SISTER NIVEDITA UNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY
B.TECH. BIOTECHNOLOGY PROGRAMME

Curriculum and Detailed Syllabus

Preamble

The curriculum for the B.Tech. in Biotechnology programme at Sister Nivedita University (SNU) is designed in accordance with AICTE guidelines and the New Education Policy (NEP). The programme follows an outcome-based education system with a choice-based credit system (CBCS). Courses are structured to meet industry and academic demands, integrating core subjects such as Bioinformatics, Molecular Biology, Bioprocess Engineering, and Medical Biotechnology. The curriculum includes hands-on lab courses such as Bioreactor Design, Fermentation Technology, Biochemistry, Microbiology, Molecular Biology, Recombinant DNA Technology, Genetics, and Immunology. These courses help students build essential skills to stay updated with advancements in these fields and foster innovation. Additionally, students are encouraged to pursue MOOCS (Massive Open Online Courses) of their interest to earn an Honors degree.

Institutional Vision & Mission

VISION

SNU aspires to provide a transformative impact on the society through its inclusiveness a continuous innovation in education that comes from encouraging creativity, entrepreneurship, and research.

MISSION

Foster an academic environment that is inclusive both in its design of curriculum and in its dissemination of knowledge.

Create a curriculum that is business connected, but also keenly sensitive to the demands of the environment to achieve a sustainable growth for businesses and the economy.

Develop an educational environment that focuses on all segments of the society not just on the privileged few.

Develop a community of learners that is based on quality faculty research, effective teaching pedagogy, and creating an enquiring student population.

Departmental Vision & Mission

Institutional Vision & Mission

VISION

To emerge as a center of excellence in biotechnology education and research, nurturing ethically grounded, innovative leaders who leverage cutting-edge science and interdisciplinary collaboration to address global challenges in health, environment, and industry while advancing sustainable development and societal responsibility.

MISSION

M1: To equip students with a robust grounding in biotechnology, engineering principles, and basic sciences through a dynamic curriculum that blends theoretical rigor with hands-on experimentation."

M2: To foster an understanding of biotechnology's role in addressing global challenges—from healthcare to sustainability—while emphasizing ethical responsibility, environmental conservation, and scalable socio-economic solutions."

M3: To cultivate critical thinking, effective communication, and leadership skills, empowering students to become agile learners, innovators, and collaborators in a rapidly evolving field.

Program Educational Objectives (PEOs) of B.Tech. in Biotechnology Programme

PEO1: To equip students with technical knowledge and skills in biotechnology for careers in industry and research.
PEO2: To instill professional ethics, teamwork, and communication skills.
PEO3: To develop analytical, problem-solving, and lifelong learning abilities.
PEO4: To prepare students for higher studies, entrepreneurship, and leadership roles.

Program Outcomes (POs)

PO1: Engineering knowledge: Apply mathematics, science, and engineering principles to solve biotechnology problems.
PO2: Problem analysis: Analyze complex biological systems using first principles.
PO3: Design/development of solutions: Develop biotechnological solutions considering public health, safety, and environment.
PO4: Conduct investigations of complex problems: Utilize research-based knowledge for data analysis and interpretation.
PO5: Modern tool usage: Implement modern biotechnological techniques and tools.
PO6: The engineer and society: Assess societal and ethical responsibilities in biotechnology.
PO7: Environment and sustainability: Promote sustainable biotechnological innovations.
PO8: Ethics: Uphold professional ethics and responsibilities.
PO9: Individual and teamwork: Function effectively in multidisciplinary teams.
PO10: Communication: Communicate complex biotechnology concepts effectively.
PO11: Project management and finance: Apply management principles in biotechnology projects.
PO12: Lifelong learning: Engage in continuous learning and research.

Program Specific Outcomes (PSOs)

PO1: Develop competency in molecular biology, genetic engineering, and bioprocess technology.
PO2: Apply biotechnology for healthcare, agriculture, and industrial applications.
PO3: Utilize computational biology and bioinformatics for data analysis and drug discovery.

