MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

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DETAILED SYLLABUS

First Year — Semesters I and II

Common to all Bachelor of Technology programmes of the University

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

Outcome-Based · NEP 2020 · NAAC and NBA Aligned

Basic-science cycle rotated across the two semesters (Physics group / Chemistry group)

Part I — The Outcome-Based Framework

I.1 Programme Outcomes

The twelve graduate attributes of the National Board of Accreditation are adopted as the Programme Outcomes of every B.Tech. programme of the University. They are stated below in the abbreviated form used in the articulation matrices of this document.

PO	Attribute	What the graduate is expected to be able to do
PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals and the specialisation to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, review the literature on, and analyse complex engineering problems, reaching substantiated conclusions from first principles.
PO3	Design / development of solutions	Design solutions and system components or processes that meet specified needs with due regard for public health, safety, culture and environment.
PO4	Investigation of complex problems	Use research-based knowledge and methods — design of experiment, analysis and interpretation of data — to reach valid conclusions.
PO5	Modern tool usage	Create, select and apply appropriate techniques, resources and modern engineering and information-technology tools, with an understanding of their limitations.
PO6	The engineer and society	Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the responsibilities that follow.
PO7	Environment and sustainability	Understand the impact of engineering solutions in societal and environmental contexts and demonstrate knowledge of sustainable development.
PO8	Ethics	Apply ethical principles and commit to professional ethics, responsibilities and the norms of engineering practice.
PO9	Individual and team work	Function effectively as an individual, as a member of a team and as a leader in diverse and multidisciplinary settings.
PO10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large.
PO11	Project management and finance	Demonstrate knowledge and understanding of engineering and management principles and apply them to the management of projects.
PO12	Life-long learning	Recognise the need for, and have the preparation and ability to engage in, independent and life-long learning.

Programme Specific Outcomes are framed by each Department for its own programme. Because the courses in this document are common to all programmes, no PSO mapping is given here; each Department is to add its own column when the syllabus is adopted into its programme handbook.

I.2 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 end-semester paper and the ECA.
L2 – Understand	explain, describe, classify	Explain a principle in the student's own words or interpret a diagram or a curve. Groups A and B.
L3 – Apply	compute, solve, use	Work a problem or a laboratory procedure by an established method. Groups B and C, and the whole practical assessment.
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 stated 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 exercises of Graphics and in the project components of later years.

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. That discontinuity differs by board and is different again for the student who left a subject at Class X. 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 and determinants, vectors, complex numbers, first-order differential equations	CBSE XII Units II–IV; WBCHSE; ISC	Ten-hour non-credit bridge in the first three weeks, recorded in the whole-semester component
Physics	Oscillations and waves; optics; electrostatics and current electricity; modern physics	CBSE XI Units VII, X, XII Units I–IX; WBCHSE; ISC	Module I begins from the differential equation of SHM, new to all; earlier material revised in two hours
Chemistry	Atomic structure and bonding; thermodynamics, equilibrium, electrochemistry; basic organic chemistry	CBSE XI Units II–IV, VI; XII Units III–IV, X–XI; WBCHSE; ISC	Three-hour bridge on atomic structure, bonding and the mole concept for students without Class XII Chemistry
Biology for Engineers	General science of Class X; Higher Secondary Biology where taken	WBBSE / CBSE / ICSE Class X; CBSE XII Biology where taken	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 logic gates	CBSE XII Units II–IV, IX; WBCHSE; ISC	The mesh and nodal methods are taught from first principles, assuming only Kirchhoff's laws
Programming for Problem Solving	Computer Science / Informatics Practices where taken; otherwise nothing	CBSE XI–XII; WBCHSE Computer Application	No programming assumed; where much of the class has taken it, Modules I–II are compressed
English / Language Lab	English of the Class XII course	WBCHSE / CBSE / ISC English	A first-week diagnostic test places students in graded groups for the Language Laboratory
Graphics & Workshop	Plane and solid geometry; coordinate geometry in three dimensions	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 Social Science and Science	Self-contained; no prior study, and no knowledge of Sanskrit, is assumed

Three provisions apply across the whole of the first year. First, the Mathematics bridge is conducted for the whole class, since it establishes the notation and rigour the University expects. Second, the English diagnostic test is used for placement and not for marks. Third, the Department is to identify within the first three weeks the students at risk on the evidence of the bridge and the diagnostic, and place them in the remedial and mentoring arrangement required under NAAC Criterion 2.2, rather than waiting for the first class test.

Part III — The Revised First-Year Structure and the Group Rotation

The tables below reproduce the revised first-year structure as adopted. The basic-science cycle is rotated across the two semesters so that the science and workshop faculty of a college are evenly loaded: Computer Science and its allied branches take Physics in Semester I and Chemistry in Semester II, while the remaining branches take Chemistry in Semester I and Physics in Semester II; Engineering Graphics and Workshop Practice rotate in the same way. The credit of each semester is the same for both groups.

III.1 Semester I

Code	Course	L – T – P	Cr.	Notes
BS-M101	Mathematics – I	3 – 0 – 0	3	Both groups
BS-PH101 / BS-CH101	Physics (CSE & allied) / Chemistry (other branches)	3 – 0 – 0	3	By group
ES-EE101	Basic Electrical and Electronics Engineering	4 – 0 – 0	4	Both groups
AEC-101	English for Communication Skills	2 – 0 – 0	2	Both groups
BS-PH191 / BS-CH191	Physics Lab / Chemistry Lab	0 – 0 – 3	1.5	By group
ES-ME191 / ES-ME192	Engineering Graphics & Design / Workshop Practice	0 – 0 – 3	1.5	By group
ES-EE191	Basic Electrical and Electronics Engineering Lab	0 – 0 – 4	2	Both groups
VAC-181	NCC / NSS / Yoga and Sports	0 – 0 – 6	3	Both groups
SEC-181	Skill Enhancement Course — MOOCs / Skills	0 – 0 – 6	3	Both groups
MC-181 / MC-182	Indian Knowledge Systems / Indian Constitution	2 – 0 – 0	NC	Non-credit, by group
	Total of Semester I		23	

III.2 Semester II

Code	Course	L – T – P	Cr.	Notes
BS-M201	Mathematics – II	3 – 0 – 0	3	Both groups
BS-BI201	Biology for Engineers	2 – 0 – 0	2	Both groups
BS-PH201 / BS-CH201	Physics (other branches) / Chemistry (CSE & allied)	3 – 0 – 0	3	By group
ES-CS201	Programming for Problem Solving	3 – 0 – 0	3	Both groups
VAC-201	Environmental Science	3 – 0 – 0	3	Both groups
BS-PH291 / BS-CH291	Physics Lab / Chemistry Lab	0 – 0 – 3	1.5	By group
ES-CS291	Programming for Problem Solving Lab	0 – 0 – 3	1.5	Both groups
ES-ME291 / ES-ME292	Engineering Graphics & Design / Workshop Practice	0 – 0 – 3	1.5	By group
AEC-291	Language Laboratory	0 – 0 – 2	1	Both groups
AEC-281	Essentials for Professional Skills	0 – 0 – 3	1.5	Both groups
SEC-282	Skill Enhancement Course — MOOCs / Skills	0 – 0 – 0	3	Both groups
MC-281 / MC-282	Indian Knowledge Systems / Indian Constitution	2 – 0 – 0	NC	Non-credit, by group
	Total of Semester II		24 / 28*	

** With the additional four credits of a work-based vocational course, internship or apprenticeship taken in the summer term, which qualify the student for the exit award of the Undergraduate Certificate (40 + 4). The two mandatory non-credit courses — the Indian Knowledge Systems foundation and the Indian Constitution — are taken one in each semester, alternated by group.*

Part IV — Detailed Syllabi: Theory Courses

The nine theory courses of the first year follow. Each carries a header block, prerequisites mapped to the school syllabus, objectives, Course Outcomes with Bloom levels, the CO–PO articulation matrix, the module-wise syllabus with hours, cross-cutting notes, texts and online resources, the assessment map, and course-specific question-paper notes.

BS-M101 Mathematics – I

Course Code	BS-M101	Course Title	Mathematics – I		
Category	Basic Science Course	L – T – P	3 – 0 – 0	Credits	3
Semester	First	Contact Hours	32	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, deliberately, a little lighter than a full thirty-six-hour course: admission to the first year is habitually late, and the effective teaching window of the first semester is shorter than the calendar suggests. The syllabus below is set at thirty-two contact hours so that it can be completed without compression, and one module is marked as capable of being carried partly by guided self-study should the session be shortened further. 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 Mathematics; ISC).
- Matrices and determinants to the third order, and the solution of a system of linear equations (CBSE XII Unit III).
- Vectors in two and three dimensions and the elementary operations on them (CBSE XII Unit IV).
- Complex numbers in the algebraic and polar form (CBSE XI; WBCHSE Class 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 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 all of this on a common, branch-neutral footing, leaving discipline-specific mathematics to Semester III.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Apply the differential calculus of one and several variables, including partial differentiation and its geometric meaning, 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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed 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 in statement and use; 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.	8
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.	8
III	Multiple Integrals (may be carried partly by guided self-study)	Double integrals in Cartesian and polar coordinates and the change of order of integration; the computation of area and volume; the idea of the triple integral. This module is the one to be reduced to guided self-study, with a problem set and two consultation hours, if the teaching window is shortened by late admission.	7
IV	Matrices and Linear Algebra	Rank of a matrix by elementary transformation; consistency and the solution of a system of linear equations; eigenvalues and eigenvectors; the Cayley–Hamilton theorem and its use; diagonalisation in outline. The linear-algebra content is deliberately generic; the discipline-specific extensions are left to Mathematics-III.	9

Total contact hours: 32.

Cross-cutting and statutory components

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. The bridge module and the self-study provision are the two levers by which the course is kept deliverable in a shortened first semester; the Department is to use them rather than compress the taught modules.

Text Books 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.

Online Resources

- NPTEL, Mathematics — Engineering Mathematics I / Multivariable Calculus, 12 weeks.
- NPTEL, Linear Algebra, 12 weeks.

Question paper notes specific to this course

The paper is to be predominantly a problem paper: at least two-thirds of the marks of Groups B and C are to be for the working of problems rather than for statement of theory. Standard results may be quoted; a numerical or matrix answer is to carry its working. No question is to draw on discipline-specific material, since the class is common to all branches.

BS-M201 Mathematics – II

Course Code	BS-M201	Course Title	Mathematics – II		
Category	Basic Science Course	L – T – P	3 – 0 – 0	Credits	3
Semester	Second	Contact Hours	36	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).
- Complex numbers in algebraic and polar form (CBSE XI; WBCHSE).
- First-order differential equations by separation of variables (CBSE XII Unit IX).

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 successful completion of this course the student will be able to:

CO	Statement	Bloom level
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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed 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; the complementary function and particular integral; the method of variation of parameters in outline; the Cauchy–Euler equation; elementary applications to growth, decay and oscillation, drawn generically rather than from any one discipline.	8
II	Laplace Transform	The Laplace transform and its elementary properties; transforms of standard functions; the inverse transform; the shifting theorems; the transform of derivatives and integrals; the solution of linear differential equations and initial-value problems by the transform method; the unit-step function in outline.	8
III	Vector Calculus	Scalar and vector fields; the 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.	8
IV	Functions of a Complex Variable	Functions of a complex variable; analyticity and the Cauchy–Riemann equations; harmonic functions; the elementary conformal mappings in outline; Cauchy's integral theorem and formula in statement, with elementary application.	7
V	Fourier Series	Periodic functions and their Fourier-series representation; the Euler formulae; even and odd functions and the half-range series; the elements of harmonic analysis. The extension to the Fourier transform and to partial differential equations is left to Mathematics-III where a programme requires it.	5

Total contact hours: 36.

Cross-cutting and statutory components

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 Books 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.

Online Resources

- NPTEL, Differential Equations for Engineers, 12 weeks.
- NPTEL, Integral and Vector Calculus / Advanced Engineering Mathematics, 12 weeks.

Question paper notes specific to this course

As in Mathematics-I, the paper is predominantly a problem paper, and no question draws on discipline-specific material. At least one question in Group C is to require the solution of a differential equation by two distinct methods, so that method as well as answer is examined.

