B.S. Abdur Rahman®
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2025
Curriculum and Syllabi
(As approved by the 24th Academic Council – August 2025)

B.Tech.
(Biotechnology)

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REGULATIONS 2025

CURRICULUM AND SYLLABI (I & II semesters)

(as approved by the 24th Academic Council – August 2025)

B.TECH. BIOTECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

VISION

B.S. Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

SCHOOL OF LIFE SCIENCES

VISION AND MISSION

VISION

To attain new heights in biotechnology research, shaping life sciences into a premier precision tool for the future for creation of wealth and ensuring social justice-specially for the welfare of the poor

MISSION

The mission of the school of life sciences and Technology is to maximize the benefits of biotechnology to the University, the nation and the globe by being an excellent quality, comprehensive, multidisciplinary school that supports, coordinates, disseminates and advances biotechnology in the areas of social welfare and entrepreneurship.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES:

- **PEO1:** This course will facilitate the graduates to be professionally competent in Biotechnology to solve the problems in environmental, food, biochemical and biomedical sciences.

- **PEO2:** This course will offer students with a solid foundation in Biological Sciences, to enable them to work on applications in biotechnology as per the requirement of the industries, and also will enable the students to pursue higher studies and research.

- **PEO3:** This course will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology to enable them to understand basic concept in modern biology and help them to build their carrier in this field.

- **PEO4:** This course will facilitate the students to acquire knowledge in skill-based courses such as Biofertilizer Technology, Agricultural Biotechnology, Medical Biotechnology, Herbal Technology, Disease Management and Mushroom Culture Technology enabling their skills and give confidence to them for business opportunities.

- **PEO5:** This programme will teach students the importance of Bioethics, entrepreneurship, communication, and management skills.

- **PEO6:** This course will also offer the graduates to demonstrate their proficiency in theory and practice of bio-techniques through life-long learning and provide confidence to perform as an individual and / or member of a team with professional and ethical behavior.

PROGRAMME OUTCOMES:

On successful completion of the programme, the graduates will

- PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences PO10: Project

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

- PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAMME SPECIFIC OUTCOMES:

On completion of B. Tech. Biotechnology programme, graduates will be able to

PSO1: Apply knowledge to find innovative solutions for biotechnological problems

PSO2 Explore problems related to biotechnology and provide valid conclusions through industry academia interface

PSO3 Infer the potentials and impact of biotechnological innovations for finding sustainable ethical solutions to issues pertaining to health, environment and agriculture

REGULATIONS – 2025
B.TECH. DEGREE PROGRAMMES
(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means theory / practical / laboratory integrated theory / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare, conduct of co-curricular, extra-curricular events and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **"Dean of the School"** means the Dean of the School of the department concerned.

x) **"Head of the Department"** means the Head of the Department concerned.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have passed the Higher Secondary Examination of the 10+2 curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto. Grade 12 or equivalent stage of education (Level 4) as per NEP 2020.

2.1 b) The student shall have studied at least any three of the following courses: Physics, Mathematics, Chemistry, Computer Science, Electronics, Information Technology, Biology, Informatics Practices, Biotechnology, Technical Vocational Subjects, Agriculture, Engineering Graphics, Business Studies, Entrepreneurship at 10+2 level. In case if the student has not studied any or all the courses viz., mathematics, physics and chemistry, he / she shall undergo bridge course(s) in the concerned course(s) at 10+2 level knowledge (Level 4 of NEP 2020).

2.2 Notwithstanding the qualifying examination, the candidate might have passed at 10+2, the candidate shall also write an entrance examination prescribed by the Institution for admission to certain programmes. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.

2.3 Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.4 The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.

2.5 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.

2.6 The eligibility and admission criteria prescribed by the respective programme regulating bodies shall be strictly followed for the selection and admission of candidates to the specific programmes.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. Degree programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

1. Aeronautical Engineering
2. Artificial Intelligence and Data Science
3. Automobile Engineering
4. Biotechnology
5. Civil Engineering
6. Computer Science and Engineering
7. Computer Science and Engineering (Cyber Security)
8. Computer Science and Engineering (Internet of Things)
9. Computer Science and Engineering (Artificial Intelligence and Machine Learning)
10. Electrical and Electronics Engineering
11. Electronics and Communication Engineering
12. Electronics and Computer Engineering
13. Electronics and Instrumentation Engineering
14. Information Technology
15. Mechanical Engineering
16. Polymer Engineering

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every programme has a curriculum with syllabi consisting of theory and practical courses as per AICTE such as,

i) Basic Science Courses - BSC
ii) Humanities and Social Sciences including Management Courses - HSC
iii) Engineering Science Courses - ESC
iv) Professional Core Courses - PCC
v) Professional Elective Courses - PEC
vi) Open Elective Courses - OEC
vii) Laboratory Courses – LC
viii) Laboratory Integrated Theory Courses – LITC
ix) Mandatory Non Credit Courses- MNC
x) Project - PROJ (Project work, seminar and internship in industry or at appropriate workplace)