GENERAL COURSE STRUCTURE

Structure of Undergraduate Biotechnology Program

Sl. No.	Category	Credits
1	Humanities and Social Sciences including Management	12
2	Basic Science Courses	19
3	Engineering Science Courses	28.5
4	Biological Science Courses	16.5
5	Professional Core Courses	43
6	Professional Electives	16
7	Open Electives	12
8	Project Work, Seminar, Internship	16
9	Mandatory Courses (Non-credit)	-
	Total	**163**
10	Honours Courses (MOOCs)	20
	Grand Total	**183**

Range of Credits (as per AICTE):

- A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credit points.
- These could be acquired through MOOCs. For details kindly refer to **APPENDIX – A.**
- A student will be eligible to get B.Tech. degree certificate, if he/ she acquires 100 MAR points in 4 years of their study.
- Lateral entry students must acquire 75 MAR points in their 3 years of study.
- For details kindly refer to **APPENDIX – B.**

Curriculum Structure

1st Year 1st Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Chemistry-I	3	0	0	3	3
2		Mathematics-I	3	1	0	4	4
3		Programming for Problem Solving	4	0	0	4	4
4		Basic Electrical Engineering	3	1	0	4	4
5		English for Technical Writing	2	0	0	2	2
	Total Theory		**15**	**2**	**0**	**17**	**17**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Chemistry-I Lab	0	0	2	2	1
2		Programming for Problem Solving Lab	0	0	3	3	1.5
3		Basic Electrical Engineering Lab	0	0	2	2	1
4		English for Technical Writing Lab	0	0	2	2	1
Total Practical			**0**	**0**	**9**	**9**	**4.5**
Total of Semester			**15**	**2**	**9**	**26**	**21.5**

1st Year 2nd Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Physics-I	3	0	0	3	3
2		Mathematics-II	3	1	0	4	4
3		Introduction to Electronics Devices & Circuits	3	0	0	3	3
4		Universal Human Values and Professional Ethics	2	1	0	3	3
Total Theory			**11**	**2**	**0**	**13**	**13**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Physics-I Lab	0	0	2	2	1
2		Introduction to Electronics Devices & Circuits Lab	0	0	2	2	1
3		Workshop / Manufacturing Practice	1	0	3	4	2.5
4		Engineering Graphics and Design	1	0	3	4	2.5
Total Practical			**2**	**0**	**10**	**12**	**7**
Total of Semester			**13**	**2**	**10**	**25**	**20**

2nd Year 1st Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Environmental Sciences	2	0	0	2	0
2		Chemistry of Biomolecules	3	0	0	3	3
3		Thermodynamics & Kinetics	3	0	0	3	3
4		Biochemistry	3	0	0	3	3
5		Microbiology	3	0	0	3	3
6		Data Structure	3	0	0	3	3
Total Theory			**17**	**0**	**0**	**17**	**15**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Biomolecular Chemistry Lab	0	0	2	2	1
2		Biochemistry Lab	0	0	2	2	1
3		Microbiology Lab	0	0	3	3	1.5
4		Data Structure Lab	0	0	2	2	1
5		Design Thinking and IDEA Lab (BT)	0	0	2	2	1
Total Practical			**0**	**0**	**11**	**11**	**5.5**
Total of Semester			**17**	**0**	**11**	**28**	**20.5**

2nd Year 2nd Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Transfer Operation-I	3	0	0	3	3
2		Industrial Microbiology & Enzyme Technology	3	0	0	3	3
3		Molecular Biology	3	0	0	3	3
4		Professional Elective – I (e.g., Bioethics & IPR, Industrial Stoichiometry)	3	0	0	3	3
5		RDBMS Concept and Computer Networking	3	0	0	3	3
6		Mathematical & Statistical Methods	3	0	0	3	3
Total Theory			**18**	**0**	**0**	**18**	**18**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Transfer Operation-I Lab	0	0	2	2	1
2		Enzyme Technology & Fermentation Technology Lab	0	0	2	2	1
3		Molecular Biology Lab	0	0	2	2	1
4		RDBMS Concept Lab	0	0	2	2	1
Total Practical			**0**	**0**	**8**	**8**	**4**
Total of Semester			**18**	**0**	**8**	**26**	**22**

3rd Year 1st Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Indian Constitution and Civil Society	2	0	0	2	0
2		Genetics	3	0	0	3	3
3		Bioinformatics	3	0	0	3	3
4		Recombinant DNA Technology	3	0	0	3	3
5		Transfer Operations-II	3	0	0	3	3
6		Professional Elective - II (e.g.,	3	0	0	3	3
		Food Biotechnology, Environmental Biotechnology, Bioprocess & Process Instrumentation)					
7	*****	Emerging Area / Open Elective-1*	3	0	0	3	3
		Water and Liquid Waste Management, Industrial Safety and Hazards, Introduction to Machine Learning, Total Quality Management (TQM)					
Total Theory			**20**	**0**	**0**	**20**	**18**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Genetics Lab	0	0	2	2	1
2		Bioinformatics Lab	0	0	2	2	1
3		Recombinant DNA Technology Lab	0	0	2	2	1
4		Transfer Operation-II Lab	0	0	2	2	1
5		Professional Elective – II Lab	0	0	2	2	1
		Food Biotechnology Lab, Environmental Biotechnology Lab, Bioprocess & Process Instrumentation Lab)					
Total Practical			**0**	**0**	**10**	**10**	**5**
Total of Semester			**20**	**0**	**10**	**30**	**23**

