode. SEC-181 is the shorter, one-credit course and SEC-282 the fuller, two-credit course. The department mentor verifies completion; for a MOOC the platform's proctored score is authoritative for its part.

Course Outcomes assessed

CO	Statement
CO1	Complete an approved skill or MOOC course and demonstrate the skill it certifies.
CO2	Apply the skill to a small task, problem or artefact.
CO3	Reflect on the learning and relate it to the programme and to employability.

Assessment components and marks

Sl.	Component	Marks	Weight	How it is assessed (rubric / evidence)
1	Course completion and proctored score	60	60%	MOOC mode: the platform's proctored final score, scaled to 60. Institutional mode: a continuous skill assessment (40) and a skill-demonstration test (20). (CO1)
2	Applied task / artefact	25	25%	A task, artefact or mini-project applying the skill, verified by the mentor against a rubric. (CO2)
3	Reflective note	15	15%	A short note relating the skill to the programme and to employability, on the reflection rubric. (CO3)
	Total	100	100%	

The two delivery modes at a glance

Mode	Component 1 (60)	Comp. 2 (25)	Comp. 3 (15)	Best suited to
MOOC (SWAYAM / NPTEL / Future Skills Prime)	Proctored platform score, scaled to 60	Applied task	Reflection	A college without the faculty to teach the skill in house
Institutional skill course	Continuous assessment 40 + demonstration test 20	Applied task	Reflection	A skill the college can deliver and assess directly

Minimum requirements to pass

- MOOC mode: the platform completion certificate with a passing proctored score. Institutional mode: at least 40% in the skill assessment.
- Mentor verification of the applied task is mandatory in both modes.
- At least 40% in the aggregate (40 of 100).
- The chosen course must be from the basket published by the department before registration.

Assessor, moderation and records

Assessed and moderated by	Evidence retained (NBA / NAAC)
The department-allocated mentor, internally; moderated by the sessional committee. For a MOOC the SWAYAM / NPTEL proctored score is used directly for component 1. External examiner associated with the final evaluation.	The published basket for the session; the platform certificate and score report (MOOC mode) or the skill-assessment sheet (institutional mode); the applied task / artefact; the reflective note; the mentor verification; and the consolidated assessment sheet.

26-MC-181/281— Indian Constitution

Course Code	26-MC-181	**Category**	Mandatory Course (Non-Credit)
Course Title	Indian Constitution	**L – T – P**	2 – 0 – 0
Credits	Nil	**Contact Hours**	24
Semester	First or Second (by group)	**Assessment**	Non-credit; Satisfactory / Unsatisfactory

Prerequisites

A mandatory non-credit course, paired with the Indian Knowledge System across the two semesters and rotated by group. It is self-contained and assumes only the civics of Class X.

- No prerequisite beyond the civics and social science of Class X.
- No prior study of law is assumed.
- The course is descriptive and civic in purpose, not a course in legal practice.

Course Objectives

- To acquaint the student with the making, structure and principles of the Constitution of India.
- To establish the fundamental rights and duties and the directive principles.
- To outline the structure of the Union, the States and the local bodies.
- To develop the constitutional and civic awareness the graduate engineer needs.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Describe the making, the Preamble, and the basic structure of the Constitution of India.	L2 – Understand
CO2	Explain the fundamental rights and duties and the directive principles of State policy.	L2 – Understand
CO3	Outline the structure and functioning of the Union, the State and the local government.	L2 – Understand

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	–	–	–	–	–	3	3	1	1	–	1
CO2	–	–	–	–	–	3	3	1	1	–	1
CO3	1	–	–	–	–	3	2	1	1	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	The Making and Framework of the Constitution	The historical background and the Constituent Assembly; the Preamble and its ideals; the salient features of the Constitution; the idea of the basic structure.	6
II	Fundamental Rights, Duties and Directive Principles	The fundamental rights and the writs; the fundamental duties; the directive principles of State policy and their relation to the rights.	7
III	The Union and the States	The Union executive, the Parliament and the judiciary; the State executive and legislature; the relation between the Union and the States in outline; the amendment of the Constitution.	6
IV	Local Government and Constitutional Bodies	The Panchayati Raj and the municipalities; the principal constitutional bodies — the Election Commission, the Union and State Public Service Commissions, the Comptroller and Auditor-General — in outline; the citizen and the Constitution.	5

Non-credit character. The course carries no credit and no marks contribute to the Semester Grade Point Average. It is a mandatory non-credit course, paired with the Indian Knowledge System across the two semesters and rotated by group, and a student must be graded Satisfactory to be eligible for the award of the degree. The grade is awarded by the college on attendance of not less than seventy-five per cent, one assignment, and one class test of twenty-five marks in which at least forty per cent is to be obtained. A student graded Unsatisfactory is re-examined in a following semester. The course gives effect to the AICTE mandatory-course requirement on the Constitution of India.

Text and Reference Books

- Durga Das Basu, Introduction to the Constitution of India, LexisNexis.
- M. V. Pylee, India's Constitution, S. Chand.
- Subhash Kashyap, Our Constitution, National Book Trust.
- AICTE material on the Indian Constitution mandatory course.

Suggested SWAYAM / NPTEL and Online Resources

- SWAYAM / NPTEL — Introduction to the Constitution of India, as offered.
- Resources of the Ministry of Law and Justice and the Election Commission of India.

Mandatory non-credit courses, paired across the two semesters and rotated by group. No marks contribute to the Semester Grade Point Average; each is graded Satisfactory or Unsatisfactory. A Satisfactory grade in both is a condition of the award of the degree.

Grading components (both courses)

Component	What it consists of	Requirement	Course outcome
Attendance	Attendance across the semester	Not less than 75% (a necessary condition)	CO1–CO3
Assignment / essay	IKS: a sourced essay of about a thousand words on a documented Indian contribution relevant to the branch, and a site or museum visit report. Constitution: one assignment on a prescribed theme.	Both submitted and judged acceptable	IKS CO2, CO3 / Const. CO2, CO3
Class test	One class test of 25 marks over the course	At least 40% (10 of 25)	CO1, CO2

The Satisfactory / Unsatisfactory decision

- Satisfactory (S): attendance not less than 75%, both the assignment / essay (and, for IKS, the visit report) submitted and acceptable, and at least 50% in the class test.
- Unsatisfactory (US): any one of the above not met.
- A student graded Unsatisfactory is re-examined or re-assessed in a following semester; the grade does not enter the SGPA either way.
- A Satisfactory grade in both mandatory courses, across the two semesters, is a necessary condition of the award of the degree.

Assessed by the subject teacher and recorded by the college; no external examiner is required for a non-credit course. Records retained: the attendance register, the essay or assignment and visit report, the class-test scripts, and the Satisfactory / Unsatisfactory award sheet. Although non-credit, the Indian Knowledge System course remains the foundational IKS course required by the UGC Guidelines of 2023.

26-MC-182 /282— Indian Knowledge System

Course Code	26-MC-182	**Category**	Mandatory Course (Non-Credit)
Course Title	Indian Knowledge System	**L – T – P**	2 – 0 – 0
Credits	Nil	**Contact Hours**	24
Semester	First or Second (by group)	**Assessment**	Non-credit; Satisfactory / Unsatisfactory

Prerequisites

A mandatory non-credit course, paired with the Indian Constitution across the two semesters and rotated by group. It is self-contained and assumes no prior study and no knowledge of Sanskrit.