BS-PH101 / BS-PH201 Physics

Course Code	BS-PH101 / BS-PH201	Course Title	Physics		
Category	Basic Science Course	L – T – P	3 – 0 – 0	Credits	3
Semester	First or Second (by group)	Contact Hours	36	Assessment	Theory: CA 30 + ESE 70

Prerequisites

The course builds directly on the Higher Secondary Physics of WBCHSE, CBSE or ISC. Under the group rotation of the first-year structure it is taken in the first semester by one group of branches and in the second by the other; the syllabus is identical in either case. The following are assumed:

- Oscillations and waves: simple harmonic motion, superposition, stationary waves, Doppler effect (CBSE XI Units VII and X; WBCHSE Class XI).
- Ray and wave optics: reflection, refraction, Huygens' principle, interference, diffraction and polarisation at an introductory level (CBSE XII Unit VI; ISC Section on Optics).
- Electrostatics, current electricity, magnetic effects and electromagnetic induction (CBSE XII Units I–IV).
- Dual nature of radiation and matter, atoms and nuclei, semiconductor electronics (CBSE XII Units VII–IX; WBCHSE Modern Physics).
- Vector algebra and elementary calculus, which is being developed in parallel in BS-M101; the Physics teacher is to sequence Module IV after the Mathematics teacher has covered partial differentiation.

Course Objectives

- To carry the treatment of oscillations and waves from the descriptive level of school physics to the analytical level of the differential equation and its solutions.
- To establish wave optics as the basis of modern metrology, and lasers and optical fibre as the basis of modern instrumentation and communication.
- To introduce quantum mechanics at the level required for an understanding of materials and devices.
- To connect the electronic structure of solids to the engineering behaviour of conductors, semiconductors, superconductors and nanomaterials.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Formulate and solve the equations of free, damped and forced oscillation, and interpret resonance, quality factor and the superposition of waves in engineering systems.	L3 – Apply
CO2	Apply the principles of interference, diffraction and polarisation to the analysis of optical measurement and thin-film problems.	L3 – Apply
CO3	Explain the physical basis of laser action and of light propagation in optical fibre, and compute the characteristic parameters of each.	L3 – Apply
CO4	Apply the Schrödinger equation to simple bound and free particle problems and interpret the results in terms of quantisation and the uncertainty principle.	L3 – Apply
CO5	Relate the band structure of solids to the observed electrical behaviour of metals, semiconductors and superconductors, and describe the distinctive behaviour of matter at the nanoscale.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	–	–	–	–	–	–	1
CO2	3	3	2	2	2	–	–	–	–	–	–	1
CO3	3	2	2	1	2	1	–	–	–	–	–	2
CO4	3	3	1	2	1	–	–	–	–	–	–	2
CO5	3	2	2	2	1	1	2	–	–	–	–	2

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Oscillations and Waves	Simple harmonic motion and its differential equation; damped harmonic oscillation — under-damped, critically damped and over-damped cases; forced oscillation, amplitude and phase resonance, sharpness of resonance and quality factor; superposition of collinear and perpendicular oscillations, Lissajous figures; the one-dimensional wave equation and its solution; energy transport by a wave.	7
II	Wave Optics	Coherence and conditions for interference; division of wavefront and of amplitude; interference in thin films, wedge-shaped film, Newton's rings and the measurement of wavelength; Fraunhofer diffraction at a single slit, double slit and plane transmission grating; resolving power; polarisation, Malus' law, Brewster's law, double refraction, quarter- and half-wave plates.	8
III	Lasers and Fibre Optics	Spontaneous and stimulated emission, Einstein's A and B coefficients; population inversion and pumping; optical resonator; the helium–neon, ruby and semiconductor lasers; holography in outline; industrial and metrological applications of lasers. Optical fibre — total internal reflection, acceptance angle, numerical aperture, step-index and graded-index fibre, attenuation and dispersion, fibre sensors.	6
IV	Quantum Mechanics	Inadequacy of classical physics; the photoelectric and Compton effects revisited; de Broglie hypothesis and the Davisson–Germer experiment; wave function and its interpretation; Heisenberg's uncertainty principle with applications; time-independent Schrödinger equation; particle in a one-dimensional infinite potential well; step potential and quantum tunnelling in outline with its device applications.	8
V	Physics of Materials	Free electron theory and its failures; origin of the energy band; classification of solids on band structure; intrinsic and extrinsic semiconductors, Fermi level and carrier concentration; Hall effect; dielectric and magnetic materials in outline; superconductivity — Meissner effect, Type I and Type II superconductors and applications; introduction to nanomaterials — quantum confinement, synthesis in outline, characterisation and engineering uses.	7

Total contact hours: 36.

Cross-cutting and statutory components

Module V ends with a one-hour treatment of materials for sustainable technology — photovoltaic materials, thermoelectrics and materials for energy storage — which serves NAAC Criterion 1.3 on environment and sustainability and prepares the ground for the Electric Vehicle Minor of Part I of the curriculum structure. Module III is the point of contact with the Industry 4.0 thread, laser and fibre sensing being the physical basis of the instrumentation taken up in PC-ME406.

Text Books and Reference Books

- D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, Wiley.
- A. Ghatak, Optics, McGraw Hill Education.
- A. Beiser, Concepts of Modern Physics, McGraw Hill Education.
- C. Kittel, Introduction to Solid State Physics, Wiley.
- M. N. Avadhanulu and P. G. Kshirsagar, A Textbook of Engineering Physics, S. Chand.
- S. O. Pillai, Solid State Physics, New Age International.

Online Resources

- NPTEL, Engineering Physics — Fundamentals and Modern Applications, 12 weeks.
- NPTEL, Introduction to Photonics / Fibre Optics, 12 weeks.
- Virtual Labs (Ministry of Education), Optics and Modern Physics laboratories.

BS-CH101 / BS-CH201 Chemistry

Course Code	BS-CH101 / BS-CH201	Course Title	Chemistry		
Category	Basic Science Course	L – T – P	3 – 0 – 0	Credits	3
Semester	First or Second (by group)	Contact Hours	36	Assessment	Theory: CA 30 + ESE 70

Prerequisites

The course builds on the Higher Secondary Chemistry of WBCHSE, CBSE or ISC. Under the group rotation of the first-year structure the course is taken in the first semester by one group of branches and in the second by the other; the syllabus is identical in either case. The following are assumed:

- Atomic structure, the quantum numbers and electronic configuration; the periodic table and periodicity (CBSE XI Units II–III; WBCHSE Class XI Chemistry).
- Chemical bonding — ionic, covalent and coordinate bonds, VSEPR, hybridisation and molecular geometry (CBSE XI Unit IV).
- Thermodynamics, equilibrium, and the elements of electrochemistry and chemical kinetics (CBSE XI Unit VI; CBSE XII Units III–IV).
- Basic organic chemistry — nomenclature, isomerism and the common functional groups (CBSE XI Units IX–X; CBSE XII Units X–XI).
- Students whose Higher Secondary stream did not carry Chemistry to Class XII are to be given a short bridge of three hours in the first fortnight covering atomic structure, bonding and the mole concept; the bridge is recorded in the Whole-Semester Component.

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 an engineer uses to predict whether and how fast a process will occur.
- To connect the structure of materials — metals, polymers, and the water an engineer must treat — to their engineering behaviour.
- To introduce the instrumental methods by which composition and structure are determined in modern practice.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Apply the quantum-mechanical model of the atom and molecular-orbital and bonding theory to explain the structure and properties of molecules and materials.	L3 – Apply
CO2	Apply the laws of thermodynamics, chemical and phase equilibrium and reaction kinetics to engineering processes, and compute the associated quantities.	L3 – Apply
CO3	Apply the principles of electrochemistry to galvanic and electrolytic cells, batteries and fuel cells, and explain and control corrosion.	L3 – Apply
CO4	Relate the structure of engineering materials — metals and alloys, polymers, and composites — and the chemistry of water to their engineering use and treatment.	L4 – Analyse
CO5	Select an appropriate spectroscopic or instrumental method for a stated analytical problem and interpret its elementary output.	L3 – Apply

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	1	2	–	–	–	–	2
CO5	3	2	1	3	2	–	–	–	–	–	–	2

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Atomic and Molecular Structure	Failure of classical mechanics in brief; the Schrödinger equation and the particle in a box as a model; atomic and molecular orbitals; molecular-orbital theory of homonuclear and heteronuclear diatomic molecules, bond order and magnetic behaviour; π-molecular orbitals of conjugated systems; band theory of solids in outline and its bearing on conductors, semiconductors and insulators; crystal-field splitting and the colour of transition-metal complexes.	8
II	Thermodynamics, Equilibrium and Kinetics	First, second and third laws in review; entropy, free energy and the criteria of spontaneity; the thermodynamics of mixtures and chemical potential; chemical and phase equilibrium, the phase rule and one-component and two-component diagrams; chemical kinetics — order and molecularity, the rate law, the Arrhenius equation and activation energy, and the elements of catalysis.	8
III	Electrochemistry and Corrosion	Electrode potential and the electrochemical series; the Nernst equation; galvanic and concentration cells; conductance and its measurement; batteries — primary, secondary and the lithium-ion cell — and fuel cells; corrosion — the electrochemical mechanism, dry and wet corrosion, factors affecting the rate, and protection by coatings, cathodic protection and inhibitors.	7
IV	Engineering Materials and Water	Metals and alloys in outline; polymers — addition and condensation polymerisation, thermoplastics and thermosets, elastomers, conducting and biodegradable polymers, and the degree of polymerisation; composites in outline; nanomaterials and their engineering uses in brief. Water — hardness and its determination, boiler troubles, softening by lime–soda, zeolite and ion-exchange methods, and municipal treatment; specifications for water for industrial use.	8
V	Instrumental Methods and Analysis	The electromagnetic spectrum and the basis of spectroscopy; the Beer–Lambert law; ultraviolet–visible, infrared and, in outline, nuclear magnetic resonance spectroscopy and their use in identification; elementary chromatography; the idea of the accuracy and precision of a measurement and the reporting of an analytical result with its uncertainty.	5

Total contact hours: 36.

Cross-cutting and statutory components

Module III on corrosion is the point at which this course serves the materials and durability concerns of the Civil, Mechanical, Electrical and Leather disciplines, and it is to be read alongside the traditional-materials content of the Indian Knowledge System modules of those programmes. Module IV on water connects directly to Environmental Science (VAC-201) and to the effluent and water-treatment courses of the later years. The Whole-Semester Component is to include one exercise in which a spectroscopic or analytical result is reduced with its uncertainty, introducing the data-discipline the Industry 4.0 thread carries forward.

Text Books and Reference Books

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

Online Resources

- NPTEL, Chemistry — Concepts 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 notes specific to this course

At least one question of Group C must be a numerical problem — a free-energy or equilibrium computation, a Nernst-equation potential, a rate or activation-energy calculation, or a hardness determination — so that the paper is not answerable entirely in prose. Structure-and-reasoning questions in Groups B and C should require the student to explain a property from the underlying bonding or thermodynamics, not merely to reproduce it.

BS-BI201 Biology for Engineers

Course Code	BS-BI201	Course Title	Biology for Engineers		
Category	Basic Science Course	L – T – P	2 – 0 – 0	Credits	2
Semester	Second	Contact Hours	24	Assessment	Theory: CA 30 + ESE 70

Prerequisites

The course is designed for a class in which a majority will not have taken Biology after Class X. It is therefore self-contained, and the first module supplies what a student without Higher Secondary Biology needs:

- General Science of Class X — cell, tissue, nutrition, respiration and heredity at the elementary level (WBBSE, CBSE or ICSE).
- Higher Secondary Biology, where taken, allows Modules I and II to be covered more rapidly; the teacher is to determine the composition of the class in the first week.
- Elementary chemistry of Class XII — organic functional groups and the idea of a catalyst.
- No prior study of biochemistry or genetics is assumed.