4.1.1 Mandatory Induction Programme for First Year Students

The first year students upon admission shall undergo a mandatory three-week Induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization with departments / schools and centres, etc.,

4.1.2 Personality and Character Development

All students shall enroll, on admission, in any of the following personality and character development programmes or in departmental societies:

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO)
- Youth Red Cross (YRC)
- Rotaract
- Crescent Indian Society Training Development (ISTD – C)
- Crescent Creative Strokes
- Crescent Technocrats club

The training activities / events / camp shall normally be organized during the weekends / vacation period.

4.1.3 Online Courses for Credit Transfer

Students are permitted to undergo department approved online courses

under SWAYAM up to 40% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean (Academic Affairs) during his / her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

4.1.4 Value Added Courses

The students are permitted to pursue department approved online courses (excluding courses registered for credit transfer) or courses offered / approved by the department as value added courses.

The details of the value added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Dean (Academic Affairs) for approval.

The students may also undergo the value added courses offered by other departments with the consent of the Head of the Department offering the course.

These value added courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and above the curriculum during the period of study.

4.1.5 Industry Internship

The students shall undergo training for a period as specified in the curriculum during the summer vacation in any industry relevant to the field of study.

The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period prescribed in the curriculum during the summer vacation, in lieu of Industrial training.

In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.

4.1.6 Industrial Visit

The student shall undergo at least one industrial visit every year from the second year of the programme. The Heads of Departments / Deans of Schools shall ensure the same.

4.2 Each course is normally assigned certain number of credits:

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions per week
- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training or 80 hours per semester.

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, etc.

4.4 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry students).

5.2 Each semester shall consist of a minimum of 90 working days including the days of examinations.

5.3 The maximum duration for completion of the programme as mentioned in clause 5.1 shall also include period of break of study vide clause 7.1 so that the student may be eligible for the award of the degree.

6.0 REGISTRATION AND ENROLLMENT

6.1 The students of first semester shall register and enroll for courses at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

6.2 Change of an Elective Course

A student can change an enrolled elective course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department

of the student.

6.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.0 BREAK OF STUDY FROM PROGRAMME

7.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

7.1.1 Medical or other valid grounds

7.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance

7.1.3 Debarred due to any act of indiscipline

7.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1).

7.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

7.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 Class Advisor

A faculty member shall be nominated by the Head of the Department as class advisor for the class throughout the period of study except first year.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their

period of study.

However, for the first and second semester, the class advisors (first year class advisors) are nominated by the first year coordinator.

8.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

9.0 COURSE COMMITTEE

9.1 Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the course faculty teaching the common course with one of them nominated as a course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending on whether all the course faculty teaching the common course belong to a single department or from several departments. The course committee shall ensure preparation of a common question paper and scheme of evaluation for the tests and semester end examination.

10.0 CLASS COMMITTEE

A class committee is constituted branch wise and semester wise by the Head of the Department / Dean of the School shall normally comprise of faculty members handling the courses, student representatives and a senior faculty member not handling any courses for that class as chairman.

10.1 The composition of class committees for first and second semester is as follows:

i) The first year coordinator shall be the chairman of the class committee
ii) Faculty members of all individual courses of first / second semester
iii) Six student representatives (male and female) of each class nominated by the first year coordinator
iv) The class advisor and faculty advisors of the class

10.2 The composition of the class committee for each branch from 3rd to 8th semester is as follows:

i) One senior faculty member preferably not handling courses for the concerned semester appointed as chairman by the Head of the Department
ii) All the faculty members handling courses of the semester
iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors
iv) All faculty advisors and the class advisors
v) Head of the Department

10.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the components of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

10.4 During these two meetings, the student members shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi, etc.

10.5 The third meeting of the class committee, excluding the student members, shall meet after the semester end examinations to analyse the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class

committee(s) by the course faculty concerned.

11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

11.1 A student can enroll for a maximum of 36 credits during a semester including Redo / Predo courses.

11.2 The minimum credits earned by the student to move to 7th semester shall not be less than 60 credits (40 credits for lateral entry students).