- No prerequisite; the course is introductory.
- No knowledge of Sanskrit is assumed; all primary material is read in translation.
- A general Class X familiarity with Indian history and geography is sufficient.

Course Objectives

- To introduce the classification, sources and vocabulary of the Indian knowledge traditions.
- To survey the Indian contribution to mathematics, astronomy, the sciences of materials and construction, and health and environment.
- To introduce the methods by which such knowledge was recorded and transmitted.
- To prepare the ground for the discipline-embedded Indian Knowledge System modules of the later years.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Describe the classification, principal sources and vocabulary of the Indian knowledge traditions.	L2 – Understand
CO2	Give examples of the Indian contribution to mathematics, science, materials and construction relevant to engineering.	L2 – Understand
CO3	Relate an element of the Indian knowledge tradition to the student's own branch of engineering.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	–	–	–	2	2	1	1	–	2
CO2	2	1	1	–	–	2	2	1	1	–	2
CO3	2	2	2	–	–	3	2	1	1	–	3

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Introduction to the Indian Knowledge System	The classification of the Indian knowledge traditions; the vidyāsthāna scheme; the primary sources and the vocabulary; the sūtra–vr□tti–bhāṣya form of recording knowledge; the oral and the manuscript tradition and their preservation.	5
II	Mathematics and Astronomy	The Indian number system and the place-value notation; śulba-sūtra geometry; the algorithmic tradition — Āryabhaṭa, Brahmagupta, Bhāskara; Piṅgala's combinatorics and binary enumeration; Indian astronomy and the yantras of the observatories, in outline.	7
III	Materials, Construction and Technology	Metallurgy — wootz (crucible) steel and the corrosion-resistant iron; construction — the Śilpa- and Vāstu-śāstra, temple and civic architecture, lime mortars and standardised brick; water — stepwells, tanks and traditional harvesting; the craft traditions and the śreṇī (guild) system.	7
IV	Health, Environment and the Engineering Connection	Āyurveda and the traditions of health in outline; the environmental and sustainability logic of the Indian traditions; the connection of the Indian knowledge tradition to the student's own branch, previewing the discipline-embedded modules of the later years.	5

Non-credit character. The course carries no credit and no marks contribute to the Semester Grade Point Average. It is a mandatory non-credit course, paired with the Indian Constitution across the two semesters and rotated by group, and a student must be graded Satisfactory to be eligible for the award of the degree. The grade is awarded by the college on attendance of not less than seventy-five per cent, one sourced short essay of about a thousand words on a documented Indian contribution relevant to the student's branch, one site or museum visit report, and one class test of twenty-five marks in which at least forty per cent is to be obtained. A student graded Unsatisfactory is re-examined in a following semester. Although non-credit, it is the foundational Indian Knowledge Systems course required by the UGC Guidelines of 2023 and the anchor of the discipline-embedded IKS modules of the later years.

Text and Reference Books

- B. Mahadevan, Vinayak Rajat Bhat and Nagendra Pavana R. N., Introduction to Indian Knowledge System: Concepts and Applications, PHI.
- Kapil Kapoor and Avadhesh Kumar Singh (eds.), Indian Knowledge Systems, D. K. Printworld.
- Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati.
- AICTE / Ministry of Education material on the Indian Knowledge System.

Suggested SWAYAM / NPTEL and Online Resources

- SWAYAM / NPTEL — Introduction to Indian Knowledge System / Indian Culture and Heritage, as offered.
- Resources of the IKS Division, Ministry of Education (iksindia.org).

Mandatory non-credit courses, paired across the two semesters and rotated by group. No marks contribute to the Semester Grade Point Average; each is graded Satisfactory or Unsatisfactory. A Satisfactory grade in both is a condition of the award of the degree.

Grading components (both courses)

Component	What it consists of	Requirement	Course outcome
Attendance	Attendance across the semester	Not less than 75% (a necessary condition)	CO1–CO3
Assignment / essay	IKS: a sourced essay of about a thousand words on a documented Indian contribution relevant to the branch, and a site or museum visit report. Constitution: one assignment on a prescribed theme.	Both submitted and judged acceptable	IKS CO2, CO3 / Const. CO2, CO3
Class test	One class test of 25 marks over the course	At least 40% (10 of 25)	CO1, CO2

The Satisfactory / Unsatisfactory decision

- Satisfactory (S): attendance not less than 75%, both the assignment / essay (and, for IKS, the visit report) submitted and acceptable, and at least 50% in the class test.
- Unsatisfactory (US): any one of the above not met.
- A student graded Unsatisfactory is re-examined or re-assessed in a following semester; the grade does not enter the SGPA either way.
- A Satisfactory grade in both mandatory courses, across the two semesters, is a necessary condition of the award of the degree.

Assessed by the subject teacher and recorded by the college; no external examiner is required for a non-credit course. Records retained: the attendance register, the essay or assignment and visit report, the class-test scripts, and the Satisfactory / Unsatisfactory award sheet. Although non-credit, the Indian Knowledge System course remains the foundational IKS course required by the UGC Guidelines of 2023.

Rubric Bank — the four-band scale for the qualitative components

Every qualitative component named in the schemes above is marked on this four-band scale. The band gives the fraction of the component's marks, and is published to the student before the task is set.

Sr.No	Criterion	Excellent (90–100%)	Good (70–89%)	Satisfactory (50–69%)	Needs Improvement (<50%)
1	Participation and regularity	Present and fully engaged throughout; initiates	Regular and engaged	Present, limited engagement	Irregular or passive
2	Discipline, conduct and responsibility	Exemplary; a model to peers	Consistently responsible	Generally acceptable	Repeated lapses
3	Skill / activity performance	Skilful, accurate, safe; near-independent	Competent and safe	Basic competence with guidance	Below the expected standard
4	Teamwork and interpersonal	Leads and enables the team	Collaborates effectively	Works in the team when directed	Works in isolation or disrupts
5	Communicati on (oral / GD / interview)	Clear, fluent, confident, well-structured	Clear and organised	Understandable, some hesitation	Unclear or disorganised
6	Task / artefact quality	Complete, correct, well-presented, original	Complete and correct	Mostly complete, minor errors	Incomplete or incorrect
7	Reflection quality	Insightful; links learning to the programme	Thoughtful and relevant	Descriptive, some reflection	Superficial or absent
8	Record / log / portfolio	Thorough, orderly, reproducible	Complete and orderly	Adequate	Sparse or disorganised

Applying the bands

- The assessor selects one band per criterion and awards the mid-point of the band unless a specific justification is recorded; the component mark is the sum, or weighted mean, across its criteria.
- For the NCC / NSS / Yoga participation, conduct and skill components, criteria 1–4 apply; for the SEC and the AEC courses, criteria 5–7; the record / log criterion applies wherever a log or portfolio is required.
- A copy of the completed rubric sheet is retained with the assessment record for audit.