Course Objectives

- To present biology to the engineer not as a descriptive natural history but as a source of design principles and of quantitative systems.
- To establish the molecular basis of life sufficiently for an understanding of biomaterials, biosensors and biotechnology.
- To show the engineering of living systems — transport, control, energy conversion and information storage — as engineering.
- To open the fields in which engineering and biology now meet.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Describe the organisation of living systems from the molecule to the organism and explain why biology is relevant to engineering practice.	L2 – Understand
CO2	Explain the structure and function of the principal biomolecules and the catalytic action of enzymes, and interpret simple enzyme kinetics.	L3 – Apply
CO3	Explain the storage, transmission and expression of biological information and the elements of inheritance and mutation.	L2 – Understand
CO4	Apply the principles of thermodynamics and transport to biological energy conversion and to flow in living systems.	L3 – Apply
CO5	Identify an engineering application of a biological principle — in biomimetics, biomaterials, biosensing, instrumentation or environmental biotechnology — and describe how it works.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	–	2	2	1	–	1	–	2
CO2	2	2	1	1	–	1	1	1	–	1	–	2
CO3	2	1	1	1	–	1	1	2	–	1	–	2
CO4	3	2	2	2	1	1	2	1	–	1	–	2
CO5	2	2	3	2	2	2	3	2	1	1	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Why Biology for the Engineer	Living and non-living systems; the hierarchy of biological organisation; classification and the diversity of life in outline; the cell as the structural and functional unit — prokaryotic and eukaryotic, the principal organelles and their function; the cell membrane as a selective barrier; scale in biology and the consequences of the square–cube law; biology as a source of engineering design.	4
II	Biomolecules and Enzymes	Carbohydrates, lipids, proteins and nucleic acids — structure, properties and function; the peptide bond and the levels of protein structure; enzymes as catalysts, active site, specificity, the effect of temperature and pH; Michaelis–Menten kinetics in outline; enzyme inhibition; industrial and diagnostic uses of enzymes; immobilised enzymes.	5
III	Biological Information	The structure of DNA and RNA; replication, transcription and translation — the central dogma; the genetic code; the gene and the chromosome; Mendelian inheritance in outline; mutation and its causes; recombinant DNA technology in principle, the polymerase chain reaction, and an outline of gene editing; bioinformatics and biological databases as an engineering problem in data.	5
IV	Energy and Transport in Living Systems	Bioenergetics — the laws of thermodynamics applied to the living cell, free energy and adenosine triphosphate; photosynthesis and cellular respiration in outline as energy conversion processes and their efficiencies; diffusion, osmosis and active transport; the circulatory system as a fluid network and the mechanics of blood flow; the nerve impulse as a signal; homeostasis and feedback control.	4
V	Biology in Engineering Practice	Biomimetics — the lotus effect, the gecko foot, honeycomb and other structural analogues, biomimetic design method; biomaterials — requirements, biocompatibility, implants and prostheses; tissue engineering and scaffolds, with a note on the additive manufacturing route; biosensors — principle, transduction and applications; bioinstrumentation — the electrocardiogram, imaging modalities in outline; environmental biotechnology — bioremediation, waste-water treatment, biofuels; bioethics and biosafety.	6

Total contact hours: 24.

Cross-cutting and statutory components

Module V carries the sustainability and social-relevance content of NAAC Criterion 1.3 and connects forward to the Minor in Additive Manufacturing of Part I of the curriculum structure, tissue scaffolding being one of its principal applications. Module IV's treatment of feedback and homeostasis is the first appearance of the control-system idea that PC-ME603 will take up formally.

Text Books and Reference Books

- AICTE, Biology for Engineers — model curriculum text.
- D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, W. H. Freeman.
- N. A. Campbell and J. B. Reece, Biology, Pearson.
- S. Thyagarajan, N. Selvamurugan et al., Biology for Engineers, Tata McGraw Hill.
- J. D. Enderle and J. D. Bronzino, Introduction to Biomedical Engineering, Academic Press — for Module V.
- Y. Bar-Cohen (ed.), Biomimetics — Biologically Inspired Technologies, CRC Press.

Online Resources

- NPTEL, Biology for Engineers / Bioengineering — an interface with biology and medicine, 12 weeks.
- NPTEL, Introduction to Biomaterials or Biomimetics, 8 or 12 weeks.

Question paper notes specific to this course

The paper is not to reward the memorising of biological nomenclature. Group C must contain at least one question requiring the student to apply an engineering principle — thermodynamic, mechanical, transport or control — to a biological system, and at least one requiring the design reasoning behind a biomimetic or biomedical application.

ES-EE101 Basic Electrical and Electronics Engineering

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

Prerequisites

Assumed from Higher Secondary Physics:

- Ohm's law, resistance in series and parallel, Kirchhoff's laws, cells and internal resistance (CBSE XII Unit II; WBCHSE Current Electricity).
- Magnetic effect of current, electromagnetic induction, self and mutual inductance, alternating current and the LCR circuit (CBSE XII Units III–IV).
- Semiconductor diode, rectification, transistor action, logic gates at the introductory level (CBSE XII Unit IX; ISC Electronics).
- Complex numbers and elementary calculus, taken in parallel in BS-M101.

Course Objectives

- To establish a systematic method of analysing direct and alternating current networks.
- To explain the construction, principle and characteristics of the electrical machines an engineer will meet on any shop floor.
- To introduce semiconductor devices and digital logic sufficiently for their use in instrumentation and control.
- To make the student competent and safe in the presence of electrical equipment.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Analyse direct current networks using Kirchhoff's laws, mesh and nodal analysis and the network theorems.	L3 – Apply
CO2	Analyse single-phase and balanced three-phase alternating current circuits using phasors, and compute power, power factor and resonance conditions.	L3 – Apply
CO3	Explain the construction and working principle of the single-phase transformer, the direct current machine and the three-phase induction motor, and interpret their nameplate and performance data.	L2 – Understand
CO4	Explain the characteristics of the p–n junction diode, the Zener diode and the bipolar junction transistor and apply them to rectifier and regulator circuits.	L3 – Apply
CO5	Apply number systems and Boolean algebra to the simplification of small combinational circuits, and state the principles of electrical safety and earthing.	L3 – Apply

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	–	–	–	–	–	–	1
CO2	3	3	2	1	1	–	–	–	–	–	–	1
CO3	3	2	1	1	1	1	1	–	–	–	–	2
CO4	3	2	2	1	2	–	–	–	–	–	–	2
CO5	3	2	2	1	2	1	–	2	–	–	–	2

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Direct Current Circuits	Circuit elements and their v–i 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
II	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, three-phase power measurement in outline.	9
III	Transformers and Rotating Machines	Single-phase transformer — construction, principle, equivalent circuit, losses, efficiency and regulation; auto-transformer in outline. Direct current machines — construction, e.m.f. and torque equations, types of excitation, characteristics and starting. Three-phase induction motor — rotating magnetic field, slip, torque–slip characteristic, starting methods. Introduction to the stepper motor and the brushless direct current motor with a note on their use in automation.	8
IV	Semiconductor Devices	Intrinsic and extrinsic semiconductors; p–n junction, forward and reverse characteristics; half-wave, full-wave and bridge rectifiers with capacitor filter, ripple factor; Zener diode and voltage regulation; light-emitting and photo diodes; bipolar junction transistor — configurations, characteristics and its use as a switch and as an amplifier in outline; operational amplifier as an ideal block, inverting and non-inverting configurations. Feedback and the concept of an amplifier gain; the operational amplifier as a summing, difference and integrator block in outline; the regulated power supply as a complete small system from transformer to regulated output.	10
V	Digital Logic, Measurement and Safety (may be carried partly by guided self-study)	Binary, octal and hexadecimal systems and conversion; Boolean algebra and De Morgan's theorems; logic gates and the simplification of small expressions; half and full adder. Principles of the moving-coil and moving-iron instrument, the digital multimeter and the cathode ray oscilloscope. Electrical safety — effects of current on the body, earthing, fuse and miniature circuit breaker, residual current device, and the elements of the Indian wiring practice. Combinational building blocks — multiplexer, decoder and their use; sequential elements — the flip-flop, register and counter in outline; the analog-to-digital and digital-to-analog conversion idea that links the electrical and the digital worlds; an introductory look at the microcontroller as the device that ties sensing, computation and control together, opening the Industry 4.0 thread on the electronics side.	8

Total contact hours: 44.

Cross-cutting and statutory components

Module V carries the electrical safety content required under NAAC Criterion 1.3 and is to be taught before the student enters ES-EE191 and ES-ME191. The note on stepper and brushless direct current motors in Module III, and on the operational amplifier in Module IV, are the entry points of the Industry 4.0 thread on the electrical side.

Content beyond the syllabus / delivery notes

The course carries four lecture hours a week (4-0-0, four credits) in recognition that it combines two subjects — electrical and electronics — within a single paper. The additional hour over a conventional two-credit treatment is to be used to give the electronics half (Modules IV and V) its due, and not merely to slow the electrical half. Being a first-semester course it is scoped for the shorter effective teaching window that late admission habitually leaves: the content is set a little below the nominal forty-eight hours, and the digital-and-measurement module is the one to be carried partly by guided self-study if the session is shortened further; the Department is to use that provision rather than compress the machines and electronics modules.

Text Books and Reference Books

- D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, McGraw Hill Education.
- E. Hughes, Electrical and Electronic Technology, Pearson.
- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- V. K. Mehta and R. Mehta, Principles of Electrical Engineering and Electronics, S. Chand.
- M. Morris Mano, Digital Design, Pearson — for Module V.

Online Resources

- NPTEL, Basic Electrical Circuits / Basic Electronics, 12 weeks.
- Virtual Labs, Basic Electrical and Electronics Laboratory.

ES-CS201 Programming for Problem Solving

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

Prerequisites

The course assumes no previous programming. Where a substantial part of the class has taken Computer Science or Informatics Practices at the Higher Secondary level, Modules I and II may be compressed and the time given to Modules IV and V.

- Computer Science or Informatics Practices of CBSE Class XI–XII, or Computer Application of WBCHSE, where taken — but not assumed.
- Elementary algebra, functions and elementary number theory (Class X Mathematics).
- Basic computer operation, covered in the Induction Programme.
- The digital literacy component of SEC-182, where the student has elected it.

Course Objectives

- To teach the student to decompose a problem and to express its solution as an algorithm before writing any code.
- To establish fluency in a procedural language sufficient for engineering computation.
- To introduce the data structures and file handling that engineering data work requires.
- To introduce the idea of the cost of an algorithm.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Decompose an engineering problem and express its solution as an algorithm, a flowchart and pseudocode.	L3 – Apply
CO2	Write, compile, execute and debug programs in C using the correct data types, operators and control structures.	L3 – Apply
CO3	Design and use functions, including recursive functions, and reason correctly about scope, parameter passing and storage class.	L4 – Analyse
CO4	Apply arrays, strings, pointers and structures to the representation and manipulation of engineering data.	L4 – Analyse
CO5	Implement file input and output and elementary searching and sorting, and compare algorithms by their order of growth.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	–	–	1	1	1	1	2
CO2	3	2	3	2	3	–	–	1	1	1	1	3
CO3	3	3	3	2	3	–	–	1	1	1	1	3
CO4	3	3	3	3	3	–	–	1	1	1	1	3
CO5	3	3	3	3	3	–	–	1	1	1	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Problem Solving and Computational Thinking	The anatomy of a computer and the idea of stored program; compiler, interpreter and the translation process; problem definition, decomposition, abstraction and pattern recognition; 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
II	Fundamentals of C	Structure of a C program; character set, identifiers and keywords; data types, qualifiers and their ranges; constants and variables; operators and their 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
III	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 — auto, register, static and extern; recursion and its trace, with factorial, Fibonacci, greatest common divisor and the Towers of Hanoi; comparison of recursion and iteration; the preprocessor, macros and header files; modular program design and the separate compilation of files.	5
IV	Arrays, Strings and Pointers	One- and two-dimensional arrays — declaration, initialisation and traversal; passing an array to a function; matrix operations. Strings and the standard string library; character handling. Pointers — 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 and how to avoid them.	6
V	Structures, Files and Algorithm Efficiency	Structures and unions; array of structures; structure within a structure; pointer to a structure; typedef; the enumerated type. File handling — text and binary streams, opening modes, reading and writing, random access, error handling; reading engineering data from a comma-separated file. Linear and binary search; bubble, selection and insertion sort; the idea of the order of growth and elementary comparison of algorithms.	4

Total contact hours: 36.

Cross-cutting and statutory components

This course is the foundation of the computational side of the Industry 4.0 thread of Part E. The Department is to ensure that at least two of the programming exercises in the concurrent laboratory use real engineering data — a set of experimental readings from BS-PH191, for example — read from a file rather than typed in, so that the student meets data handling and not merely syntax. Where the Department subsequently offers the Minor in Computer Science and Data Science of Part I, this course is its prerequisite.

Text Books and Reference Books

- B. W. Kernighan and D. M. Ritchie, The C Programming Language, Prentice Hall of India.
- E. Balagurusamy, Programming in ANSI C, McGraw Hill Education.
- R. Thareja, Programming in C, Oxford University Press.
- Y. Kanetkar, Let Us C, BPB Publications.
- P. Dey and M. Ghosh, Programming in C, Oxford University Press.
- A. V. Aho, J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms — for the Module V material only.

Online Resources

- NPTEL, Problem Solving through Programming in C (IIT Kharagpur), 12 weeks.
- NPTEL, Programming, Data Structures and Algorithms using Python (IIT Madras) — for the student who wishes to go further.
- Virtual Labs, Problem Solving and Programming laboratory.

Question paper notes specific to this course

The paper must require the writing of code on paper, not only the description of it. Group B is to include at least one output-prediction or error-identification question on a given fragment. Group C must require at least two complete programs with correct declarations, and at least one question on pointers or structures. Questions asking for the definition of a compiler or a list of the features of C are not to be set.