*** To be offered by other departments**

3rd Year 2nd Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Economics for Engineers	3	0	0	3	3
2		Immunology	3	0	0	3	3
3		Bioseparation Technology	3	0	0	3	3
4		Plant Biotechnology	3	0	0	3	3
5		Professional Elective – III	3	0	0	3	3

Sl.	Code	Subject	L	T	P	Total	Credit Points
		Molecular Modelling and Drug Designing, Biophysics of Macromolecules, Biosensors and Diagnostics)					
6	*****	Emerging Area/ Open Elective-II)	3	0	0	3	3
		Animal Cell Culture & Animal Biotechnology, Basics of Nanotechnology					
7		Indian Constitution and Civil Society	2	0	0	2	0
Total Theory			**20**	**0**	**0**	**20**	**18**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Immunology Lab	0	0	2	2	1
2		Bioseparation Technology Lab	0	0	2	2	1
3		Plant Tissue Culture Lab	0	0	2	2	1
Total Practical			**0**	**0**	**6**	**6**	**3**

C. Sessional

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Term Paper and Seminar	0	0	4	4	2
Total Sessional			**0**	**0**	**4**	**4**	**2**
Total of Semester			**20**	**0**	**10**	**28**	**23**

4th Year 1st Semester

A. Theory

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Principles of Management	3	0	0	3	3
2		Bioreactor Design and Analysis	3	0	0	3	3
3		Professional Elective – IV	3	0	0	3	3
		Biomaterials, Biofertilizers and Biopesticides, Post-harvest Technology, Medical & Pharmaceutical Biotechnology					
4	*****	Emerging Area/ Open Elective-III	3	0	0	3	3
		Proteomics and Protein Engineering, Human Genomics, Biomedical Engineering					
5	*****	Emerging Area/ Open Elective-IV*	3	0	0	3	3
6		Professional Elective – V	3	0	0	3	3
		Renewable Energy Technology, Tissue Engineering,					

Sl.	Code	Subject	L	T	P	Total	Credit Points
		Metabolic Engineering)					
Total Theory			**18**	**0**	**0**	**18**	**18**

B. Practical

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Bioreactor Design Lab	0	0	2	2	1
Total Practical			**0**	**0**	**2**	**2**	**1**

C. Sessional

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Industrial Training / Internship	4 to 6 weeks	-	-	-	2
2		Project-I	0	0	6	6	3
Total Sessional			**0**	**0**	**6**	**6**	**5**
Total of Semester			**18**	**0**	**8**	**26**	**24**

Training in a suitable industry, R&D Organization, Reputed Laboratory or Research Institute for 4 to 6 weeks to be arranged during summer vacation.

*** To be offered by other departments**

4th Year 2nd Semester

A. Sessional

Sl.	Code	Subject	L	T	P	Total	Credit Points
1		Project-II	0	0	14	14	7
2		Comprehensive Viva-voce	-	-	-	-	2
Total Sessional			**0**	**0**	**14**	**14**	**9**
Total of Semester			**0**	**0**	**14**	**14**	**9**

Open Elective-II Papers Offered by the Department of Biotechnology

Sl. No.	Code	Subject	Contact Periods/Week				Credit Points
			L	T	P	Total	
1		Introduction to Biology	3	0	0	3	3
2		Biopolymer	3	0	0	3	3
3		Computational Biology	3	0	0	3	3
Total Theory			**3**	**0**	**0**	**3**	**3**

Open Elective-IV Papers Offered by the Department of Biotechnology

Sl. No.	Code	Subject	Contact Periods/Week				Credit Points
			L	T	P	Total	
1		Biology for Engineers	3	0	0	3	3
2		Biosensor	3	0	0	3	3
3		Bioenergy and Other Non-conventional Energy	3	0	0	3	3

Total Theory	**3**	**0**	**0**	**3**	**3**

APPENDIX – A

Point Description for Mandatory Additional Requirement (MAR)