26-BS-M201 — Mathematics – II

Course Code	26-BS-M201	**Category**	Basic Science Course
Course Title	Mathematics – II	**L – T – P**	3 – 0 – 0
Credits	3	**Contact Hours**	36
Semester	Second	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

Continues Mathematics-I and, like it, is generic to every branch. Assumed:

- The differential and integral calculus of Mathematics-I.
- Elementary vectors and the dot and cross product (CBSE XII Unit IV).
- First-order differential equations by separation of variables (CBSE XII Unit IX).
- Complex numbers in algebraic and polar form (CBSE XI; WBCHSE).

Course Objectives

- To develop the solution of ordinary differential equations, the principal analytical tool of engineering.
- To establish the transform methods and the vector calculus used across the later curriculum.
- To introduce the elements of complex-variable and Fourier methods on a common footing.
- To keep the treatment branch-neutral, discipline-specific mathematics being reserved to Mathematics-III.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Solve linear ordinary differential equations of first and higher order and apply them to elementary engineering models.	L3 – Apply
CO2	Apply the Laplace transform and its inverse to the solution of differential equations and initial-value problems.	L3 – Apply
CO3	Apply the differential and integral calculus of vectors, including the theorems of Green, Stokes and Gauss in outline.	L3 – Apply
CO4	Use the elements of complex-variable theory and of Fourier series in the analysis of engineering functions.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1	1	–	–	–	–	–	1
CO2	3	2	2	1	2	–	–	–	–	–	1
CO3	3	2	1	1	1	–	–	–	–	–	1
CO4	3	3	1	1	1	–	–	–	–	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Ordinary Differential Equations	Linear differential equations of the first order; exact equations and integrating factors; linear equations of higher order with constant coefficients; complementary function and particular integral; variation of parameters in outline; the Cauchy–Euler equation; elementary applications to growth, decay and oscillation, drawn generically.	9
II	Laplace Transform	The Laplace transform and its properties; transforms of standard functions; the inverse transform; the shifting theorems; the transform of derivatives and integrals; solution of linear differential equations and initial-value problems by the transform method; the unit-step function in outline.	9
III	Vector Calculus	Scalar and vector fields; gradient, divergence and curl and their physical meaning; line, surface and volume integrals; the theorems of Green, Gauss and Stokes in statement and elementary use.	9
IV	Complex Variables and Fourier Series	Functions of a complex variable; analyticity and the Cauchy–Riemann equations; harmonic functions; Cauchy's integral theorem and formula (statement, elementary use). Periodic functions and their Fourier-series representation; the Euler formulae; even and odd functions and half-range series. The Fourier and partial-differential extensions are left to Mathematics-III.	9

Cross-cutting notes. This is a generic mathematics course, common to every branch of the University; it deliberately carries no discipline-specific material. Where a programme requires mathematics particular to it — discrete structures and graph theory for the computing branches, additional transforms and complex analysis for the electronics and electrical branches, additional statistics and numerical methods for the others — that requirement is to be met either in Mathematics-III in Semester III, which each Department frames for its own programme, or in Module I of the relevant discipline course where it is small enough to be carried there. The first-year mathematics is thus kept uniform, so that the common first-year examination and inter-branch mobility are preserved.

Text and Reference Books

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- Erwin Kreyszig, Advanced Engineering Mathematics, Wiley.
- M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand.
- N. P. Bali and M. Goyal, A Textbook of Engineering Mathematics, Laxmi Publications.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Differential Equations for Engineers, 12 weeks.
- NPTEL — Integral and Vector Calculus, 12 weeks.
- NPTEL — Advanced Engineering Mathematics, 12 weeks.
- SWAYAM — Mathematics II (AICTE / SWAYAM), as offered.

Question-paper note. As in Mathematics-I the paper is predominantly a problem paper, and no question draws on discipline-specific material. At least one Group C question requires the solution of a differential equation by two distinct methods.

26-BS-BI101/201 — Biology for Engineers

Course Code	26-BS-BI201	**Category**	Basic Science Course
Course Title	Biology for Engineers	**L – T – P**	2 – 0 – 0
Credits	2	**Contact Hours**	26
Semester	Second	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

A two-credit course scoped at about twenty-six hours (13 h per credit). It is self-contained and assumes only the general science of Class X; a student without Higher Secondary Biology is fully provided for. Assumed:

- The general biology and chemistry of Class X (WBBSE / CBSE / ICSE Science).
- No Higher Secondary Biology is assumed; Module I supplies what such a student requires.
- Elementary chemistry to the level of the concurrent or preceding Chemistry course.

Course Objectives

- To present biology to the engineer as a source of design principles rather than as descriptive natural history.
- To establish the molecule, the cell and the gene as the units of living systems.
- To introduce the bio-engineering interfaces — biomechanics, biomaterials, sensors and biotechnology.
- To connect biological principle to engineering application across the branches.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Explain the molecular and cellular basis of living systems and the flow of genetic information.	L2 – Understand
CO2	Relate the structure and properties of biomolecules and biomaterials to their engineering use.	L3 – Apply
CO3	Explain the bio-engineering interfaces — biomechanics, biosensors and biotechnology — and their applications.	L2 – Understand
CO4	Draw an engineering analogy or design principle from a biological system.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1	1	1	–	–	–	1
CO2	3	2	2	1	1	1	2	–	–	–	1
CO3	2	2	2	1	2	2	2	–	–	–	2
CO4	2	3	3	2	2	2	2	–	–	–	2

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	The Cell and the Molecules of Life	Life as a chemical system; the cell as the structural and functional unit; prokaryotic and eukaryotic cells; the biomolecules — carbohydrates, lipids, proteins and nucleic acids — and their structure and function; enzymes as catalysts; bioenergetics in outline.	7
II	Genetics and the Flow of Information	The gene and the chromosome; the structure of DNA and RNA; replication, transcription and translation in outline; the genetic code; the elements of inheritance; an introduction to genetic engineering and its applications.	6
III	Biomaterials, Biomechanics and Bio-inspired Design	Natural materials — bone, wood, silk, shell — and their remarkable properties; biomaterials and biocompatibility in outline; the mechanics of the musculoskeletal system; bio-inspired and biomimetic design with engineering examples.	7
IV	Biotechnology, Biosensors and Applications	The elements of biotechnology and its industrial, agricultural and medical applications; the biosensor — principle and examples; bioinformatics in brief; the interface of biology with the engineering disciplines, including biomedical instrumentation and environmental biotechnology.	6

Cross-cutting notes. The course is deliberately application-facing: each module ends with an engineering analogy or design principle, so that the biology serves the engineer. It connects to the environmental and effluent content of the later years and, for the relevant branches, to biomedical and bioprocess electives.

Text and Reference Books

- Nelson and Cox, Lehninger Principles of Biochemistry (selected chapters), Macmillan.
- A. K. De, Biology for Engineers, university-level text.
- S. B. Primrose, Principles of Gene Manipulation (selected chapters), Blackwell.
- T. A. Brown, Biotechnology (introductory chapters).

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Biology for Engineers / Introductory Biology (IITs), 8 / 12 weeks.
- NPTEL — Bioengineering: An Interface with Biology and Medicine, 12 weeks.
- SWAYAM — Biology for Engineers, as offered.