AEC-101 English for Communication Skills

Course Code	AEC-101	Course Title	English for Communication Skills		
Category	Ability Enhancement Course	L – T – P	2 – 0 – 0	Credits	2
Semester	First	Contact Hours	22	Assessment	Theory: CA 30 + ESE 70

Prerequisites

The course assumes English at the Higher Secondary level and is designed for a class of mixed proficiency, a large proportion of whose students will have been taught in Bengali or another Indian language medium.

- English of the WBCHSE, CBSE or ISC Class XII course — comprehension, composition, and the grammar of tense, voice, and reported speech.
- No prior training in public speaking or technical writing is assumed.
- A diagnostic test in the first week is to be used to form graded groups for the Language Lab (AEC-291) of the second semester.

Course Objectives

- To repair the specific grammatical and lexical weaknesses that recur in the writing of Indian engineering entrants.
- To develop reading strategies appropriate to technical and expository material.
- To establish the conventions of technical writing in the forms the student will actually use.
- To build the confidence to speak in a professional setting.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Use the grammar and vocabulary of standard written English accurately in technical and professional contexts.	L3 – Apply
CO2	Read a technical or expository passage with speed and accuracy and extract, summarise and paraphrase its content.	L3 – Apply
CO3	Compose technical prose in the standard forms — description, definition, instruction, e-mail, memorandum, notice and short report.	L4 – Analyse
CO4	Listen to and comprehend spoken technical English, and speak with clarity in a presentation, a discussion and a telephone conversation.	L3 – Apply
CO5	Prepare a professional résumé and covering letter and conduct oneself in a selection interview.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	–	–	–	1	1	–	1	2	3	1	2
CO2	1	2	–	2	1	1	–	1	1	3	1	3
CO3	1	2	1	1	2	1	1	2	2	3	2	2
CO4	–	–	–	–	1	1	–	2	3	3	1	2
CO5	–	–	–	–	1	1	–	2	2	3	2	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	The Grammar and Vocabulary of Technical English	Common error analysis for the Indian learner — articles, prepositions, subject–verb agreement, tense sequence, modals, voice and the misuse of the continuous; sentence structure and the avoidance of the run-on; technical vocabulary building, word roots, affixes, collocation and register; the difference between formal, neutral and informal usage.	5
II	Reading and Comprehension	Skimming, scanning and intensive reading; identifying the thesis, the argument and the evidence; reading a data table, a graph and a specification; note-making in linear and diagrammatic form; summarising and précis writing; paraphrase and the avoidance of plagiarism.	4
III	Technical Writing	Paragraph unity, coherence and cohesion; technical definition and description of an object, a process and a mechanism; instructions and procedures; classification and comparison; business and technical correspondence — e-mail, memorandum, notice, circular, letter of enquiry, order and complaint; the short technical report and its structure; use of visual aids in text.	6
IV	Listening and Speaking	Listening for gist and for detail; note-taking from a lecture; barriers to listening; pronunciation, stress and intonation for intelligibility rather than accent; oral presentation — structure, delivery, use of slides and handling of questions; group discussion — initiating, agreeing, disagreeing and summarising; telephone and video-conference etiquette.	5
V	Communication for Employability	The résumé and curriculum vitae — structure, action verbs, quantified achievement, common faults; the covering letter and the statement of purpose; the selection interview — preparation, behavioural questions, the STAR method, and the post-interview follow-up; building a professional digital presence; the ethics of self-representation.	4

Total contact hours: 22.

Cross-cutting and statutory components

Module V is coordinated with the Training and Placement Cell and produces a résumé that the student will carry forward and revise before the summer internship of Semester V. Module III introduces the citation and anti-plagiarism conventions that govern every project report in the programme, including the fourth-year project of Part K.

Content beyond the syllabus / delivery notes

Being a first-semester course, this is scoped for the shorter effective teaching window that late admission habitually leaves; the reading and comprehension work of Module II may be carried partly through guided assignment where the session is short, the taught hours being reserved for the writing, listening and speaking modules that need the classroom.

Text Books and Reference Books

- M. Raman and S. Sharma, Technical Communication — Principles and Practice, Oxford University Press.
- S. Kumar and P. Lata, Communication Skills, Oxford University Press.
- P. C. Wren and H. Martin, High School English Grammar and Composition, S. Chand.
- N. Lewis, Word Power Made Easy, Goyal Publishers.
- A. Ashraf Rizvi, Effective Technical Communication, McGraw Hill Education.

Online Resources

- SWAYAM / NPTEL, Technical English for Engineers and Soft Skills, 8 or 12 weeks.
- British Council LearnEnglish and the BBC Learning English archive — for self-access listening.

Question paper notes specific to this course

The end-semester paper of this course must not be answerable from memory. Group A tests grammar, usage and vocabulary in context. Group B carries an unseen comprehension passage and a précis. Group C requires the composition of at least two of the technical forms taught in Module III against a stated situation. No question may ask the student to reproduce a definition of communication or to list its barriers.

VAC-201 Environmental Science

Course Code	VAC-201	Course Title	Environmental Science		
Category	Value-Added Course	L – T – P	3 – 0 – 0	Credits	3
Semester	Second	Contact Hours	42	Assessment	Theory: CA 30 + ESE 70 (with a mandatory 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) at the undergraduate level. It assumes only the general science, geography and civics of Class X (WBBSE / CBSE / ICSE) and is otherwise self-contained. It carries a compulsory activity-and-field component, since both the environmental-education mandate and Mission LiFE are addressed to conduct and not only to knowledge.

- The general science and environmental content of Class X (WBBSE / CBSE / ICSE Science and Social Science).
- No prior study of environmental science at the Higher Secondary level is assumed.
- A smartphone or shared institutional device is required for the Meri LiFE portal and app activities of Modules V and VI; the institution is to arrange 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 and national missions and in the United Nations Sustainable Development Goals.
- To introduce Mission LiFE — its genesis, its seven themes, and the theory and practice of the behavioural change it seeks — as the organising idea of individual and community environmental action.
- To convert the above into measured practice through footprint accounting, environmental audits and a documented behavioural-change portfolio.

Course Outcomes

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

CO	Statement	Bloom level
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 patterns.	L4 – Analyse
CO3	Explain India's environmental law, policy, national missions and SDG commitments, and the constitutional and institutional framework of environmental protection.	L2 – Understand
CO4	Explain Mission LiFE — its genesis, pillars of Demand, Supply and Policy, and seven themes — and the principal theories of behavioural change on which it rests.	L3 – Apply
CO5	Conduct a personal or household 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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	–	3	3	1	–	1	–	2
CO2	3	3	1	2	1	3	3	1	–	1	–	2
CO3	2	2	1	1	–	3	3	2	–	1	1	2
CO4	2	2	2	1	1	3	3	3	1	2	1	3
CO5	2	3	3	3	2	3	3	2	2	2	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	The Environment, Ecosystems and Biodiversity	The multidisciplinary nature of environmental studies; the environment as a system and the 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; the major ecosystems in brief. Biodiversity — genetic, species and ecosystem; its value and the ecosystem services it renders; threats to it and its 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 and their 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 the over-extraction of groundwater. The linkage between lifestyle and consumption patterns and environmental impact, and the ecological and carbon footprint as its measure. [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, its Nationally Determined Contributions and its commitment to the United Nations Sustainable Development Goals. India's national missions — the National Solar Mission, the Green Hydrogen Mission, the Jal Jeevan Mission, Atal Bhujal Yojana, the 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) — its context, genesis and launch, and its promotion at the national and international level; the pillars of Demand, Supply and Policy; the making of sustainable living into a mass movement and the idea of a circular economy of mindful consumption. The role of individual and collective behaviour; the principal theories of behavioural change and their maintenance; the design of a behavioural nudge; the contribution of India's own timeless 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; the fostering of community engagement and social responsibility. The Whole-Semester Component of this course is the field and activity portfolio built on this module — an energy, water, waste or plastic audit, a footprint calculation, and a documented behavioural-change intervention reported, where feasible, on the Meri LiFE portal. [Mission LiFE Units V–VI.]	9

Total contact hours: 42.

Cross-cutting and statutory components

This course is the point at which the University's environmental-education obligation and the national Mission LiFE programme are delivered together, and it connects forward to the Environment and Sustainability content of every discipline (PO7) and to the water, effluent and cleaner-production courses of the later years. The bracketed references map the modules to the six units of the UGC draft Mission LiFE framework, so that a college can satisfy both requirements from a single course. The field-and-activity portfolio is compulsory: a student who does not submit it is not to be passed in the course, since both the environmental mandate and Mission LiFE are directed at practice. The University's own Indian Knowledge System modules on traditional water and resource management (in the discipline structures of the later years) are the natural companion to Module IV's treatment of India's traditions of sustainability.

Text Books 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) — the framework integrated into Modules II–V.
- NITI Aayog, LiFE — Lifestyle for Environment, and Thinking for Our Planet: 75 Ideas to Promote LiFE.
- Ministry of Environment, Forest and Climate Change, 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; and the India State of Forest Report, Forest Survey of India.
- Y. Anjaneyulu, Introduction to Environmental Science, BS Publications.

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 notes specific to this course

The end-semester paper covers Modules I–IV; Module V is assessed through the portfolio in the whole-semester component rather than by written examination, since it is a course of practice. At least one question in Group C is to require the student to relate a lifestyle or consumption pattern to its environmental consequence and to a Mission LiFE theme, so that the behavioural argument, and not only the science, is examined. Prescribed data — emission factors, footprint coefficients — are to be printed with the paper.

Part VII — Detailed Syllabi: Laboratory and Practical Courses

The eight 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.

BS-PH191 / BS-PH291 Physics Laboratory

Course Code	BS-PH191 / BS-PH291	Course Title	Physics Laboratory		
Category	Basic Science Course	L – T – P	0 – 0 – 3	Credits	1.5
Semester	First or Second (by group)	Contact Hours	36	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with BS-PH101. Assumed from school practical work:

- Use of the vernier calliper, screw gauge, spherometer and travelling microscope (CBSE and WBCHSE Class XI–XII practical syllabus).
- Elementary circuit assembly and the use of an ammeter, voltmeter and rheostat.
- The idea of significant figures and of the reporting of a result with its unit.

Course Objectives

- To develop competence in measurement, in the handling of instruments and in the honest recording of data.
- To connect the phenomena of BS-PH101 to observation.
- To introduce the estimation and propagation of uncertainty as a routine part of every measurement.
- To develop the discipline of the laboratory record.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Operate standard optical, electrical and mechanical laboratory instruments and take readings to their rated precision.	L3 – Apply
CO2	Determine physical constants and material properties from measured data using the appropriate graphical or analytical method.	L3 – Apply
CO3	Estimate the uncertainty in a measured result, propagate it through the calculation, and report the result correctly.	L4 – Analyse
CO4	Maintain a laboratory record that would allow another person to repeat the experiment, and defend the result at a viva-voce.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	2	–	–	2	2	2	–	2
CO2	3	3	2	3	2	–	–	2	1	2	–	2
CO3	3	3	1	3	2	–	–	3	1	2	–	2
CO4	2	2	1	3	2	–	–	3	2	3	1	2

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Determination of the acceleration due to gravity and the rigidity of a wire by a torsional pendulum or bar pendulum.	CO1, CO2
2	Study of a damped oscillation and determination of the damping constant and quality factor.	CO2, CO3
3	Determination of Young's modulus of a beam material by the method of flexure.	CO1, CO2
4	Determination of the wavelength of light by Newton's rings.	CO1, CO2
5	Determination of the wavelength of the lines of a mercury source by a plane transmission grating using a spectrometer.	CO1, CO2
6	Determination of the wavelength of a laser source and the width of a single slit by diffraction.	CO2, CO3
7	Verification of Malus' law and determination of Brewster's angle.	CO1, CO2
8	Determination of the numerical aperture and the attenuation of an optical fibre.	CO2, CO3
9	Determination of the Planck constant using light-emitting diodes of several colours.	CO2, CO3
10	Determination of the energy band gap of a semiconductor by the four-probe method or by the reverse saturation current of a junction.	CO2, CO3
11	Determination of the Hall coefficient and carrier type of a semiconductor specimen.	CO2, CO3
12	Study of the characteristics of a solar cell and determination of its fill factor.	CO2, CO4

A student is to perform not fewer than eight experiments. At least one experiment in each cycle is to be recorded and reduced using a spreadsheet or a Python script rather than by hand, in order to introduce the data-handling habits carried forward by the Industry 4.0 thread. Every result is to be reported with its estimated uncertainty; a result reported without one is to be treated as incomplete.