Sl. No.	Name of the Activity	Points	Maximum Points Allowed
1	MOOCS (SWAYAM/NPTEL/Spoken Tutorial) (per course)	20	40
2	**Tech Fest / Teachers Day / Freshers Welcome**		
	(i) Organizer	05	10
	(ii) Participants	03	06
3	Rural Reporting	05	10
4	Tree Plantation (per tree)	01	10
5	Participation in Relief Camps	20	40
6	Participation in Debate/Group Discussion/Tech Quiz	10	20
7	Publication of Wall Magazine at Institutional Level (magazine/article/internet)	10	20
8	Publication in Newspaper, Magazine & Blogs	10	20
9	Research Publication (per publication)	15	30
10	Innovative Projects (other than course curriculum)	30	60
11	**Blood Donation Camp**		
	(i) Donor	08	16
	(ii) Camp Organizer	10	20
12	**Participation in Sports/Games**		
	(i) College Level	05	10
	(ii) University Level	10	20
	(iii) District Level	12	24
	(iv) State Level	15	30
	(v) National / International Level	20	40
13	Cultural Programme (Dance, Drama, Elocution, Music etc.)	10	20
14	Member of Professional Society	10	20
15	**Student Chapter Activities / Seminars**		
	(i) Participant	05	20
	(ii) Presentation	10	20
	(iii) Organizer	10	20
16	Relevant Industry Visit & Report	10	20
17	Activities in Different Clubs at HIT (Photography Club, Cine Club etc.)	05	10
18	Participation in Yoga Camp	05	10
19	Self-Entrepreneurship Programme	20	20
20	Adventure Sports	10	20
21	Training to Underprivileged / Physically Challenged	15	30
22	Community Service & Allied Activities	10	20

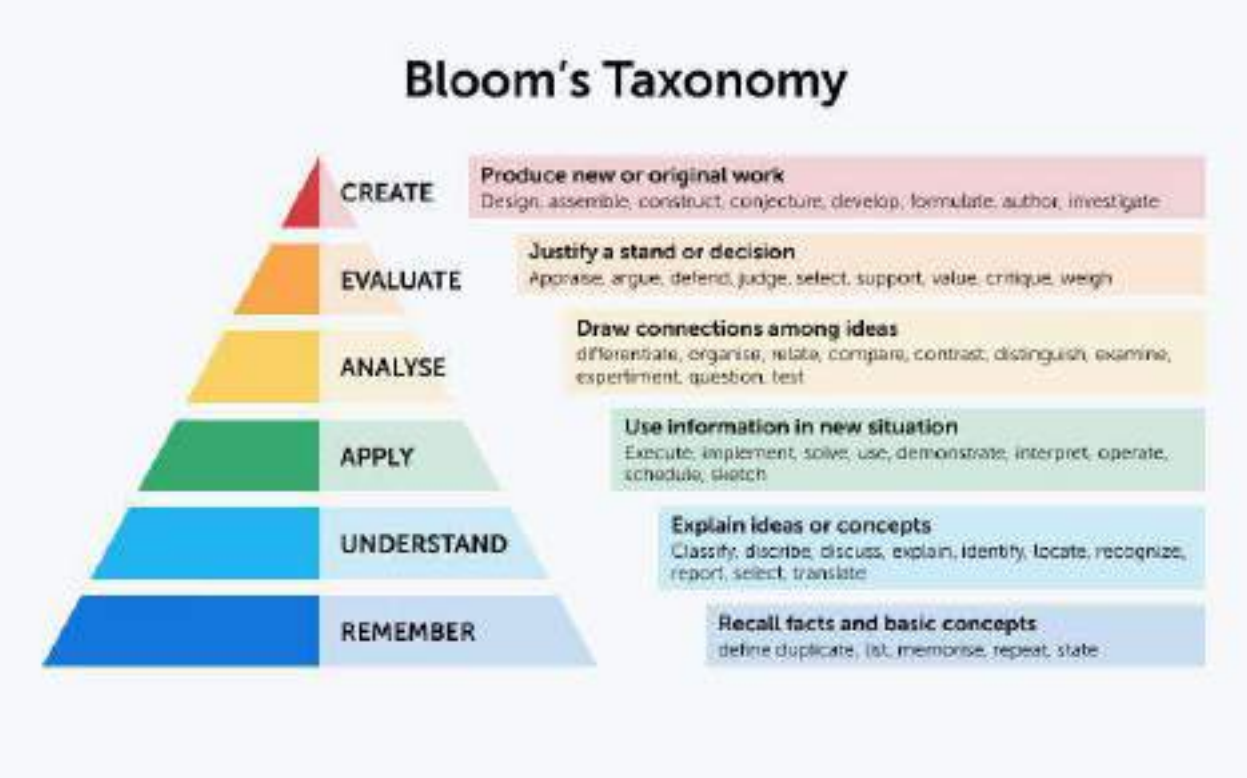
Sl. No.	Name of the Activity	Points	Maximum Points Allowed
23	**Hackathon (State / National Level)**		
	(i) Participation in Hackathon	10	20
	(ii) Qualifier for Final Round (not prize winner)	20	40
	(iii) Prize Winners of Hackathon	30	60