Question-paper note. The paper is to test understanding and application rather than recall of biological detail. At least one Group C question is to ask the student to draw an engineering design principle from a biological system.

26-ES-CS101/201 — Programming for Problem Solving and Introduction to AI

Course Code	26-ES-CS201	**Category**	Engineering Science Course
Course Title	Programming for Problem Solving and Introduction to AI	**L – T – P**	3 – 0 – 0
Credits	3	**Contact Hours**	36
Semester	Second	**Assessment**	Theory: CA 30 + ESE 70

Prerequisites

A three-credit course of thirty-six hours, following the syllabus adopted by the University and carrying, in Module VIII, an introduction to Artificial Intelligence. It assumes no prior programming. Assumed:

- Computer Science or Informatics Practices of the Higher Secondary course where taken (CBSE XI–XII; WBCHSE Computer Application); otherwise nothing.
- The problem-solving mathematics of Mathematics-I.
- Where much of the class has programmed before, Modules I–II are compressed and the time given to Modules VI–VIII.

Course Objectives

- To develop computational thinking — decomposition, abstraction and algorithm design.
- To establish programming in C from first principles to pointers, structures and files.
- To introduce the analysis of an algorithm's efficiency.
- To introduce Artificial Intelligence — its concepts, types and applications — as the foundation for later study.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Explain the organisation of a digital computer and the translation of a high-level program.	L2 – Understand
CO2	Apply computational thinking — decomposition, abstraction and algorithm design — to a problem and express the solution as an algorithm and flowchart.	L3 – Apply
CO3	Write, test and debug C programs using control structures, functions, arrays, strings and pointers.	L3 – Apply
CO4	Use structures, files and the elementary search and sort algorithms, and reason about an algorithm's efficiency.	L4 – Analyse
CO5	Explain the concepts, types and applications of Artificial Intelligence and the distinction between human and machine intelligence.	L2 – Understand

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	–	–	–	–	–	2
CO2	3	3	2	2	2	–	–	–	–	–	2
CO3	3	3	3	2	3	–	–	1	–	–	2
CO4	3	3	2	3	3	–	–	–	–	–	2
CO5	2	2	2	1	2	1	1	–	1	–	3

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	Introduction to Computer	Information and data; the components of a digital computer — the CPU, primary and secondary storage, and input–output devices; system and application software; machine language, assembly language and high-level languages.	4
II	Generation of Computers	Super, mainframe, mini and personal computers; high-performance computing systems; graphics-processing-unit (GPU) computers.	2
III	Problem Solving and Computational Thinking	The stored-program idea; compiler, interpreter and the translation process; problem definition, decomposition, abstraction and pattern recognition; the algorithm and its properties; flowchart symbols and construction; pseudocode; stepwise refinement; testing an algorithm by hand tracing; the classification of errors — syntax, run-time and logical.	4
IV	Fundamentals of C	Structure of a C program; character set, identifiers and keywords; data types and qualifiers; constants and variables; operators, precedence and associativity; type conversion; formatted and unformatted input and output; conditional statements — if, if–else, nested if and switch; loops — while, do–while and for; break, continue and goto; nested loops.	5
V	Functions and Program Structure	The function as a unit of abstraction; declaration, definition and call; parameter passing by value; return values; scope and lifetime; storage classes; recursion and its trace — factorial, Fibonacci, greatest common divisor and the Towers of Hanoi; recursion compared with iteration; the preprocessor, macros and header files; modular design and separate compilation.	5
VI	Arrays, Strings and Pointers	One- and two-dimensional arrays — declaration, initialisation, traversal and passing to a function; matrix operations. Strings and the standard string library. Pointers — the address and dereference operators, pointer arithmetic, pointers and arrays, pointer to a function, array of pointers; call by reference; dynamic memory allocation with malloc, calloc, realloc and free; common pointer errors.	6
VII	Structures, Files and Algorithm Efficiency	Structures and unions; array of structures; nested structures; pointer to a structure; typedef and the enumerated type. File handling — text and binary streams, opening modes, reading and writing, random access and error handling; reading engineering data from a comma-separated file. Linear and binary search; bubble, selection and insertion sort; the order of growth and elementary comparison of algorithms.	4
VIII	Introduction to Artificial Intelligence	What Artificial Intelligence is and how it works; its advantages and disadvantages; a brief history; types of AI — weak and strong AI; machine learning and deep learning in outline. Defining intelligence and its components; the difference between human and machine intelligence; the agent and its environment; different applications of AI.	6

Cross-cutting notes. The concurrent laboratory (ES-CS291, Programming for Problem Solving Lab & AI Tools) carries the practice, including the AI-tools exercises that accompany Module VIII. The course is the entry point of the computational thread that runs through every programme, and Module VIII opens the artificial-intelligence content that the later years develop.

Text and Reference Books

- E. Balagurusamy, Programming in ANSI C, McGraw-Hill.
- Kernighan and Ritchie, The C Programming Language, Pearson.
- Byron Gottfried, Programming with C (Schaum's Outline), McGraw-Hill.
- Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (introductory chapters), Pearson.
- Reema Thareja, Programming in C, Oxford University Press.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Problem Solving through Programming in C (IIT Kharagpur), 12 weeks.
- NPTEL — Introduction to Programming in C, 8 / 12 weeks.
- NPTEL — An Introduction to Artificial Intelligence / AI: Search Methods for Problem Solving, 12 weeks.
- SWAYAM — Programming in C; Introduction to AI, as offered.

Question-paper note. At least half the marks of Groups B and C require the writing or reading of C code. At least one Group C question is on Module VIII (Artificial Intelligence). Dry-run and output-prediction questions are encouraged in Group A.

26-VAC-201 — Environmental Science

Course Code	26-VAC-201	**Category**	Value-Added Course
Course Title	Environmental Science	**L – T – P**	3 – 0 – 0
Credits	3	**Contact Hours**	42
Semester	Second	**Assessment**	Theory: CA 30 + ESE 70 (with a compulsory field / activity portfolio in the WCA)

Prerequisites

A compulsory course for every undergraduate under the direction of the Hon'ble Supreme Court of India and the consequent UGC syllabus, here integrated with the University Grants Commission's draft Guidelines and Curriculum Framework on Mission LiFE (Lifestyle for Environment). It is self-contained. Assumed:

- The general science, geography and civics of Class X (WBBSE / CBSE / ICSE).
- No Higher Secondary environmental science is assumed.
- A smartphone or shared institutional device for the Meri LiFE portal and app activities of Module V; the institution arranges access for any student who lacks one.