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Examination	Full course	3 hours	50%

12.2 Theory Course

Appearing for semester end theory examination for each course is mandatory and a student shall secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

12.3 Laboratory Course

Every practical course shall have 60% weightage for continuous assessments and 40% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory (LIT) Courses

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and

consolidated by assigning a weightage of 75% for theory component and 25% for practical component (for a 4 credit LIT course). Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

Component	Maximum Marks	Weightage for Final Grade	Mode of Assessment
Theory Component	100	75%	CAT1 (25%) + CAT2 (25%) + SEE (50%)
Practical Component	100	25%	Continuous assessment only
Final Grade Basis	Consolidated	100%	75% Theory + 25% Practical
Pass Requirement	-	-	Minimum 40% in Semester-End Theory Exam (SEE)

Note:

1. Proportionate weightage shall be assigned to LIT courses based on their credit value, whether 2 or 3 credits.

2. In Lab-Integrated Professional Elective courses, the laboratory component shall be assessed by the course faculty.

12.5 The components of continuous assessment for theory / practical / laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.6 Industry Internship

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research

/ academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work (Mini and Capstone Project)

Mini project work, shall be carried out individually or as a group activity involving a maximum of four students.

Each group shall identify a suitable topic within their domain, either disciplinary or interdisciplinary, based on the students' abilities and in consultation with the faculty mentor. The topic must lead to the development of a small-scale system or application.

The progress of the mini project shall be evaluated through three periodic reviews: two interim reviews and one final review. A project report shall be submitted by the end of the semester. The reviews shall be conducted by a committee of faculty members constituted by the Head of the Department / Dean of the School.

An oral examination (viva voce) shall be conducted as the semester-end examination by an internal examiner approved by the Controller of Examinations, based on the project report.

The weightage for assessment shall be as follows:

• Periodic Reviews: 50%

- 25% by the Project Guide
- 25% by the Review Committee

• Project Report: 20%

• Viva Voce Examination: 30%

In the case of capstone project work, the project shall be carried out individually or as a group activity, involving a maximum of three or four students.

A committee of faculty members, constituted by the Head of the Department / Dean of the School, shall conduct three periodic reviews during the semester to monitor and assess the progress of the project.

At the end of the semester, students shall submit a project report, based on which a semester-end oral examination (viva voce) shall be conducted by an external examiner approved by the Controller of Examinations.

The assessment weightage shall be as follows:

• Periodic Reviews – 50%

- 25% by the Project Guide
- 25% by the Review Committee

• Project Report – 20%

• Viva Voce Examination – 30%.

12.8 Assessment of seminars and comprehension shall be carried out by a committee of faculty members constituted by the Head of the Department.

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. **There shall be no arrear or improvement examination for lab components**.

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of the School for that purpose. There is no substitute examination for semester end examinations.

13.2 A student shall apply for a substitute exam in the prescribed form to the Head of the Department / Dean of the School within a week from the date of assessment test. However, the substitute examination will be conducted

only after the last instructional day of the semester.

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the scheduled contact hours (such as lectures, tutorials, labs, etc.) for that course. However, a **relaxation** of up to 25% in attendance may be granted to account for valid reasons such as medical emergencies, participation in co-curricular or extracurricular activities with prior approval, or other genuine circumstances.

If a student's attendance falls below 75% in a particular course, even after considering the permissible relaxation, they will not be allowed to appear for the semester-end examination in that course. Instead, the student will be awarded an “I” grade (Incomplete) for the course.

14.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

14.3 If a student’s attendance in any course falls between 65% and 75% due to medical reasons (e.g., hospitalization, illness) or participation in institution-approved events, they may be granted exemption from the minimum attendance requirement and allowed to appear for the semester-end exam. The student must submit valid documents to the class advisor upon rejoining, with approval from the HoD/Dean. Final approval for **condonation** will be granted by the Vice Chancellor based on the Dean (Academic Affairs)’s recommendation.

14.4 A student who has obtained an **“I”** grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall

repeat all the courses of the semester in the subsequent academic year.

14.5 The student awarded **"I"** grade, shall enroll and repeat the course when it is offered next. In case of "I" grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the Department / Dean of the School.

14.6 A student who is awarded **"U"** grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to **redo** the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains "U" grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

14.7 If a student with "U" grade, who **prefers to redo** any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier "U" grade and continuous assessment marks shall continue.

15.0 REDO / PRE-DO COURSES

15.1 A student can register for a maximum of three redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the concerned department, based on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

15.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is **no provision for any substitute examination and withdrawal from a redo course**.

15.3 A student shall be permitted to pre-do a course offered by the concerned department, provided it does not affect the regular semester class schedule. Such permission shall be granted based on the availability of faculty

members, the maximum permissible credit limit of the semester, and the student's fulfillment of the necessary prerequisites for the course. The proposal shall be recommended by the Dean of the School and the Head of the Department, and shall require final approval from the Dean (Academic Affairs).

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis. The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-
PA	-
FA	-

"W"- denotes withdrawal from the course

"I" - denotes "Incomplete" ie. inadequate attendance in the course and prevention from appearance of semester end examination

"U" - denotes unsuccessful performance in the course.

"PA" - denotes the 'Pass' of the zero credit courses.