Format for Report Submission

Name:
Department:
Year/Semester:
Title of the Activity:
Date:
Name of the Organization:
Report:

Signature
(Coordinator / Competent Authority)
Points Earned:
Signature of the Mentor:

APPENDIX - B


Bloom's Taxonomy
CREATE
Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate
EVALUATE
Justify a stand or decision
Appraise, argue, defend, judge, select, support, value, critique, weigh
ANALYSE
Draw connections among ideas
differentiate, organise, relate, compare, contrast, distinguish, examine, experiment, question, test
APPLY
Use information in new situation
Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch
UNDERSTAND
Explain ideas or concepts
Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate
REMEMBER
Recall facts and basic concepts
define duplicate, list, memorise, repeat, state

INFRASTRUCRE REQUIREMENTS

Infrastructure Requirements for B.Tech Biotechnology (Batch of 60 Students)

Category	Type	Quantity	Minimum Carpet Area (sq. m)	Remarks
Classroom	Standard Classroom	5	66 (per classroom)	Accommodates 60 students per room.
Laboratories				
1.	Biochemistry Lab	1	66	Equipped with spectrophotometers, centrifuges, electrophoresis units, etc.
2.	Microbiology Lab	1	66	Requires laminar flow hoods, autoclaves, incubators, and microbial culture facilities.
3.	Molecular Biology Lab	1	66	Needs PCR machines, gel documentation systems, and DNA/RNA extraction setups.
4.	Genetics & Cell Biology Lab	1	66	Microscopes (compound, fluorescence), karyotyping tools, cell culture hoods.
5.	Bioprocess Engineering & Fermentation Lab	1	66	Fermenters (bench-scale), bioreactors, downstream processing equipment.
6.	Bioinformatics & Computational Biology Lab	1	66	High-performance computers, software licenses (e.g., BLAST, PyMOL).
7.	Environmental Biotechnology Lab	1	66	BOD/COD analyzers, air/water sampling kits, bioremediation setups.
8.	Plant Biotechnology Lab	1	66	Plant tissue culture room, growth ROOM, etc.
9.	Immunology Lab	1	66	ELISA readers, electrophoresis units, -80°C freezers for antibody storage, etc.
10.	Animal Cell Culture Facility	1	66	CO_2 incubators - Biosafety cabinets - Cryopreservation units, etc.

Additional Notes

1. **Classrooms**: 5 classrooms (66 sq. m each) to accommodate parallel lectures/tutorials.
2. **Laboratories**: Each lab must have:
    - Basic furniture (workbenches, storage cabinets).
    - Safety equipment (fire extinguishers, first-aid kits).
    - Utilities (continuous power backup, RO water, gas lines for Bunsen burners).
3. **Special Requirements**:

- **Biosafety Level-2 (BSL-2)** compliance for Microbiology/Molecular Biology Labs.
- Dedicated server room for Bioinformatics Lab.

Faculty & Staff Requirements for B.Tech Biotechnology Program

Role	Number Required	Qualifications/Specialization	Key Responsibilities
Teaching Faculty			
•Assistant Professor	8–10	Specializations:	– Deliver core theory/practical courses. – Mentor student projects. – Conduct research/publish papers. – Develop course content.
		- Biochemistry	
		- Microbiology	
		- Molecular Biology	
		- Bioinformatics	
		- Bioprocess Engineering	
		- Immunology	
		- Biomedical Engineering	
		- Animal Biotechnology	
Technical Staff			
•Lab Technicians	5–6	– B.Sc/M.Sc in Biotechnology/Life Sciences + Lab experience.	– Maintain lab equipment. – Prepare reagents/samples for practicals. – Assist students during experiments. – Ensure lab safety protocols.
Support Staff			
Administrative Staff	1–2	– Diploma/Degree in Office Management.	– Handle departmental logistics. – Manage student records.
Lab Attendants/Cleaners	2–3	– Basic training in lab hygiene/safety.	– Daily cleaning/disinfection of labs. – Waste disposal management.