Course Objectives

- To establish the structure and functioning of natural systems and the environmental crisis the engineer's work must reckon with.
- To ground the student in India's environmental law, policy, national missions and the UN Sustainable Development Goals.
- To introduce Mission LiFE — its genesis, seven themes, and the theory and practice of behavioural change.
- To convert the above into measured practice through footprint accounting, environmental audits and a documented behavioural-change portfolio.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Explain the structure and functioning of ecosystems, the value of biodiversity and the ecosystem services on which human activity depends.	L2 – Understand
CO2	Analyse the principal forms of environmental pollution and the triple planetary crisis and relate them to lifestyle and consumption.	L4 – Analyse
CO3	Explain India's environmental law, policy, national missions and SDG commitments.	L2 – Understand
CO4	Explain Mission LiFE — its genesis, pillars of Demand, Supply and Policy, and seven themes — and the principal theories of behavioural change.	L3 – Apply
CO5	Conduct a footprint calculation and an environmental audit and design and document a behavioural-change intervention using the Meri LiFE framework.	L5 – Evaluate

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	–	3	1	–	1	–	2
CO2	3	3	1	2	1	3	1	–	1	–	2
CO3	2	2	1	1	–	3	2	–	1	1	2
CO4	2	2	2	1	1	3	3	1	2	1	3
CO5	2	3	3	3	2	3	2	2	2	1	3

Course Plan — Module-wise Syllabus

Module	Title	Contents	Hours
I	The Environment, Ecosystems and Biodiversity	The multidisciplinary nature of environmental studies; natural resources — forest, water, soil, mineral, food and energy — and the consequences of their over-use. The structure and function of an ecosystem; energy flow, the food chain and the ecological pyramid. Biodiversity — genetic, species and ecosystem; its value and the ecosystem services it renders; threats and conservation, with reference to India as a mega-diverse country.	9
II	Environmental Pollution and the Global Challenges	Air, water, soil, noise and thermal pollution — sources, effects and control; solid, hazardous and electronic waste and its management; the triple planetary crisis of climate change, pollution and biodiversity loss; global water resources, microplastics and groundwater over-extraction; the linkage between lifestyle and consumption and environmental impact, and the ecological and carbon footprint. [Mission LiFE Units I–II.]	8
III	India's Sustainability Policy and Legal Framework	The constitutional provisions and the principal environmental legislation — the Water, Air and Environment (Protection) Acts, the Wildlife Protection and Forest Conservation Acts — and the institutional framework; India's climate policy, Nationally Determined Contributions and SDG commitment. India's national missions — the National Solar Mission, Green Hydrogen Mission, Jal Jeevan Mission, Atal Bhujal Yojana, Smart Cities Mission and AMRUT — and their relation to Mission LiFE. [Mission LiFE Unit III.]	8
IV	Mission LiFE and Behavioural Change	Mission LiFE (Lifestyle for Environment) — context, genesis, launch, and promotion nationally and internationally; the pillars of Demand, Supply and Policy; sustainable living as a mass movement and the circular economy of mindful consumption. The role of individual and collective behaviour; theories of behavioural change and their maintenance; the design of a behavioural nudge; India's own traditions of sustainability. [Mission LiFE Units IV and, in part, I.]	8
V	The Seven Themes of Mission LiFE, and Practice	The seven themes — Save Energy, Save Water, Reduce Single-Use Plastic, Adopt Sustainable Food Systems, Reduce Waste, Adopt Healthy Lifestyles, and Reduce E-Waste — and the eco-friendly practices under each. Communication for behavioural change; the Meri LiFE portal and app and other innovations for mass engagement; community engagement and social responsibility. The whole-semester component of the course is the field-and-activity portfolio built on this module. [Mission LiFE Units V–VI.]	9

Cross-cutting notes. This course delivers the University's environmental-education obligation and the national Mission LiFE programme together; the bracketed references map the modules to the six Mission LiFE units, so a college satisfies both from a single course. The field-and-activity portfolio is compulsory: a student who does not submit it is not to be passed, since both requirements are directed at practice. It connects to the Environment-and-Sustainability graduate attribute (PO6, The Engineer and the World) and to the water, effluent and cleaner-production courses of the later years.

Text and Reference Books

- Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, UGC / Universities Press.
- University Grants Commission, Guidelines and Curriculum Framework on Mission LiFE at the Undergraduate Level (draft) — integrated into Modules II–V.
- NITI Aayog, LiFE — Lifestyle for Environment; and Thinking for Our Planet: 75 Ideas to Promote LiFE.
- MoEFCC, Parampara — India's Culture of Climate-Friendly Sustainable Practices; and Prayaas Se Prabhaav Tak (MoEFCC and UNDP, 2022).
- IPCC, Synthesis Report of the Sixth Assessment Report (2023); India State of Forest Report, Forest Survey of India.
- Y. Anjaneyulu, Introduction to Environmental Science, BS Publications.

Suggested SWAYAM / NPTEL and Online Resources

- Mission LiFE portal and Meri LiFE app (missionlife-moefcc.nic.in; merilife.nic.in) — for the activity and reporting component.
- SWAYAM / NPTEL — Environmental Studies / Sustainability, as offered.
- WWF and Global Footprint Network carbon- and ecological-footprint calculators — for the footprint activities.

Question-paper note. The end-semester paper covers Modules I–IV; Module V is assessed through the portfolio, not by written examination, since it is a module of practice. At least one Group C question relates a lifestyle or consumption pattern to its environmental consequence and to a Mission LiFE theme. Prescribed data — emission and footprint factors — are printed with the paper.

26-ES-CS191/291 — Programming for Problem Solving Lab & AI Tools

Course Code	26-ES-CS291	**Category**	Engineering Science Course
Course Title	Programming for Problem Solving Lab & AI Tools	**L – T – P**	0 – 0 – 4
Credits	2	**Contact Hours**	48
Semester	Second	**Assessment**	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with ES-CS201 and sequenced to follow its modules. A two-credit laboratory of about forty-eight hours, carrying both the C-programming practice and the introductory AI-tools exercises. Assumed:

- The development-environment induction (editor, compiler and debugger), in the first session.
- No prior programming; the laboratory begins from the first program.
- The theory of ES-CS201, taken concurrently.

Course Objectives

- To develop competence in writing, compiling, testing and debugging C programs.
- To implement the control structures, functions, arrays, strings, pointers, structures and files of the theory.
- To implement elementary search and sort algorithms and reason about their behaviour.
- To introduce, through guided exercises, the use of contemporary AI tools for problem solving and for assisted programming.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Write, compile, test and debug a C program in a standard development environment.	L3 – Apply
CO2	Implement control structures, functions and recursion to solve a computational problem.	L3 – Apply
CO3	Implement programs using arrays, strings, pointers, structures and files.	L4 – Analyse
CO4	Implement and compare elementary search and sort algorithms.	L4 – Analyse
CO5	Use an AI tool responsibly to explore, prototype or explain a solution, and evaluate its output critically.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	3	–	1	1	1	–	2
CO2	3	3	3	2	3	–	–	1	–	–	2
CO3	3	3	3	3	3	–	–	1	–	–	2
CO4	3	3	2	3	3	–	–	1	–	–	3
CO5	2	2	2	2	3	1	2	2	2	–	3

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Familiarisation with the development environment; the first program; compilation, the classification of errors and debugging.	CO1
2	Programs on operators, type conversion and formatted input and output.	CO1, CO2
3	Programs using if, if–else, nested if and switch.	CO2
4	Programs using while, do–while, for and nested loops (series, factorial, prime, patterns).	CO2
5	Programs using functions and parameter passing; recursion — factorial, Fibonacci, GCD, Towers of Hanoi.	CO2
6	Programs on one- and two-dimensional arrays and matrix operations.	CO3
7	Programs on strings and the string library.	CO3
8	Programs using pointers, call by reference and dynamic memory allocation.	CO3
9	Programs using structures, array of structures, and files (reading engineering data from a CSV).	CO3
10	Implementation of linear and binary search and of bubble, selection and insertion sort, with a count of comparisons.	CO4
11	AI-tools exercise 1 — using an AI assistant to explain, debug or optimise a C program, and critically evaluating its output for correctness.	CO5
12	AI-tools exercise 2 — using an AI or no-code tool to solve a small data or classification problem, and reflecting on its capabilities and limits.	CO5

A student is to perform not fewer than ten programming exercises and both AI-tools exercises. The AI-tools exercises are to emphasise responsible and critical use — the student must verify, not merely accept, the tool's output, and must be able to explain the code submitted.