Text Books and Reference Books

- C. L. Arora, B.Sc. Practical Physics, S. Chand.
- S. Panigrahi and B. Mallick, Engineering Practical Physics, Cengage Learning.
- J. R. Taylor, An Introduction to Error Analysis, University Science Books — for the uncertainty component.

Online Resources

- Virtual Labs (Ministry of Education) — Physical Sciences laboratories, for pre-laboratory preparation.

BS-CH191 / BS-CH291 Chemistry Laboratory

Course Code	BS-CH191 / BS-CH291	Course Title	Chemistry Laboratory		
Category	Basic Science Course	L – T – P	0 – 0 – 3	Credits	1.5
Semester	First or Second (by group)	Contact Hours	36	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with Chemistry (BS-CH101/201) and to be sequenced so that the relevant theory module precedes the experiment. Assumed:

- The laboratory safety induction, which is to be conducted in the first session; no student may handle a reagent without it.
- Elementary volumetric practice — the use of the burette, pipette and volumetric flask (CBSE and WBCHSE Class XI–XII practical syllabus).
- The idea of significant figures and of 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 course to observation.
- To introduce instrumental measurement and the estimation of uncertainty as routine.
- To establish the discipline of the laboratory record.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Work safely in a chemical laboratory and carry out volumetric and gravimetric determinations to their rated precision.	L3 – Apply
CO2	Determine physicochemical quantities — hardness, rate constant, cell potential, viscosity, partition coefficient — from measured data using the appropriate method.	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 laboratory record that would allow the experiment to be repeated.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	2	1	1	2	2	2	–	2
CO2	3	3	2	3	2	–	–	2	1	2	–	2
CO3	3	2	1	3	3	–	–	2	1	2	–	2
CO4	2	2	1	3	2	–	–	3	2	3	1	2

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Laboratory safety, the handling of reagents and glassware, and the treatment of measurement, significant figures and uncertainty; preparation of a standard solution.	CO1, CO4
2	Determination of the total, permanent and temporary hardness of a water sample by the EDTA method.	CO1, CO2
3	Estimation of an alkali or of a mixture of carbonate and bicarbonate by double-indicator titration.	CO1, CO2
4	Determination of the amount 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, or of the reaction between potassium persulphate and potassium iodide.	CO2, CO4
6	Determination of the strength of an acid by conductometric titration.	CO2, CO3
7	Determination of the strength of an acid, or the dissociation constant of a weak acid, by pH-metric titration.	CO2, CO3
8	Determination of the concentration of a coloured species (for example potassium permanganate or a metal complex) by colorimetry and the verification of the Beer–Lambert law.	CO2, CO3
9	Determination of the viscosity or the surface tension of a liquid and its variation with concentration.	CO2
10	Determination of the partition coefficient of a solute between two immiscible solvents.	CO2
11	Determination of the cell constant and the equivalent conductance of a strong electrolyte at several dilutions.	CO2, CO3
12	Preparation of a simple polymer (for example a phenol–formaldehyde or urea–formaldehyde resin) or of a metal complex.	CO1

A student is to perform not fewer than eight experiments. At least one experiment in each cycle is to be recorded and reduced using a spreadsheet or a short script rather than by hand, and every result is to be reported with its estimated uncertainty; a result reported without one is to be treated as incomplete.

Text Books 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.
- J. R. Taylor, An Introduction to Error Analysis, University Science Books — for the uncertainty component.

Online Resources

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

ES-EE191 Electrical and Electronics Engineering Laboratory

Course Code	ES-EE191	Course Title	Electrical and Electronics Engineering Laboratory		
Category	Engineering Science Course	L – T – P	0 – 0 – 4	Credits	2
Semester	First	Contact Hours	48	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with ES-EE101, and to be sequenced so that the relevant theory module precedes the experiment. Assumed:

- Ohm's law, Kirchhoff's laws and the elementary alternating current circuit (CBSE XII Unit II–IV; WBCHSE Current Electricity).
- Semiconductor diode and transistor at the introductory level (CBSE XII Unit IX).
- Module V of ES-EE101 on electrical safety and earthing, which must be completed before the first live session.

Course Objectives

- To verify by measurement the network laws and theorems established in ES-EE101.
- To develop competence in the use of the multimeter, oscilloscope, function generator and regulated power supply.
- To give direct acquaintance with the machines and devices the student will meet in practice.
- To establish safe working around live circuits.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Assemble and test direct and alternating current circuits safely, and use the multimeter, oscilloscope and function generator competently.	L3 – Apply
CO2	Verify the network theorems and the behaviour of resonant circuits by measurement and reconcile the result with computation.	L4 – Analyse
CO3	Obtain and interpret the characteristics of the diode, the Zener diode and the bipolar junction transistor, and test rectifier and regulator circuits.	L3 – Apply
CO4	Perform standard tests on a single-phase transformer and a rotating machine and interpret the results, and verify simple logic circuits.	L3 – Apply

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	1	–	2	2	2	–	2
CO2	3	3	2	3	2	–	–	2	1	2	–	2
CO3	3	3	2	3	2	–	–	2	1	2	–	2
CO4	3	2	1	3	2	1	1	2	2	2	–	2

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Familiarisation with laboratory instruments — multimeter, regulated power supply, function generator and cathode ray oscilloscope; measurement of amplitude, frequency and phase on the oscilloscope.	CO1
2	Verification of Kirchhoff's voltage and current laws on a two-loop network.	CO1, CO2
3	Verification of the superposition theorem and of the Thevenin and Norton equivalents of a network.	CO2
4	Verification of the maximum power transfer theorem and plotting of the power against load resistance.	CO2
5	Study of the transient response of an RC and an RL circuit and determination of the time constant.	CO1, CO2
6	Determination of the resonant frequency, bandwidth and quality factor of a series RLC circuit.	CO2
7	Measurement of power and power factor in a single-phase alternating current circuit; improvement of power factor by capacitor.	CO1, CO2
8	Forward and reverse characteristics of a p–n junction diode and of a Zener diode; determination of the knee and breakdown voltages.	CO3
9	Study of half-wave, full-wave and bridge rectifiers with and without a capacitor filter; measurement of ripple factor.	CO3
10	Input and output characteristics of a bipolar junction transistor in the common-emitter configuration; determination of the h-parameters.	CO3
11	Open-circuit and short-circuit tests on a single-phase transformer; determination of the equivalent circuit, regulation and efficiency.	CO4
12	Speed control of a direct current shunt motor, or determination of the torque–slip characteristic of a three-phase induction motor.	CO4
13	Verification of the truth tables of the basic logic gates and realisation of a half adder.	CO4
14	Study of an earthing arrangement, a miniature circuit breaker and a residual current device; measurement of earth continuity.	CO1, CO4

A student is to perform not fewer than ten experiments, of which at least two must be from the machines group. Experiments 2 to 6 are to be repeated in a free circuit simulator and the measured and simulated results compared in the record; this comparison is the first exercise in model validation, which the Industry 4.0 thread carries forward to the digital twin.

Text Books and Reference Books

- D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, McGraw Hill Education — laboratory sections.
- R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson.
- A. K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai.

Online Resources

- Virtual Labs, Basic Electrical and Electronics and Analog Electronics laboratories.

ES-CS291 Programming for Problem Solving Laboratory

Course Code	ES-CS291	Course Title	Programming for Problem Solving Laboratory		
Category	Engineering Science Course	L – T – P	0 – 0 – 3	Credits	1.5
Semester	Second	Contact Hours	36	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

Concurrent with ES-CS201 and to be sequenced one week behind it.

- Basic computer operation and file management, from the Induction Programme.
- The corresponding module of ES-CS201, which must be delivered before the laboratory exercise on it.
- No prior programming experience is assumed.

Course Objectives

- To convert the algorithmic reasoning of ES-CS201 into working, tested code.
- To develop the discipline of compiling, debugging and testing rather than of transcribing.
- To apply programming to engineering data and computation rather than to artificial exercises alone.
- To establish habits of readable code — naming, indentation and comment.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Use an editor, compiler and debugger to write, build, run and correct a C program.	L3 – Apply
CO2	Implement control structures, functions and recursion correctly and test them against boundary cases.	L3 – Apply
CO3	Implement programs using arrays, strings, pointers and structures to manipulate engineering data.	L4 – Analyse
CO4	Read and write files, implement elementary search and sort, and document and defend the program at a viva-voce.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	3	–	–	1	1	2	1	3
CO2	3	3	3	2	3	–	–	1	1	1	1	3
CO3	3	3	3	3	3	–	–	1	1	1	1	3
CO4	3	3	3	3	3	–	–	2	1	2	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Familiarisation with the operating system, editor, compiler and debugger; a first program; the anatomy of a compilation error.	CO1
2	Programs using data types, operators, type conversion and formatted input and output — including one unit-conversion utility for an engineering quantity.	CO1, CO2
3	Programs using if, if–else, nested if and switch — including the roots of a quadratic equation with all cases, and the classification of a material from a measured property.	CO2
4	Programs using while, do–while and for loops — series summation, factorial, prime testing, Fibonacci, number reversal and digit operations.	CO2
5	Programs using nested loops — pattern printing, multiplication tables, and the numerical evaluation of a series to a stated tolerance.	CO2
6	Programs using functions with and without return values; parameter passing; a library of engineering formulae written as functions.	CO2
7	Programs using recursion — factorial, greatest common divisor, Fibonacci and Towers of Hanoi — with a comparison of the recursive and iterative versions.	CO2
8	Programs on one-dimensional arrays — mean, standard deviation, maximum and minimum of a set of measured readings; linear search.	CO3
9	Programs on two-dimensional arrays — matrix addition, multiplication, transpose and the solution of a small linear system by Gauss elimination.	CO3
10	Programs on strings — length, copy, concatenation, comparison and palindrome, written both with and without the standard library.	CO3
11	Programs using pointers — swapping by reference, pointer arithmetic on an array, dynamic memory allocation for an array whose size is read at run time.	CO3
12	Programs using structures — a record of student or component data, an array of structures, sorting by a field.	CO3
13	Programs on file handling — writing computed results to a text file; reading a comma-separated file of experimental readings taken in BS-PH191 or ES-EE191 and computing a required quantity from it.	CO4
14	Programs implementing binary search and two sorting methods, with a count of comparisons to illustrate the difference in the order of growth.	CO4

Not fewer than twelve exercises are to be completed. Exercise 13 is to use data actually recorded by the student in another laboratory of the same year; this is the first point at which the student handles real measured data in code, and it is the entry of the Industry 4.0 thread on the computational side. Every submitted program is to carry a header comment, meaningful identifiers and consistent indentation, and marks are to be allotted for these.

Text Books and Reference Books

- B. W. Kernighan and D. M. Ritchie, The C Programming Language, Prentice Hall of India.
- E. Balagurusamy, Programming in ANSI C, McGraw Hill Education.
- Y. Kanetkar, Let Us C, BPB Publications.

Online Resources

- NPTEL, Problem Solving through Programming in C — programming assignments.
- Virtual Labs, Problem Solving and Programming laboratory.

ES-ME191 / ES-ME291 Engineering Graphics and Design

Course Code	ES-ME191 / ES-ME291	Course Title	Engineering Graphics and Design		
Category	Engineering Science Course	L – T – P	0 – 0 – 3	Credits	1.5
Semester	First or Second (by group)	Contact Hours	36	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

Engineering drawing is the language in which the discipline records its intentions, and no prior training in it is assumed. Prerequisite:

- Plane and solid geometry of Class X — construction of perpendiculars, bisectors, polygons and circles; properties of triangles (WBBSE, CBSE or ICSE Mathematics).
- Coordinate geometry in two and three dimensions and the equation of a plane (CBSE XII Unit IV; WBCHSE).
- Elementary trigonometry.
- Basic computer operation, for the computer-aided drafting sections.