Library & Research Facilities Requirements for B.Tech Biotechnology Program

Category	Description	Quantity/Scope	Remarks
Physical Library			
• Textbooks	Latest editions of core biotechnology textbooks	200+ titles (multiple copies of key books)	Cover all subjects from curriculum
• Reference Books	Advanced books for research and projects	100+ titles	Include competitive exam prep books
• Journals	Print versions of key international journals	20+ journal subscriptions (Nature Biotech, J. Biological Chemistry, etc.)	Current + archive of last 5 years
Digital Resources			
• E-Journal Subscriptions	Access to digital databases	ScienceDirect, PubMed, Springer, Wiley, ACS, Taylor & Francis	Institutional license for all students
• E-Books	Digital versions of textbooks and references	500+ titles	Accessible on-campus and remotely
• Thesis/Dissertations	Collection of previous student and faculty research works	Digital archive of all projects	Searchable database
Research Facilities			
• Project Incubation Lab	Small research spaces for student projects	2 labs (66 sq m each)	Basic equipment for prototyping
• Computer Terminal Zone	Dedicated computers for literature search and bioinformatics work	10-15 high-speed computers	With specialized software access
• Discussion Rooms	Spaces for group study and research discussions	3 rooms (capacity 8-10 students each)	Whiteboards and presentation tools

Additional Facilities Requirements for B.Tech Biotechnology Program

Facility	Specifications	Purpose	Key Features
Seminar Hall	- Capacity: 100-150 students	- Guest lectures - Workshops - Student presentations - Conferences	- Advanced audio-visual system - Projector & screen - PA system - Video conferencing setup
Industry Collaboration Room	- Capacity: 15-20 - Area: 50-60 sq.m	- Industry meetings - Collaborative research - Project discussions	- Interactive whiteboard - Video conferencing - Display screens

Facility	Specifications	Purpose	Key Features
			- Secure document storage
Common Instrumentation Room	- Area: 100-120 sq.m	- Shared access to high-end equipment	
Greenhouse Facility	- Area: 100 sq.m - Polyhouse/glasshouse	- Plant growth studies - Transgenic plant research	- Temperature control - Automated irrigation - Growth monitoring systems

DETAILED SYLLABUS

1st Year 1st Sem

Course Title: Chemistry-I					
Course Code:					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course outcomes:
The Course Outcomes for the subject are furnished below:

CO-1: Knowledge acquisition of bulk properties of materials and understanding of reaction processes using thermodynamic considerations.
CO-2: Conception of energy conversion and its importance in clean energy scenario, the operating principles for batteries, fuel cells and the materials and reactions involved there in, their applications as sustainable energy devices, particularly in automobiles sectors to reduce environmental pollution.
CO-3: Analytic view of microscopic chemistry in terms of atomic structure, molecular orbital and intermolecular forces to reinforce a strong background on materials science and engineering.
CO-4: Rationalize periodic trends of elements to explain various physico-chemical properties.
CO-5: Understanding of the spectrum of electromagnetic radiation used for exciting different molecular energy levels in various spectroscopic techniques.
CO-6: Knowledge of stereochemistry and conception of the mechanism of major chemical reactions involved in synthesis of drug molecules.

MODULE I: [9L]
Thermodynamics-5L
The 1st and 2nd laws of thermodynamics and thermodynamic functions like free energy, work function and entropy; Carnot cycle, Joule-Thomson effect, Gibbs-Helmholtz equation; Chemical Potential, Gibbs- Duhem Equation and Clausius-Clapeyron Equation.

Electrochemical Cell-4L
Generation of electromotive force in electrochemical cells and application of Nernst equation; Electrode potentials and the redox reactions; Cell configuration and half-cell reactions; Standard Hydrogen Electrode, Reference electrode, evaluation of thermodynamic functions; Electrochemical corrosion. Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

MODULE II: [9L]
Molecular Structure-5L
Molecular geometry, Hybridization, Ionic, dipolar and van Der Waals interactions; Molecular Orbital Theory and its application in diatomic molecule; Pi-molecular orbital of unsaturated system; Band structure of solids, intrinsic and extrinsic semiconductors and the role of doping on band structures.

Periodic Properties-4L

Effective nuclear charge, penetration of orbitals; variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes; ionization energies, electron affinity and electro-negativity, polarizability, oxidation states, coordination numbers and geometries; hard-soft acid base theory.

MODULE III: [9L]

Atomic structure and Wave Mechanics-5L

Brief outline of the atomic structure, wave particle duality, Heisenberg uncertainty principle; Introduction to quantum mechanics, Schrodinger wave equation for particle in one dimensional box.

Spectroscopic Techniques & Applications-4L

Electromagnetic spectrum: Interaction of EMR with matter; Principle and applications of Fluorescence & Phosphorescence, UV-Visible, Infrared and NMR spectroscopy

MODULE IV: [9L]

Stereochemistry-5L

Representations of 3-dimensional structures, structural isomers and stereo-isomers, configurations, symmetry and chirality; enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of drug molecules-4L

Introduction to reaction mechanism: substitution, addition, elimination and oxidation, reduction reactions. Synthesis of commonly used drug molecules.