Text and Reference Books

- E. Balagurusamy, Programming in ANSI C, McGraw-Hill.
- Byron Gottfried, Programming with C (Schaum's Outline), McGraw-Hill.
- Laboratory manual, Programming for Problem Solving, MAKAUT (to be issued).

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Problem Solving through Programming in C (with programming assignments), 12 weeks.
- SWAYAM / Future Skills Prime — introductory AI and Python tool courses, as approved.

Indicative Assessment Map

Component	Coverage	Outcomes
Practical CA – I (PCA1, 40)	First cycle — C programming (control, functions, arrays, strings): conduct 10, program and output 10, debugging and result 10, viva 10	CO1, CO2, CO3
Practical CA – II (PCA2, 40)	Second cycle — pointers, structures, files, algorithms and the AI-tools exercises, on the same rubric	CO3, CO4, CO5
End-Semester Practical Examination (60)	Record, performance and viva-voce before an external examiner	All COs

Part VI — Detailed Syllabi: Sessional and Non-Credit Mandatory Courses

A. What a sessional course is, and which courses this document covers

A sessional course is assessed wholly by internal, continuous evaluation across the semester, against published rubrics, rather than by a single end-of-semester written theory paper. In the first-year structure the courses below are assessed on a sessional or continuous basis, and are covered here. Marks are out of 100 unless the course is non-credit, in which case it is graded Satisfactory or Unsatisfactory.

Code	Course	Credits / L-T-P	Assessment basis
26-AEC-281	Language Laboratory	1 (0-0-2)	Pure sessional — 100 marks, wholly internal continuous evaluation
26-AEC-282	Essentials for Professional Skills	1.5 (0-0-3)	Pure sessional — 100 marks, wholly internal continuous evaluation
26-SEC-282	Skill Enhancement Course — MOOCs / Skills	2 (0-0-4)	Sessional / MOOC — 100 marks; as SEC-181, a fuller course
26-MC-181/281	Indian Constitution	Non-credit (2-0-0)	Sessional, non-credit — graded Satisfactory / Unsatisfactory
26-MC- 182/282	Indian Knowledge System	Non-credit (2-0-0)	Sessional, non-credit — graded Satisfactory / Unsatisfactory

B. General principles governing every sessional assessment

Principle	What it means
Continuous, not terminal	Assessment is distributed across the whole semester in at least two cycles; no sessional course is settled by a single end-point exercise.
Rubric published in advance	Every qualitative component is marked against a written rubric (the Rubric Bank at the end of this document) given to the student before the task is set.
Assessor and moderation	The subject teacher or stream in-charge assesses; a sessional committee of the department moderates. An external examiner is associated with the final evaluation of every credit-bearing sessional course, but not the non-credit courses.
Minimum conditions	Attendance of not less than 75% is a necessary but not sufficient condition of a pass; the student must also secure at least 40% of the sessional marks, or, for a non-credit course, a Satisfactory grade.
Outcome attainment	Course-Outcome attainment is computed as in Part I of the syllabus — 80% from the direct marks mapped to each outcome and 20% from an outcome-based student feedback instrument.
Records for NBA / NAAC	Attendance registers, rubric sheets, log books, artefacts, certificates and the assessment sheet are retained for not fewer than three assessment years, as the NBA continuous-improvement criterion requires.
Uniformity across colleges	The scheme, the components and the rubrics are uniform across every affiliated college; a college may not vary the marks distribution.

26-AEC-281 — Language Laboratory

Course Code	26-AEC-281	**Category**	Ability Enhancement Course
Course Title	Language Laboratory	**L – T – P**	0 – 0 – 2
Credits	1	**Contact Hours**	28
Semester	Second	**Assessment**	Sessional: ESE 100

Prerequisites

A one-credit laboratory of about twenty-eight hours, carrying the intensive listening-and-speaking practice that complements English for Communication Skills (AEC-101). A diagnostic places students in graded groups. Assumed:

- The English of AEC-101 (Semester I), taken as the companion.
- The first-week diagnostic, used for placement and not for marks.
- Access to the language-laboratory software or a suitable substitute.

Course Objectives

- To develop listening comprehension and correct pronunciation.
- To build fluency and confidence in speaking.
- To practise the group discussion, the interview and the presentation.
- To prepare the student for the spoken-communication demands of employability.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Listen to and comprehend spoken English of varied accents and speeds.	L3 – Apply
CO2	Speak with acceptable pronunciation, stress and intonation.	L3 – Apply
CO3	Participate effectively in a group discussion and an interview.	L3 – Apply
CO4	Deliver a short prepared and an extempore presentation.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	–	–	2	1	1	2	3	–	2
CO2	1	–	–	–	1	1	–	2	3	–	2
CO3	1	1	–	–	1	1	1	3	3	–	2
CO4	1	1	1	–	2	1	1	3	3	1	2

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Listening — comprehension of dialogues, talks and technical audio; note-taking from listening.	CO1
2	Phonetics in outline — the sounds of English, word stress and intonation; pronunciation practice.	CO2
3	Conversation practice — introductions, everyday and professional situations, telephone etiquette.	CO2
4	The group discussion — conventions, practice and self-review from recording.	CO3
5	The interview — the personal interview, common questions, and mock interviews.	CO3
6	The presentation — preparing and delivering a short prepared and an extempore talk, with peer and recorded review.	CO4

The laboratory is conducted in graded groups from the diagnostic. Each student's group discussion, interview and presentation are recorded and reviewed. Assessment is continuous and by direct observation against a rubric.

Text and Reference Books

- Board of Editors, A Course in Communication Skills and Language Laboratory Practice, Orient BlackSwan.
- Meenakshi Raman and Sangeeta Sharma, Technical Communication (listening and speaking chapters), Oxford.
- D. Jones, English Pronouncing Dictionary, Cambridge, for reference.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Speaking Effectively / Enhancing Soft Skills and Personality, 8 / 12 weeks.
- SWAYAM — Communication Skills, as offered.