Course Objectives

- To teach the student to read and to produce a drawing that conforms to the Indian Standard.
- To develop the spatial visualisation on which all subsequent design work depends.
- To establish orthographic projection and its inverse, isometric representation, as fluent skills.
- To carry the student from the drawing board to the parametric solid model, and to show that the model is now the master document.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Apply the conventions of the Indian Standard for lines, lettering, dimensioning, scales and sheet layout.	L3 – Apply
CO2	Construct engineering curves and draw the projections of points, lines, planes and solids in the first-angle system.	L3 – Apply
CO3	Produce sectional views and the development of surfaces for a given solid, and interpret a sectioned drawing.	L4 – Analyse
CO4	Convert between orthographic and isometric representations of an object, including the reading of a drawing to visualise a missing view.	L4 – Analyse
CO5	Create a parametric solid model of a part and generate a dimensioned drawing from it using a computer-aided design package.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	–	3	1	–	2	1	3	1	2
CO2	3	2	2	1	2	–	–	1	1	3	–	2
CO3	3	3	3	2	2	–	–	1	1	3	–	2
CO4	3	3	3	2	2	–	–	1	1	3	–	2
CO5	3	2	3	1	3	1	1	1	2	3	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Drawing standards and instruments — IS SP 46; sheet layout and title block; types of line; single-stroke lettering; dimensioning systems and their rules; plain, diagonal and vernier scales.	CO1
2	Engineering curves — conic sections by the eccentricity and other methods; cycloid, epicycloid and hypocycloid; involute; the drawing of a helix.	CO2
3	Indian Knowledge System module — geometric construction in the Śulba-sūtras: squaring the circle, the construction of a square equal in area to a given rectangle, and the śulba statement of the theorem on the diagonal; the proportion and modular systems of the Śailpa-śāstra and their use in temple plan and elevation, with a measured sketch of a documented example.	CO1, CO2
4	Orthographic projection — principles, the first-angle system, projection of points in the four quadrants.	CO2
5	Projection of straight lines — lines inclined to one and to both reference planes; true length and true inclination; traces of a line.	CO2
6	Projection of planes — planes inclined to one and to both reference planes; true shape of a plane figure.	CO2
7	Projection of solids — prisms, pyramids, cylinders and cones in simple and inclined positions.	CO2, CO3
8	Sections of solids — sectional views, true shape of a section, the conventions of hatching.	CO3
9	Development of surfaces — parallel line and radial line methods for prisms, cylinders, pyramids and cones, including truncated solids; the development of a transition piece.	CO3
10	Isometric projection — isometric scale, axes and planes; isometric views of solids and of simple machine parts from orthographic views.	CO4
11	Conversion of a pictorial view to orthographic views, and the completion of a missing view from two given views.	CO4
12	Introduction to computer-aided drafting — the interface, coordinate entry, draw and modify commands, layers, blocks, dimensioning and plotting; reproduction of two earlier board exercises on the computer.	CO5
13	Parametric solid modelling — sketching with constraints, extrude, revolve, sweep and loft, fillet and chamfer; modelling of a small machine part.	CO5
14	Assembly and drawing generation — mating of two or three modelled parts; generation of a dimensioned orthographic drawing with a section and an exploded isometric view from the model; export of the model to a neutral format and, where facilities exist, to the three-dimensional printer of ES-ME191.	CO5

Not fewer than twelve sheets or files are to be completed, of which at least four are to be produced on the computer. Exercise 3 gives effect to the Indian Knowledge System module prescribed for this course in Table F.2 of the curriculum structure. Exercise 14 is the point at which the drawing ceases to be the master document and the model takes its place; this is the beginning of the digital thread that Part E of the curriculum structure carries to PC-ME692 and to the Industry 4.0 core course. Free or educational-licence packages are acceptable and are to be named in the college laboratory manual.

Text Books and Reference Books

- N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House.
- K. Venugopal, Engineering Drawing and Graphics, New Age International.
- Bureau of Indian Standards, SP 46 — Engineering Drawing Practice for Schools and Colleges.
- D. A. Jolhe, Engineering Drawing with an Introduction to AutoCAD, McGraw Hill Education.
- F. E. Giesecke et al., Technical Drawing with Engineering Graphics, Pearson.

Online Resources

- NPTEL, Engineering Drawing and Computer Graphics, 12 weeks.
- NPTEL, Computer Aided Design and Manufacturing — introductory weeks.

ES-ME192 / ES-ME292 Workshop Practice

Course Code	ES-ME192 / ES-ME292	Course Title	Workshop Practice		
Category	Engineering Science Course	L – T – P	0 – 0 – 3	Credits	1.5
Semester	First or Second (by group)	Contact Hours	36	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

No prior prerequisite of content. The prerequisite is of conduct:

- Attendance at the workshop safety induction, which is to be held in the first session and repeated for any student who misses it. No student may operate a machine without it.
- Module V of ES-EE101 on electrical safety is to be taught before the welding and machine shop sections are taken up.
- Class X general science; no previous experience of hand tools is assumed.

Course Objectives

- To give the student direct experience of how material is cut, joined and formed, so that the drawing and the analysis of later semesters rest on something seen and handled.
- To establish safe practice as a habit rather than as a rule.
- To introduce measurement and tolerance at the bench.
- To show, in the same building, the traditional Indian practice, the conventional machine shop and the digitally controlled shop, so that the student grasps the continuity between them.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Observe the safety practice of a mechanical workshop and use hand tools and measuring instruments correctly.	L3 – Apply
CO2	Produce a specified job in fitting, carpentry, sheet metal, welding and smithy to a stated dimension and tolerance.	L3 – Apply
CO3	Explain the operating principle of the lathe, the drilling machine and the common welding processes, and select a process for a given job.	L4 – Analyse
CO4	Prepare a part on a computer-numerically-controlled machine or a three-dimensional printer from a digital model, and describe the digital thread from model to part.	L3 – Apply
CO5	Describe a traditional Indian metalworking or joinery practice and relate it to the corresponding modern process.	L2 – Understand

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	–	1	2	2	3	2	1	1	2
CO2	2	2	2	1	2	1	1	2	2	1	1	2
CO3	3	3	2	2	2	1	2	2	1	1	1	2
CO4	3	2	3	1	3	1	2	1	2	1	1	3
CO5	2	1	1	1	–	3	2	2	1	2	–	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Workshop safety, layout, personal protective equipment, first aid and fire response; introduction to linear measurement, the steel rule, calliper, vernier calliper and micrometer, and to tolerance and fit.	CO1
2	Fitting shop — marking, sawing, filing, chipping, drilling and tapping; production of a square or dovetail fitting job to a stated tolerance.	CO1, CO2
3	Carpentry shop — timber and its defects; marking, sawing, planing and chiselling; production of a lap, mortise-and-tenon or dovetail joint.	CO2
4	Sheet metal shop — development of surfaces; shearing, bending, folding, riveting and soldering; production of a tray, funnel or elbow.	CO2
5	Welding shop — arc welding and gas welding; edge preparation; lap and butt joints; inspection of a weld for common defects; demonstration of gas-tungsten and gas-metal arc welding and of resistance spot welding.	CO2, CO3
6	Smithy and forging — the hearth, tools and operations; upsetting, drawing down and bending; production of a simple forged job.	CO2, CO3
7	Foundry — moulding sand and its testing, pattern and its allowances; preparation of a green sand mould; demonstration of pouring.	CO2, CO3
8	Machine shop — the centre lathe and its parts; plain turning, facing, step turning, taper turning, knurling and thread cutting; drilling and reaming.	CO2, CO3
9	Computer numerical control and additive manufacturing — part programming in outline; production of a small part on a trainer CNC lathe or milling machine; slicing and printing of a small part from a solid model on a fused deposition printer; discussion of the digital thread from model to part.	CO4
10	Indian Knowledge System module — traditional Indian metalworking and joinery: a demonstration of, or documented visit to, a working craft practice of the region (Dhokra lost-wax casting of Bankura and Bardhaman, blacksmithy, or traditional carpentry joinery), with a written comparison of the traditional and the modern process for the same operation.	CO5

A student is to complete at least one job in each of the fitting, carpentry, sheet metal, welding and smithy sections. Item 9 may be conducted as a supervised demonstration where the college does not yet possess the equipment, but the print or the CNC part must be produced in the student's presence. Item 10 gives effect to the Indian Knowledge System module prescribed for this course in Table F.2 of the curriculum structure.

Text Books and Reference Books

- H. S. Bawa, Workshop Practice, McGraw Hill Education.
- W. A. J. Chapman, Workshop Technology, Parts I–III, Routledge / CBS.
- S. K. Hajra Choudhury and A. K. Hajra Choudhury, Elements of Workshop Technology, Volumes I and II, Media Promoters.
- B. S. Raghuwanshi, A Course in Workshop Technology, Dhanpat Rai.
- Bureau of Indian Standards, SP 46 — Engineering Drawing Practice for Schools and Colleges, for the drawing conventions used at the bench.

Online Resources

- NPTEL, Manufacturing Processes I / Introduction to Manufacturing, 12 weeks — for pre-laboratory preparation.
- Virtual Labs, Manufacturing and Workshop laboratories.

AEC-291 Language Laboratory

Course Code	AEC-291	Course Title	Language Laboratory		
Category	Ability Enhancement Course	L – T – P	0 – 0 – 2	Credits	1
Semester	Second	Contact Hours	24	Assessment	Practical: PCA 40 + ESE 60

Prerequisites

Follows AEC-101 and runs alongside AEC-201. Students are to be placed in graded groups on the basis of the diagnostic test taken in the first semester, so that the beginner and the fluent speaker are not taught together.

- AEC-101 English for Communication Skills.
- The first-semester diagnostic test, which determines the group in which the student is placed.
- No prior laboratory training is assumed; where a digital language laboratory is not available, the exercises may be conducted with a computer laboratory and free recording software.

Course Objectives

- To improve intelligibility of speech rather than to impose an accent.
- To develop listening comprehension of technical and professional English in a range of accents.
- To give repeated, recorded and reviewed practice in the speaking situations the student will face.
- To build the confidence of the student whose schooling was in another language.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Produce the sounds, stress patterns and intonation of English with sufficient accuracy to be readily intelligible.	L3 – Apply
CO2	Comprehend spoken technical and professional English delivered at natural speed and take accurate notes from it.	L3 – Apply
CO3	Deliver a prepared and an extempore oral presentation with appropriate structure, delivery and visual support.	L4 – Analyse
CO4	Participate effectively in a group discussion, a telephone conversation and a mock interview.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	–	–	–	–	1	–	–	1	2	3	–	2
CO2	–	1	–	1	1	1	–	1	2	3	–	3
CO3	–	–	1	–	2	1	–	2	3	3	1	3
CO4	–	–	–	–	1	1	–	2	3	3	2	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

List of Experiments / Exercises

Sl.	Experiment / Exercise	CO addressed
1	Diagnostic recording and self-assessment; introduction to the laboratory software and to the recording and playback method used throughout.	CO1
2	Sounds of English — vowels, consonants and the phonetic symbols; minimal pairs; the sounds that most commonly cause difficulty to speakers of Bengali and other Indian languages.	CO1
3	Word stress, sentence stress, rhythm and weak forms; connected speech.	CO1
4	Intonation — falling, rising and fall–rise patterns and their meaning; reading aloud a technical passage with correct phrasing.	CO1
5	Listening comprehension — short technical talks and instructions in Indian, British and American accents; note-taking from a recorded lecture.	CO2
6	Listening for specific information — announcements, telephone messages and safety instructions; dictation of technical text.	CO2
7	Self-introduction and the two-minute personal statement, recorded, played back and revised.	CO3
8	Describing an object, a process and a graph orally; giving and following directions and instructions.	CO3
9	Prepared oral presentation with slides on a technical topic, recorded and assessed on a rubric; handling of questions.	CO3
10	Extempore speaking and the just-a-minute exercise; structuring an answer under time pressure.	CO3
11	Group discussion — two rounds on a technical and a general topic, video-recorded, with peer and self-assessment against a rubric.	CO4
12	Telephone and video-conference practice — making and receiving a professional call, taking a message, and conducting an online meeting.	CO4
13	Mock personal interview before a panel, video-recorded, with individual feedback; the behavioural question and the STAR method in practice.	CO4
14	Role-play of workplace situations — reporting a problem to a superior, negotiating a deadline, and handling a disagreement courteously.	CO4

Every speaking exercise is to be recorded, played back to the student, and repeated after feedback; the recording, not the teacher's impression, is the evidence of improvement, and a comparison of the first and last recordings is to form part of the end-semester assessment. The group discussion and mock interview are to be conducted with the participation of the Training and Placement Cell.

Text Books and Reference Books

- T. Balasubramanian, A Textbook of English Phonetics for Indian Students, Macmillan.
- E. Sethi and P. V. Dhamija, A Course in Phonetics and Spoken English, PHI Learning.
- M. Raman and S. Sharma, Technical Communication — Principles and Practice, Oxford University Press.
- D. Jones, English Pronouncing Dictionary, Cambridge University Press — for reference.

Online Resources

- British Council LearnEnglish — pronunciation and listening resources.
- BBC Learning English — archive of listening material.
- SWAYAM, Spoken English and Soft Skills courses of the current session.

AEC-281 Essentials for Professional Skills

Course Code	AEC-281	Course Title	Essentials for Professional Skills		
Category	Ability Enhancement Course	L – T – P	0 – 0 – 3	Credits	1.5
Semester	Second	Contact Hours	36	Assessment	Practical / Sessional: PCA 40 + ESE 60

Prerequisites

The course follows AEC-101 and assumes the communication competence developed there. It is distinct from Universal Human Values – II of Semester III, which treats values; this course treats professional practice.