Books:

1. Atkins' Physical Chemistry, P.W. Atkins (10^{th} Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6^{th} Edition)
3. Engineering Chemistry, Jain & Jain,(16^{th} Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2^{nd} Edition)
5. Engineering Chemistry-I, Gourkrishna Dasmohapatra, (3^{rd} Edition)

Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7^{th}Edition)
3. Organic Chemistry, Morrison & Boyd, (7^{th}Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4^{th}Edition)
5. Physical Chemistry, G. W. Castellan, (3^{rd}Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1^{st}Edition)

Course Title: Mathematics-I					
Course Code:					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

After completing this course the students will be able to:

CO-1: Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
CO-2: Develop the concept of eigen values and eigen vectors.
CO-3: Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
CO-4: Analyze the nature of sequence and infinite series
CO-5: Choose proper method for finding solution of a specific differential equation.
CO-6: Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

Module I:-10L
Matrix: Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module II:-10L
Vector Calculus: Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics.
Infinite Series: Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module III:-10L
First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.
Ordinary differential equations of higher orders: General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module IV:-10L
Calculus of functions of several variables: Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables.
Multiple Integration: Concept of line integrals, Double and triple integrals. Green's Theorem, Stoke'sTheorem and Gauss Divergence Theorem.

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.

8. Vector Analysis(Schaum's outline series): M. R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Title: Programming for Problem Solving					
Course Code:					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	4	0	0	4	4

Course Outcomes:
After completion of the course, students will be able to:
CO-1: Remember and understand the functionalities of the different hardware and software components present in a computer system, the standard representations of various types of data in a computer system.
CO-2: Illustrate how a computer system with one way of representation can be converted to one another equivalent representation.
CO-3: Construct flow charts for any arithmetic or logical problems in hand.
CO-4: Remember and understand the C programming development environment, writing, compiling, debugging, linking and executing a C program using that development environment, basic syntax and semantics of C programming language and interpret the outcome of any given C program.
CO-5: Use loop constructs, conditional branching, iteration, recursion to solve simple engineering problems.
CO-6: Apply pointers, arrays, structures, files to formulate simple engineering problems.

Module I: [12L]
Fundamentals of Computer
History of Computers, Generations of Computers, Classification of Computers. Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler. Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit). Basic concepts of operating systems like MS WINDOWS, LINUX How to write algorithms & draw flow charts.

Module II: [12L]
Basic Concepts of C and C
Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf. Flow of Control: Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module III: [12L]
Program Structures in C
Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables. C preprocessor (macro, header files), command line arguments. Arrays and Pointers: One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality. String and character arrays; C library string functions and their use.

Module IV: [12L]
Data Handling in C and User defined data types and files:
Basic of structures; structures and functions; arrays of structures. Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell();

Text Books
1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books
1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D. M. Ritchie, B.W. Kernighan

Course Title: Basic Electrical Engineering					
Course Code:					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes
After attending the course, the students will be able to
CO-1: Analyze DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
CO-2: Analyze DC Machines; Starters and speed control of DC motors.
CO-3: Analyze magnetic circuits.
CO-4: Analyze single and three phase AC circuits.
CO-5: Analyze the operation of single phase transformers.
CO-6: Analyze the operation of three phase induction motors.

Module I: [11L]

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [6L]
Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet. [5L]

Module II: [10L]
AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and seriesparallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

Module III: [11L]
Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [4L] **DC Machines:** Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.[7L]

Module IV: [10L]
Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer.[6L]
Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.[4L]

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition.
2. Basic Electrical Engineering, V.N Mittle&Arvind Mittal, TMH, Second Edition.
3. Basic Electrical Engineering, Hughes.
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication.
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand& Company.

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall.
2. Advance Electrical Technology, H. Cotton, Reem Publication.
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers.
4. Basic Electrical Engineering, N.K. Mondal, DhanpatRai.
5. Basic Electrical Engineering, Nath & Chakraborti.
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

Course Title: English for Technical Writing					
Course Code:					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**

	2	0	0	2	2

Course Outcomes:
Students will be able to:
CO-1: Communicate effectively in an official and formal environment.
CO-2: Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment.
CO-3: Use various techniques of communication for multiple requirements of globalized workplaces.
CO-4: Learn to articulate opinions and views with clarity.
CO-5: Write business letters and reports.
CO-6: Apply various communication strategies to achieve specific communication goals.

Module I: [6L]
Introduction to Phonology and Morphology: Phonetics- Vowel and Consonant Sounds (Identification & Articulation). Word- stress, stress in connected speech. Intonation (Falling and Rising Tone). Vocabulary Building-The concept of Word Formation

Module II: [6L]
Communication Skills: The Basics of Business Communication- Process, types, levels. Barriers to Communication Common obstacles to effective communication. Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections Identify common audiences and design techniques for communicating with each audience.