Assessment components (total 100 marks)

Sl.	Component	Marks	Weight	How it is assessed (rubric / evidence)
1	Listening comprehension	20	20%	Continuous listening practice and a listening-comprehension test. (CO1)
2	Pronunciation and speaking	20	20%	Continuous observation of pronunciation, stress and intonation, and conversation practice, on the communication rubric. (CO2)
3	Group discussion	20	20%	A recorded group discussion, assessed on the communication rubric with self-review. (CO3)
4	Mock interview	15	15%	A personal mock interview, on the communication rubric. (CO3)
5	Presentation	20	20%	A short prepared and an extempore presentation, with peer and recorded review. (CO4)
6	Attendance and participation	5	5%	From the attendance register and observed engagement across the semester.
	Total	100	100%	

Conduct across the semester

Cycle	Indicative weeks	Components assessed	Marks
Cycle 1	Weeks 3–7	Listening comprehension; pronunciation and speaking	40
Cycle 2	Weeks 9–14	Group discussion; mock interview; presentation	55
Continuous	Throughout	Attendance and participation	5
Final consolidation	Week 15	Review and consolidation of the marks, with the external examiner associated	—

Minimum requirements and records

- Attendance not less than 75% (a necessary condition); at least 40% in the aggregate (40 of 100).
- Completion of the listening test, the group discussion, the mock interview and the presentation.

Records retained: the rubric sheet for each component; the listening-test record; the recordings of the group discussion, the mock interview and the presentation; and the consolidated mark sheet.

26-AEC-282 — Essentials for Professional Skills

Course Code	26-AEC-282	**Category**	Ability Enhancement Course
Course Title	Essentials for Professional Skills	**L – T – P**	0 – 0 – 3
Credits	1.5	**Contact Hours**	36
Semester	Second	**Assessment**	Sessional: ESE 100

Prerequisites

A one-and-a-half-credit practical course of about thirty-six hours, developing the professional and life skills that the workplace and the later curriculum assume. It is activity-based throughout. Assumed:

- No prior study; the course is self-contained and experiential.
- A willingness to participate in individual and group activities and to be assessed on them.
- The communication foundation of AEC-101 and AEC-281.

Course Objectives

- To develop self-management — goal-setting, time management and learning to learn.
- To develop critical and creative thinking and problem-solving.
- To develop team-working, leadership and interpersonal skills.
- To develop career-readiness — the résumé, the interview and professional ethics and etiquette.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Apply self-management techniques — goal-setting, time management and reflective learning.	L3 – Apply
CO2	Apply critical- and creative-thinking methods to a problem and present a reasoned solution.	L3 – Apply
CO3	Work effectively in a team and demonstrate elementary leadership and interpersonal skills.	L3 – Apply
CO4	Reason through a professional-ethics case and articulate a defensible position.	L4 – Analyse
CO5	Prepare a résumé and perform in a mock interview to a professional standard.	L3 – Apply

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	1	1	1	1	2	3	2	2	3
CO2	1	3	2	2	1	1	1	2	2	1	3
CO3	1	1	1	1	1	2	2	3	3	2	3
CO4	1	2	1	1	1	3	3	2	2	1	2
CO5	1	1	1	1	2	2	2	2	3	2	3

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	Self-awareness and goal-setting — a personal SWOT and a goal and time-audit portfolio.	CO1
2	Time management and learning to learn — planning tools and a reflective learning log.	CO1
3	Critical thinking — argument, evidence and fallacy; a structured problem-solving task.	CO2
4	Creative thinking — idea generation and a small design-thinking exercise.	CO2
5	Team-working — a team task with defined roles and peer assessment.	CO3
6	Leadership and interpersonal skills — a role-play and a recorded group discussion.	CO3
7	Professional ethics — a written ethical-case analysis and a class discussion.	CO4
8	Career readiness — preparing the résumé and the covering letter, and a mock interview.	CO5

The course is assessed wholly by continuous evaluation of the activities against rubrics, with an external examiner associated with the final assessment. Attendance and participation are necessary conditions of a pass.

Text and Reference Books

- Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press.
- E. H. McGrath and S. J. Bhagawan, Basic Managerial Skills for All, PHI.
- Stephen Covey, The 7 Habits of Highly Effective People (selected), Simon & Schuster.
- Institute training material on employability and professional ethics, MAKAUT.

Suggested SWAYAM / NPTEL and Online Resources

- NPTEL — Enhancing Soft Skills and Personality (IIT Kanpur), 12 weeks.
- NPTEL — Developing Soft Skills and Personality / Effective Writing, as offered.
- SWAYAM / Future Skills Prime — employability and professional-skills courses, as approved.

Assessment components (total 100 marks)

Sl.	Component	Marks	Weight	How it is assessed (rubric / evidence)
1	Self-management portfolio	20	20%	A personal SWOT, a goal and time-audit, and a reflective learning log, on the self-management rubric. (CO1)
2	Critical- and creative-thinking task	20	20%	A structured problem-solving task and a small design-thinking exercise, on the thinking rubric. (CO2)
3	Team task and interpersonal skills	15	15%	A team task with defined roles and peer assessment, and a role-play or recorded group discussion. (CO3)
4	Professional-ethics case analysis	15	15%	A written analysis of a professional-ethics case and a class discussion, on the reasoning rubric. (CO4)
5	Career readiness — résumé and mock interview	25	25%	The résumé and covering letter, and a mock interview before the assessor, on the communication rubric. (CO5)
6	Attendance and participation	5	5%	From the attendance register and observed engagement across the semester.
	Total	100	100%	

Conduct across the semester

Cycle	Indicative weeks	Components assessed	Marks
Cycle 1	Weeks 3–7	Self-management portfolio; critical- and creative-thinking task	40
Cycle 2	Weeks 9–14	Team task; professional-ethics case; career readiness (résumé and mock interview)	55
Continuous	Throughout	Attendance and participation	5
Final consolidation	Week 15	Review and consolidation of the marks, with the external examiner associated	—

Minimum requirements and records

- Attendance not less than 75% (a necessary condition); at least 40% in the aggregate (40 of 100).
- Completion of all five activity components — the portfolio, the thinking task, the team task, the ethics case and the career-readiness component.

Records retained: the rubric sheet for each component; the self-management portfolio; the thinking-task and ethics-case scripts; the résumé and covering letter; the recording of the team task or group discussion; and the consolidated mark sheet.

26-SEC-282 (0-0-4, 2) — Skill Enhancement Course — MOOCs / Skills

Course Code	26-SEC-282 (0-0-4, 2)	**Category**	Skill Enhancement Course
Course Title	Skill Enhancement Course — MOOCs / Skills	**L – T – P**	See note
Credits	2 (26-SEC-282)	**Contact Hours**	As per the credit of the chosen course
Semester	First and Second	**Assessment**	Sessional: as per the mode of the chosen course

Prerequisites

A skill course taken from a specified, published basket — through SWAYAM Plus, Future Skills Prime, an approved MOOC, or a practical / hands-on / soft-skill course offered by the institution or University. SEC-181 in Semester I carries one credit; SEC-282 in Semester II carries two credits. The Department publishes the basket, with the outcomes, mode, effort, assessment and fallback of each entry, before registration each session; the student chooses from the basket, not from the whole of a platform.

- The prerequisite of the specific course chosen, as stated in the published basket.
- Registration on the platform, and mentor allocation by the Department.
- For a credit-bearing MOOC, the proctored examination the platform requires.

Course Objectives

- To bring an employable practical skill to the student from the first year.
- To place at least part of the first year on a national digital-learning platform, on the University's early-mover credit-transfer policy.
- To let the student begin to shape the degree towards an interest or a specialisation.
- To do so under a specified and quality-assured basket rather than an open choice.