- AEC-101 English for Communication Skills.
- Participation in the three-week Induction Programme with Universal Human Values – I, on which Modules I and IV build.
- No prior training in aptitude or in interviewing is assumed.

Course Objectives

- To develop the self-knowledge and self-management on which professional effectiveness rests.
- To develop structured thinking about problems and decisions.
- To build the interpersonal capability required to work in a team and eventually to lead one.
- To establish professional and ethical conduct as a matter of practice.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Assess one's own strengths, values and goals and manage time, priorities and stress accordingly.	L4 – Analyse
CO2	Apply structured methods of critical thinking, problem solving and decision making to a defined situation.	L3 – Apply
CO3	Work effectively in a team, manage conflict, and demonstrate the behaviours of leadership appropriate to the situation.	L4 – Analyse
CO4	Identify the ethical dimension of a professional situation and reason towards a defensible course of action.	L5 – Evaluate
CO5	Prepare for and perform in the standard selection processes — aptitude test, group discussion and personal interview.	L3 – Apply

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	–	–	–	–	–	1	–	2	2	1	3	3
CO2	2	3	2	2	1	1	1	2	2	2	2	3
CO3	–	–	–	–	–	2	1	2	3	2	3	3
CO4	1	1	1	1	–	3	2	3	2	2	2	3
CO5	1	1	–	1	1	1	–	2	2	3	2	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Self-Management	Self-awareness — strengths, values and interests; the Johari window; self-esteem and self-efficacy; goal setting and the writing of a specific and time-bound goal; time management — the priority matrix, planning, and the sources of procrastination; stress — causes, recognition and management; personal finance and the habit of saving in outline.	4
II	Thinking and Problem Solving	Critical thinking — argument, evidence, assumption and inference; identifying fallacies; the difference between an opinion and a claim supported by evidence; creative thinking — brainstorming, lateral thinking, the six thinking hats; structured problem solving — problem definition, root cause analysis, the five whys and the cause-and-effect diagram; decision making under constraint, the weighted matrix, and the recognition of bias.	5
III	Working with Others	The group and the team; stages of team formation; roles within a team; delegation; interpersonal communication and assertiveness as distinct from aggression and passivity; emotional intelligence — self-regulation, empathy and social skill; conflict — sources, styles of handling, negotiation and the search for a joint gain; giving and receiving feedback; leadership styles and the situational choice among them.	5
IV	Professional and Ethical Conduct	The professional as distinct from the employee; codes of conduct of the engineering profession; honesty in data, in reporting and in attribution; plagiarism and academic integrity; conflict of interest; confidentiality and the duty to the public; whistleblowing and its consequences; workplace etiquette and the digital equivalent; diversity, inclusion and gender sensitivity at the workplace, and the law on the prevention of sexual harassment; safety as an ethical obligation; case discussion of engineering failures.	5
V	Career Readiness	The recruitment process and what each stage tests; quantitative aptitude, logical reasoning and verbal ability — method and practice; the group discussion — content, structure and conduct; the personal interview — preparation, the behavioural question and the STAR method, questions to ask, and the follow-up; the internship as a professional engagement rather than a formality, with reference to the summer internship of Semester V and the fourth-year placement of Part K.	5

Total contact hours: 24.

Cross-cutting and statutory components

Module IV carries the professional ethics and gender-sensitisation components required under NAAC Criterion 1.3 and Programme Outcome 8, and is deliberately placed a semester before Universal Human Values – II so that the student meets professional conduct first and its philosophical basis second. Module V is coordinated with the Training and Placement Cell and revises the résumé prepared in AEC-101.

Text Books and Reference Books

- B. K. Mitra, Personality Development and Soft Skills, Oxford University Press.
- D. Goleman, Emotional Intelligence, Bantam Books.
- S. R. Covey, The Seven Habits of Highly Effective People, Simon and Schuster.
- M. Govindarajan, S. Natarajan and V. S. Senthilkumar, Engineering Ethics, PHI Learning.
- R. Gupta, Quantitative Aptitude / R. S. Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, S. Chand — for Module V practice.
- E. Schein, Organizational Culture and Leadership — for the teacher's preparation of Module III.

Online Resources

- SWAYAM / NPTEL, Soft Skills / Developing Soft Skills and Personality (IIT Kanpur), 8 or 12 weeks.
- NPTEL, Ethics in Engineering Practice, 12 weeks.

Question paper notes specific to this course

This paper is to be case-based. Group B and Group C are to present short professional situations — a team in conflict, a data result that does not suit the client, a safety concern reported late — and require the student to analyse and to recommend. Questions asking for a list of the qualities of a leader or the definition of emotional intelligence are not to be set.

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

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

VAC-181 NCC / NSS / Yoga and Sports

Course Code	VAC-181	Course Title	NCC / NSS / Yoga and Sports		
Category	Value-Added Course	L – T – P	0 – 0 – 0	Credits	3
Semester	First	Contact Hours	Activity based	Assessment	Sessional: 100, wholly internal

Prerequisites

No academic prerequisite. The student elects one of the four streams at the beginning of the semester and may not change it thereafter without the permission of the Head of the Institution. A medical fitness declaration is required for the Yoga and Sports streams.

- Physical fitness declaration in the prescribed form.
- For the National Cadet Corps stream, enrolment in the unit attached to the college.
- For the National Service Scheme stream, enrolment in the unit and availability for the special camping programme.

Course Objectives

- To develop discipline, physical fitness and the habit of service.
- To bring the student into contact with a community outside the campus.
- To establish yoga as a living Indian knowledge tradition practised rather than merely described.
- To give effect to the National Education Policy on holistic development and to NAAC Criterion 3 on extension activities.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Participate regularly and with discipline in the chosen stream over a full semester.	L3 – Apply
CO2	Demonstrate the skills of the chosen stream — drill and map reading, community survey and service, yogic practice, or the technique and rules of a sport.	L3 – Apply
CO3	Work effectively as a member and, on occasion, as a leader of a team.	L4 – Analyse
CO4	Reflect in writing on the social or personal value of the activity undertaken.	L5 – Evaluate

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	–	–	–	–	–	2	1	3	3	1	2	3
CO2	–	–	–	–	–	3	2	2	3	2	1	3
CO3	–	–	–	–	–	2	1	2	3	2	3	3
CO4	–	–	–	1	–	3	3	3	2	3	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
A	National Cadet Corps	Organisation and ethos; drill; map reading and field craft; weapon training as applicable; disaster management; social service and community development; national integration; the annual training camp.	—
B	National Service Scheme	Orientation and the NSS philosophy of service; village or slum survey; regular activity in the adopted area; health, literacy, sanitation and environment campaigns; blood donation and disaster relief; the seven-day special camping programme.	—
C	Yoga	Introduction to yoga and its literature — the Yoga-sūtra of Patañjali and the eight limbs; āsana practice in a graded sequence; prā□āyāma and □a□ karma in outline; dhyāna and relaxation; yoga for the sedentary and the student; the documented physiological basis of the principal practices; Āhāra and daily regimen. Conducted by a qualified instructor.	—
D	Sports and Games	Fitness assessment and conditioning; technique, tactics and rules of the chosen game; officiating and scoring; participation in intra- and inter-college competition; sports injury prevention and first aid; the ethics of sport.	—

Total contact hours: undefined.

Cross-cutting and statutory components

Stream C gives effect to the Indian Knowledge System module prescribed for this course in Table F.2 of the curriculum structure, yoga being treated as a living tradition to be practised and understood rather than a topic to be described. Streams A and B carry the community engagement and extension component assessed under NAAC Criterion 3 and the gender-sensitisation and social-responsibility components of Criterion 1.3.

Text Books and Reference Books

- NCC Cadet's Handbook, Directorate General of NCC — for Stream A.
- National Service Scheme Manual, Ministry of Youth Affairs and Sports — for Stream B.
- Swami Satyananda Saraswati, Asana Pranayama Mudra Bandha, Yoga Publications Trust — for Stream C.
- Common Yoga Protocol, Ministry of Ayush — for Stream C.
- Rules of the game as published by the relevant national federation — for Stream D.

Assessment Scheme

Component	Basis	Marks
Regularity and participation	Attendance record of the activity, maintained session by session by the officer in charge	30
Skill and performance	Assessment against the stream rubric — drill and field craft, community work, yogic practice, or sporting technique	30
Camp, event or competition participation	Special camp, community event, yoga demonstration or competition as applicable to the stream	15
Reflective report and viva-voce	A written report of about a thousand words on the work done and its value, defended before the internal committee	25
Total	—	100

SEC-181 / SEC-282 Skill Enhancement Course — MOOCs and Skill Training

Course Code	SEC-181 / SEC-282	Course Title	Skill Enhancement Course — MOOCs and Skill Training		
Category	Skill Enhancement Course	L – T – P	0 – 0 – 0	Credits	3
Semester	First	Contact Hours	Platform based	Assessment	Sessional: 100, wholly internal

Prerequisites

No academic prerequisite. The student selects one course from the basket approved and published by the Department before registration, and registers on the platform within the notified window.

- Access to a computer and to the internet; the college is to provide laboratory access to any student who does not have it at home.
- The digital literacy component of the Induction Programme.
- For a course requiring programming, concurrent registration in ES-CS201 is advised, the two being sequenced by the Department.

Course Objectives

- To give the student an employable skill early in the programme, independent of the theory sequence.
- To establish the habit of self-directed learning on a national platform, which the fourth-year structure will rely on.
- To bring the student's credits onto the Academic Bank of Credits from the first semester.
- To open the Industry 4.0 thread on the skill side.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Complete an approved skill course on SWAYAM Plus, Future Skills Prime or an equivalent platform within the notified schedule.	L3 – Apply
CO2	Demonstrate the specific skill acquired through an artefact, a portfolio or a supervised task.	L3 – Apply
CO3	Manage one's own learning — plan, keep to a schedule, use the discussion forum and seek help appropriately.	L4 – Analyse
CO4	Present the skill acquired and its application to the discipline before a departmental committee.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	3	–	–	1	1	2	1	3
CO2	2	2	2	1	3	–	–	1	1	2	1	3
CO3	–	–	–	–	2	–	–	2	2	2	3	3
CO4	1	1	1	1	2	–	–	2	2	3	2	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
—	Indicative basket for the first semester	Digital literacy and productivity tools; introduction to Python programming; computer-aided drafting fundamentals; introduction to the Internet of Things; basic electrical wiring and safety; welding or machining skill courses of the Future Skills or sector skill council catalogue; spoken English and workplace communication; entrepreneurship awareness. The Department publishes the approved list, with a named fallback against each entry, before registration opens; the list is to be reviewed each session against the current platform catalogue.	—

Total contact hours: undefined.

Cross-cutting and statutory components

The Department is encouraged to place at least one Industry 4.0 skill course in the first-semester basket — an introduction to the Internet of Things, to sensors and data acquisition, or to Python for data handling — so that the thread of Part E of the curriculum structure begins in the first semester rather than the fourth. The credits earned are to be deposited in the Academic Bank of Credits and count towards the forty credits required for the exit award of the Undergraduate Certificate.

Text Books and Reference Books

- Course material of the platform on which the student is registered.
- UGC (Credit Framework for Online Learning Courses through SWAYAM) Regulations, 2021 — for the credit transfer procedure.

Online Resources

- SWAYAM Plus — skill and employability catalogue.
- Future Skills Prime, NASSCOM and the Ministry of Electronics and Information Technology.
- NPTEL and SWAYAM — 8-week skill courses of the current session.

Assessment Scheme

Component	Basis	Marks
Registration, progress and forum participation	Verified on the platform dashboard by the faculty mentor at three checkpoints in the semester	20
Platform assignments	Weekly or periodic assignment scores as recorded on the platform	20
Proctored platform examination	Result of the platform's proctored examination; a pass is a precondition to the award of the credit	30
Skill artefact or portfolio	The programme, drawing, circuit, job or portfolio produced as evidence of the skill	15
Presentation and viva-voce	Before a departmental committee at the end of the semester	15
Total	—	100

MC-181 / MC-281 Indian Knowledge Systems (Foundation)

Course Code	MC-181 / MC-281	Course Title	Indian Knowledge Systems (Foundation)		
Category	Mandatory Course (Non-Credit)	L – T – P	2 – 0 – 0	Credits	Nil
Semester	First or Second (by group)	Contact Hours	24	Assessment	Non-credit; Satisfactory / Unsatisfactory

Prerequisites

No formal prerequisite. The course is the compulsory foundational Indian Knowledge Systems course required by the UGC Guidelines of 2023 and is common to every programme of the University. It assumes only the general history and science of the Higher Secondary curriculum:

- Indian history of the Class XI and XII social science or history course, where taken; no prior knowledge of Sanskrit is assumed or required.
- Elementary geometry, arithmetic and the properties of numbers (Class X Mathematics).
- Elementary chemistry of metals and the general science of Class X.
- All primary material is presented in translation with the original term supplied in transliteration.