Module III: [6L]
Organizational Communication: Business Letters. Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular.Organizing e-mail messages, E-mail etiquette.Techniques for writing precisely: Creating coherence, organizing principles –accuracy, clarity, brevity. Different styles of writing: descriptive, narrative, expository.

Module IV: [6L]
Principles, techniques and skills for professional writing: Logic in writing, thinking and problem-solving; applying deductive and inductive reasoning; Use of infographics in writing. Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies. Interpreting data and writing reports.Writing proposals and Statement of purpose.

Text Books:

1 Kumar,S. & Lata, P. Communication Skills, OUP, New Delhi2011
2 Rizvi, Ashraf, M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Reference Books:

1. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
2. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.

Course Title: Chemistry-I Lab

Course Code:					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course outcomes:
The course outcomes of the subject are
CO-1: Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.
CO-2: Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^{-} present in water sample to know the composition of industrial water.
CO-3: Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.
CO-4: Handling physicochemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.
CO-5: Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.
CO-6: Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

Experiments
1. Estimation of iron using KMnO4 self indicator.
2. Iodometric estimation of Cu2+.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das.
3. Practicals in Physical Chemistry- P. S. Sindhu.

Course Title : Programming for Problem Solving Lab					
Course Code :					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	1.5

Course Outcomes:
After completion of this course the students should be able to:
CO-1: Write simple programs relating to arithmetic and logical problems.
CO-2: Interpret, understand and debug syntax errors reported by the compiler.
CO-3: Implement conditional branching, iteration (loops) and recursion.
CO-4: Decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
CO-5: Use arrays, pointers and structures effectively in writing programs.
CO-6: Create, read from and write into simple text files.

List of Practicals
Software to be used: GNU C Compiler (GCC) with LINUX NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors
Topic 2: Basic Problem Solving
Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)
Topic 4: Loops - Part I (for, while, do-while)
Topic 5: Loops - Part II
Topic 6: One Dimensional Array
Topic 7: Array of Arrays
Topic 8: Character Arrays/ Strings Topic
Topic 9: Basics of C Functions
Topic 10: Recursive Functions
Topic 11: Pointers
Topic 12: Structures
Topic 13: File Handling

Text Books:
1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Course Title : Basic Electrical Engineering Lab					
Course Code :					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	2	2	1

Course Outcomes:
The students are expected to:
CO-1: Get an exposure to common electrical apparatus and their ratings.

CO-2: Make electrical connections by wires of appropriate ratings.
CO-3: Understand the application of common electrical measuring instruments.
CO-4: Understand the basic characteristics of different electrical machines.

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's& Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

Course Title : English for Technical Writing Lab					
Course Code :					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	2	2	1

Course Outcome:
Students will be able to:
CO-1: Communicate in an official and formal environment.
CO-2: Effectively communicate in a group and engage in relevant discussion.
CO-3: Engage in research and prepare presentations on selected topics.
CO-4: Understand the dynamics of multicultural circumstances at workplace and act accordingly.
CO-5: Organize content in an attempt to prepare official documents.
CO-6: Appreciate the use of language to create beautiful expressions.

Detailed Syllabus

Module I [6hrs]
The Art of Speaking

1. Techniques for Effective Speaking
2. Voice Modulation: Developing correct tone
3. Using correct stress patterns: word stress, primary stress, secondary stress. Rhythm in connected speech
4. Encoding Meaning Using Nonverbal Symbols.
5. How to Improve Body Language.
6. Eye Communication, Facial Expression, Dress and Appearance.
7. Posture and Movement, Gesture, Paralanguage.
8. Encoding meaning using Verbal symbols: How words work and how to use words.

9. Volume, Pace, Pitch and Pause.
10. Structuring content for delivery in accordance with time, platform, and audience.

Module II [6hrs]
Group Discussion

1. Nature and purpose and characteristics of a successful Group Discussion.
2. Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure

Module- III [6hrs]

1. Interviewing,Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
2. Cover Letter & CV
3. Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module IV [6 hrs]
Professional Presentation Skills

1. Nature and Importance of Presentation skills
2. Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.
3. Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides
4. Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, and provide closure.
5. Improving Delivery: Choosing Delivery methods, handling stage fright
6. Post-Presentation discussion: Handling Questions-opportunities and challenges.

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001.
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004.
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999.
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, McGraw Hill Education.2015.
5. Malhotra, A., Campus Placements, McGraw Hill Education.2015.