Course Outcomes

On completion of the course the student will be able to:

CO	Statement	Bloom
CO1	Complete an approved skill or MOOC course and demonstrate the skill it certifies.	L3 – Apply
CO2	Apply the skill to a small task, problem or artefact.	L3 – Apply
CO3	Reflect on the learning and relate it to the programme and to employability.	L4 – Analyse

CO–PO Articulation Matrix

Correlation: 3 substantial, 2 moderate, 1 slight, – none. Mapped against the eleven Programme Outcomes of the NBA (GAPC v4.0).

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	1	3	–	–	1	1	–	3
CO2	2	2	2	1	3	–	–	1	1	–	3
CO3	1	1	1	1	2	1	1	1	1	–	3

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO
1	An indicative basket — digital productivity and office tools; an introduction to Python; computer-aided drafting; an introduction to the Internet of Things; a communication, entrepreneurship or financial-literacy skill.	CO1
2	Completion of the chosen course with its certificate or the institutional assessment.	CO1
3	A small applied task, artefact or portfolio demonstrating the skill.	CO2
4	A short reflective note relating the skill to the programme.	CO3

The credit is awarded on completion of the chosen course and the associated applied task, verified by the mentor. For a SWAYAM course the platform's proctored score is used; for an institutional course the internal assessment is used. The specified basket, with outcomes and a named fallback against each entry, is a matter for the Board (Part X) and is to be published before registration.

Text and Reference Books

- As prescribed by the specific course chosen from the published basket.

Suggested SWAYAM / NPTEL and Online Resources

- SWAYAM Plus and SWAYAM — the approved credit-bearing courses of the published basket.
- Future Skills Prime (NASSCOM – MeitY) — approved digital-skill courses.
- NPTEL — short (4 / 8-week) skill courses aligned to the basket, as approved.

26-SEC-282 (2 cr, 0-0-4, Sem II) — Skill Enhancement Course (MOOCs / Skills)

A sessional course taken from the specified, published basket, in one of two modes — an approved SWAYAM / NPTEL MOOC, or an institutional skill course. It carries 100 marks in either mode. SEC-181 is the shorter, one-credit course and SEC-282 the fuller, two-credit course. The department mentor verifies completion; for a MOOC the platform's proctored score is authoritative for its part.

Course Outcomes assessed

CO	Statement
CO1	Complete an approved skill or MOOC course and demonstrate the skill it certifies.
CO2	Apply the skill to a small task, problem or artefact.
CO3	Reflect on the learning and relate it to the programme and to employability.

Assessment components and marks

Sl.	Component	Marks	Weight	How it is assessed (rubric / evidence)
1	Course completion and proctored score	60	60%	MOOC mode: the platform's proctored final score, scaled to 60. Institutional mode: a continuous skill assessment (40) and a skill-demonstration test (20). (CO1)
2	Applied task / artefact	25	25%	A task, artefact or mini-project applying the skill, verified by the mentor against a rubric. (CO2)
3	Reflective note	15	15%	A short note relating the skill to the programme and to employability, on the reflection rubric. (CO3)
	Total	100	100%	

The two delivery modes at a glance

Mode	Component 1 (60)	Comp. 2 (25)	Comp. 3 (15)	Best suited to
MOOC (SWAYAM / NPTEL / Future Skills Prime)	Proctored platform score, scaled to 60	Applied task	Reflection	A college without the faculty to teach the skill in house
Institutional skill course	Continuous assessment 40 + demonstration test 20	Applied task	Reflection	A skill the college can deliver and assess directly

Minimum requirements to pass

- MOOC mode: the platform completion certificate with a passing proctored score. Institutional mode: at least 40% in the skill assessment.
- Mentor verification of the applied task is mandatory in both modes.
- At least 40% in the aggregate (40 of 100).
- The chosen course must be from the basket published by the department before registration.

Assessor, moderation and records

Assessed and moderated by	Evidence retained (NBA / NAAC)
The department-allocated mentor, internally; moderated by the sessional committee. For a MOOC the SWAYAM / NPTEL proctored score is used directly for component 1. External examiner associated with the final evaluation.	The published basket for the session; the platform certificate and score report (MOOC mode) or the skill-assessment sheet (institutional mode); the applied task / artefact; the reflective note; the mentor verification; and the consolidated assessment sheet.

Part VII — Sources and Benchmarking

VII.1 Policy and regulatory instruments

- Ministry of Education, Government of India. National Education Policy 2020.
- University Grants Commission. Curriculum and Credit Framework for Undergraduate Programmes, 2022.
- University Grants Commission. Guidelines for Incorporating Indian Knowledge System in Higher Education Curricula, 2023; and the draft Guidelines and Curriculum Framework on Mission LiFE at the Undergraduate Level.
- All India Council for Technical Education. Model Curriculum for Undergraduate Degree Courses in Engineering and Technology — the first-year common syllabus, Universal Human Values and the mandatory course list.
- National Board of Accreditation. GAPC v4.0 accreditation framework (Washington Accord aligned) — the eleven Programme Outcomes of Part I and the attainment framework.
- National Assessment and Accreditation Council. Revised Assessment and Accreditation Framework — Criteria 1 and 2.
- Bureau of Indian Standards, SP 46 — Engineering Drawing Practice, for the Graphics course.
- Direction of the Hon'ble Supreme Court of India on compulsory environmental education, and the consequent UGC syllabus.

VII.2 University documents

- MAKAUT, WB. Finalised NEP 2020 Compliant Curriculum Structure for the First Year (B.Tech. First Year, MAKAUT 2026), effective A.Y. 2026–27 — reproduced in Part V.
- MAKAUT, WB. Suggested modifications to the Basic Electrical and Electronics Engineering theory and laboratory syllabus — incorporated in ES-EE101 and ES-EE191.
- MAKAUT, WB. Detailed syllabus of ES-CS201 Programming for Problem Solving (with the Introduction to Artificial Intelligence module) — incorporated in ES-CS201 and ES-CS291.

VII.3 School syllabi consulted for the prerequisite mapping

- West Bengal Council of Higher Secondary Education — Mathematics, Physics, Chemistry, Biology, Computer Application and English, Classes XI and XII.
- Central Board of Secondary Education — the corresponding subjects, Classes XI and XII.
- Council for the Indian School Certificate Examinations — the ISC syllabuses for the corresponding subjects.
- West Bengal Board of Secondary Education — Class X Science and Mathematics.

VII.4 Institutional syllabi consulted

The first-year syllabi of the following were examined for the module sequence, depth and treatment of the common first year. No syllabus has been adopted; the responsibility for the content is the University's.

- Indian Institute of Technology Kharagpur and Madras — first-year core courses, the Physics and Chemistry laboratories, and Problem Solving through Programming.
- Jadavpur University, Faculty of Engineering and Technology — first-year Mathematics, Physics, Chemistry and Basic Electrical and Electronics.
- National Institute of Technology Durgapur and IIEST Shibpur — first-year common curriculum, workshop and graphics.
- Anna University Regulation 2023 and Visvesvaraya Technological University 2022 scheme — NEP-aligned first-year structures and the Physics/Chemistry group rotation.
- AICTE model first-year cycle-rotation scheme, and the AICTE model syllabus for the Introduction to Artificial Intelligence content.