Course Objectives

- To give the student a map of the Indian knowledge traditions and of the sources in which they are recorded.
- To establish, by specific and documented example, that the Indian tradition contains substantive scientific and engineering knowledge and not merely philosophy.
- To connect that knowledge to the courses the student will study in later semesters, so that the tradition is met again inside the discipline.
- To develop a critical and evidence-based attitude to claims made about the Indian past, in either direction.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Describe the classification of the Indian knowledge traditions, the principal textual sources, and the methods by which knowledge was recorded, verified and transmitted.	L2 – Understand
CO2	Explain the principal contributions of the Indian tradition in mathematics and astronomy and work simple problems using its methods.	L3 – Apply
CO3	Explain documented Indian achievements in metallurgy, materials and construction, and relate them to the corresponding modern engineering principle.	L3 – Apply
CO4	Outline the Indian traditions of health, agriculture and environmental management and assess their relevance to present questions of sustainability.	L4 – Analyse
CO5	Evaluate a claim made about Indian knowledge against its documentary and archaeological evidence, and cite the source correctly.	L5 – Evaluate

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	–	–	–	–	3	2	2	–	2	–	3
CO2	2	2	–	1	–	2	–	1	–	1	–	3
CO3	2	2	1	1	–	3	2	1	–	1	–	3
CO4	1	1	1	1	–	3	3	2	–	1	–	3
CO5	1	2	–	2	1	3	2	3	–	2	–	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	The Map of Indian Knowledge	What is meant by an Indian Knowledge System; the fourteen and eighteen vidyāsthānas; the Vedic corpus and the six Vedā gas; the a -darśana in outline; the śramana traditions and their contribution; classical Tamil and other regional traditions; oral and manuscript transmission, the guru–śi ya method, and the manuscript wealth of India; the vocabulary of IKS — pramā a, tarka, sūtra, bhā ya — and why the sūtra form was used.	5
II	Mathematics and Astronomy	The Śulba-sūtras and the geometry of altar construction; the decimal place-value system and the concept of zero; Āryabha a, Brahmagupta, Mahāvīra, Bhāskara II and the Kerala school of Mādhava; the kuttaka and cakravāla methods; infinite series for π and for the trigonometric functions; combinatorics and prosody — Pi gala and the binary representation; Indian astronomy — the siddhāntas, planetary models, calendrical computation, and the instruments of the Jantar Mantar.	5
III	Materials, Metallurgy and Construction	Crucible or wootz steel — process, microstructure and its transmission westward; the iron pillar at Mehrauli and the metallurgy of its corrosion resistance; zinc distillation at Zawar; bronze and the lost-wax process; the Śailpa- and Vāstu-śāstras and their systems of proportion and modular measure; temple construction, corbelling and stone dressing; water architecture — stepwells, tanks and the ara ha a; shipbuilding and textile technology in outline.	5
IV	Life, Health and Environment	The structure of Āyurveda and its principles; the Caraka- and Suśruta-Sa hitās and the surgical tradition; Yoga — the eight limbs and the documented physiological basis of its practices; Vṛk āyurveda and traditional agronomy; traditional water harvesting and management systems across the regions of India; ethnobotany and the traditional pharmacopoeia; the relation of these traditions to present questions of sustainability and public health.	5
V	Governance, Economy and Contemporary Relevance	The Arthaśāstra on administration, standards, weights and measures, audit and the regulation of workshops; the śre ī or guild — apprenticeship, quality assurance, credit and dispute resolution; ethics and puru ārtha as a framework for professional conduct; the recovery and documentation of traditional knowledge, the Traditional Knowledge Digital Library and the intellectual property questions it raises; how the Indian tradition will be met again in the engineering courses of this programme; the method of assessing a historical claim against its evidence.	4

Total contact hours: 24.

Cross-cutting and statutory components

This course is Layer 1 of the three-layer Indian Knowledge System design set out in Part F of the curriculum structure. Every module points forward to a specific later course — Module II to BS-M101 and BS-M201, Module III to ES-ME191, ES-ME291, ES-ME301 and PC-ME403, Module IV to VAC-181 and VAC-201, Module V to AEC-301 and PC-ME604 — and the teacher is to make those connections explicit. Two hours of the Whole-Semester Component are reserved for a visit, physical or virtual, to a site, museum or craft cluster of the region, of which West Bengal has many.

Text Books and Reference Books

- B. Mahadevan, V. R. Bhat and Nagendra Pavana R. N., Introduction to Indian Knowledge System — Concepts and Applications, PHI Learning.
- K. Kapoor and A. K. Singh (eds.), Indian Knowledge Systems, Volumes I and II, Indian Institute of Advanced Study and D. K. Printworld.
- Pride of India — A Glimpse into India's Scientific Heritage, Samskrita Bharati.
- S. Balachandra Rao, Indian Mathematics and Astronomy — Some Landmarks, Bhavan's Gandhi Centre.
- D. P. Agrawal, Ancient Metal Technology and Archaeology of South Asia, Aryan Books International.
- A. Rahman (ed.), History of Indian Science, Technology and Culture, Oxford University Press.
- K. Ramasubramanian et al., Ga ita-Yukti-Bhā ā — for the Kerala school material.

Online Resources

- SWAYAM / NPTEL, Introduction to Indian Knowledge Systems and allied courses of the IKS Division, Ministry of Education.
- IKS Division, Ministry of Education — course repository and the list of IKS Centres.
- National Mission for Manuscripts and the Traditional Knowledge Digital Library — for source material.

Assessment Scheme

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 a student must be graded Satisfactory in it to be eligible for the award of the degree. The grade is awarded by the college on the basis of 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 a minimum of forty per cent is to be obtained. A student graded Unsatisfactory is to be re-examined in the following semester. Although the course is non-credit, it remains the foundational Indian Knowledge Systems course required by the UGC Guidelines of 2023, and it is the anchor of the discipline-embedded Indian Knowledge System modules that appear in the later years of every programme.

Question paper notes specific to this course

Questions must be answerable from evidence rather than from sentiment. At least one question in Group C is to require the student to state what the documentary or archaeological evidence for a given claim is, and what it does not establish; and at least one is to require the connection of a traditional practice to the modern engineering principle that explains it. Questions inviting unsupported assertion about the Indian past are not to be set.

MC-182 / MC-282 Indian Constitution

Course Code	MC-182 / MC-282	Course Title	Indian Constitution		
Category	Mandatory Course (Non-Credit)	L – T – P	2 – 0 – 0	Credits	Nil
Semester	First	Contact Hours	24	Assessment	Non-credit; Satisfactory / Unsatisfactory

Prerequisites

No prerequisite. The course is a mandatory non-credit course of the AICTE model curriculum and is common to every programme of the University. A student must be graded Satisfactory in it to be eligible for the award of the degree.

- The Political Science or Social Science of Class X, where taken; the course assumes nothing beyond general awareness.
- The course is to be taught in the medium the class is comfortable with; the constitutional text is to be read in translation where necessary.

Course Objectives

- To acquaint the engineering student with the constitutional framework within which every public and professional act takes place.
- To establish the fundamental rights and duties as matters of daily consequence rather than of ceremony.
- To give a working knowledge of the institutions of governance the student will deal with professionally.
- To connect constitutional values to professional ethics.

Course Outcomes

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

CO	Statement	Bloom level
CO1	Describe the making of the Constitution, its sources, the Preamble and its philosophy.	L2 – Understand
CO2	Explain the Fundamental Rights, the Directive Principles and the Fundamental Duties and identify their application to a given situation.	L3 – Apply
CO3	Describe the structure and working of the Union and State executive, legislature and judiciary, and of local self-government.	L2 – Understand
CO4	Relate constitutional values to the professional and ethical obligations of an engineer.	L4 – Analyse

CO – PO Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	–	–	–	–	–	3	1	3	1	1	–	2
CO2	–	–	–	–	–	3	2	3	1	2	–	2
CO3	–	–	–	–	–	3	1	2	1	1	1	2
CO4	–	–	–	–	–	3	2	3	2	2	1	3

Correlation: 3 substantial, 2 moderate, 1 slight, – nil. Programme Specific Outcomes are to be added by the Department concerned, the first-year courses being common to all programmes.

Detailed Syllabus

Module	Title	Contents	Hours
I	Making and Philosophy of the Constitution	Historical background and the Constituent Assembly; sources and salient features; the Preamble and its philosophy; the idea of a constitution as a limit on power; citizenship.	5
II	Rights, Duties and Directive Principles	Fundamental Rights — equality, freedom, against exploitation, of religion, cultural and educational, constitutional remedies; reasonable restrictions; Directive Principles of State Policy; Fundamental Duties; the relation between the three; the right to information and the right to education as illustrations.	6
III	Union and State Government	The President, Prime Minister and Council of Ministers; Parliament, its composition and procedure; the Governor, Chief Minister and State Legislature; the distribution of legislative powers and the Union, State and Concurrent Lists; emergency provisions in outline; the amendment procedure and the basic structure doctrine.	6
IV	Judiciary and Local Self-Government	The Supreme Court and the High Courts — jurisdiction, judicial review and public interest litigation; subordinate courts and tribunals; the seventy-third and seventy-fourth amendments; Panchayati Raj and municipal institutions and their relevance to public works; the Election Commission and other constitutional bodies.	4
V	Constitutional Values in Professional Practice	Constitutional morality and professional ethics; equality and non-discrimination at the workplace; the law on the prevention of sexual harassment; rights of persons with disabilities and accessible design; environmental jurisprudence and the right to a clean environment; the engineer as a public servant and the duty of care.	3

Total contact hours: 24.

Cross-cutting and statutory components

Module V is the point at which this course connects to Universal Human Values – II in Semester III, to the sustainability content of VAC-201, and to the gender-sensitisation requirement of NAAC Criterion 1.3. It should be taught by the same teacher who will take AEC-302 wherever that is possible.

Text Books and Reference Books

- M. Laxmikanth, Indian Polity, McGraw Hill Education.
- D. D. Basu, Introduction to the Constitution of India, LexisNexis.
- Government of India, The Constitution of India (Bare Act with the latest amendments).
- S. N. Busi and B. R. Ambedkar, Framing of the Indian Constitution — A Study.

Online Resources

- SWAYAM, Introduction to the Constitution of India / Indian Constitution and Polity.
- The India Code portal, Legislative Department, Ministry of Law and Justice — for the constitutional text.

Assessment Scheme

The course carries no credit and no marks contribute to the Semester Grade Point Average. The student is graded Satisfactory or Unsatisfactory by the college on the basis of attendance of not less than seventy-five per cent, one written assignment, and one class test of twenty-five marks in which a minimum of forty per cent is to be obtained. A Satisfactory grade is a condition of eligibility for the award of the degree and is recorded on the transcript. A student graded Unsatisfactory is to be re-examined in the following semester.

Part V — Sources and Benchmarking

V.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.
- 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. Accreditation criteria and the Self-Assessment Report — for the Programme Outcomes and the attainment framework of Part I.
- 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 for Environmental Studies.

V.2 University documents

- MAKAUT, WB. NEP 2020 Compliant Curriculum Structure for the First Year of the B.Tech. programmes, as revised and adopted (effective A.Y. 2026–27) — reproduced in Part V.
- MAKAUT, WB. NEP 2020 Compliant Curriculum Structures for the B.Tech. in Mechanical, Electronics and Communication, Computer Science, Electrical, Information Technology, Leather Technology and Civil Engineering — the companion documents with which this common first year is shared.

V.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 — Mathematics, Physics, Chemistry, Biology, Computer Science, Informatics Practices and English Core, Classes XI and XII.
- Council for the Indian School Certificate Examinations — ISC syllabuses for the corresponding subjects.
- West Bengal Board of Secondary Education — Class X Science and Mathematics, for the courses that assume nothing beyond it.

V.4 Institutional syllabi consulted

The first-year syllabi of the following institutions were examined for the module sequence, the depth expected and the 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 — first-year core courses and the Physics and Chemistry laboratory practice.
- Indian Institute of Technology Madras — computational thinking and programming in the first year.
- Jadavpur University, Faculty of Engineering and Technology — first-year Mathematics, Physics and Chemistry, for comparability within the State.
- 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.
- Dr. B. R. Ambedkar National Institute of Technology and other institutions using the AICTE model first-year cycle rotation.