"FA" - denotes the 'Fail' of the zero credit courses.

16.2 A student who earns a minimum of five grade points ('E' grade) in a course

is declared to have successfully completed the course. Such a course cannot be **repeated by the student for improvement of grade**.

16.3 Upon awarding grades, the results shall be endorsed by the chairman of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to the Controller of Examinations. Subsequently, the Head of the Department / Dean of the School offered the course shall constitute a revaluation committee consisting of chairman of the class committee as convener, the faculty member of the course and a senior faculty member having expertise in that course as members. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

16.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from the first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i, is the number of credits assigned for the i^{th} course and GP_i is the Grade

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i}$$

Point in the i^{th} course,

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

"I", "W", "PA" and **"FA"** grades are excluded for calculating GPA.

"U", "I", "W", "PA" and **"FA"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage equivalent of marks = CGPA X 10

16.6 After successful completion of the programme, the degree shall be awarded to the students with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the prescribed period of 8 semesters for all students (except lateral entry students) and 6 semesters for lateral entry students
First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters for lateral entry students
Second Class	Others

16.6.1 Eligibility for First Class with Distinction

- A student should not have obtained 'U' or 'I' grade in any course during his/her study
- A student should have completed the UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 Eligibility for First Class

- A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 7.1.1)

16.6.3 The students who do not satisfy clause 16.6.1 and clause 16.6.2 shall be classified as second class.

16.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out students can apply for supplementary examination for a maximum of **three** courses thus providing an opportunity to complete their degree programme. Likewise, students with less credits in VI semester can also apply for supplementary examination for a maximum of **three** courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in the **even semester**.

18.0 DISCIPLINE

18.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

18.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the Head of the Department / Dean of the School concerned shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

19.0 MULTI ENTRY AND MULTI EXIT (MEME) FRAMEWORK

In accordance with the provisions of the National Education Policy (NEP) 2020, the programme shall support a Multi Entry – Multi Exit (ME-ME) framework to provide flexibility in the academic pathway of students.

19.1 Exit Option:

19.1.1 Credit Requirement for Award of B.Tech. Degree

To qualify for the award of a B.Tech. degree from the Institute, a student must successfully complete the total credit requirements as prescribed in the approved curriculum of the respective programme. The specific credit requirements are determined by the programme curriculum.

19.1.2 Provision for Multiple Exit

In alignment with NEP 2020 guidelines, the Institute provides students enrolled in undergraduate programmes with the option of multiple exits, subject to the following conditions:

a. Exit at the End of First or Second Year

Students may choose to exit the programme at the end of either the first year or the second year, provided they have fulfilled the prescribed academic requirements.

b. Application for Exit

A student intending to exit must submit a formal written application in the prescribed format at least **eight weeks prior to the scheduled end of the academic year**.

c. Departmental Recommendation

1. Upon receipt of the application, the concerned Department shall evaluate the academic record of the student and recommend the award of a **Certificate or Diploma** as applicable, based on the credits earned.
2. In the case of arrear courses, the Certificate/Diploma will be conferred only after successful clearance of all pending arrears.

d. Notification of Completion

Once a student has fulfilled the requirements for the award of Certificate/Diploma, the Department shall notify the same to Controller of Examinations for further processing and issuance.

19.1.3 Award of Qualifications under Multiple Exit Scheme

1. **Certificate**: Awarded after successful completion of the first year, subject to earning the minimum prescribed first-year credits as per respective curriculum along with a **3-credit Skill Based Course**.
2. **Diploma**: Awarded after successful completion of the second year, subject to earning the minimum prescribed cumulative credits as per the respective curriculum (e.g., 44 credits from the first year + 42 credits

from the second year) along with **6 credits of Skill Based Courses**.

19.1.4 Conditions Governing Exit

1. The multiple exit facility is intended strictly for **genuine and exceptional circumstances**, such as prolonged illness, or securing an employment opportunity necessitating a temporary withdrawal from the programme.
2. Students opting for a temporary exit after the first or second year must obtain **prior approval from the Registrar through the Dean (Academics)**, based on the recommendation of the respective Head of the Department.

19.1.5 Expectation of Programme Continuity

While the option for multiple exits exists, it is generally expected that students admitted to a B.Tech. programme shall pursue their studies continuously until completion of the final degree requirements.

19.2. Entry Option:

Students seeking re-entry into the programme (multi-entry) must submit an application through the proper channel at the beginning of the odd semester. Admission shall be subject to fulfilment of institutional guidelines, credit mapping, and availability of seats.

19.3. Credits Requirement for the Certifications:

Name of the Certificate Programme	Required Credits
Certificate (Level 4.5 as per NEP 2020)	40* - 45
Diploma (Level 5 as per NEP 2020)	80* - 87

* The minimum number of credits that a student must earn (as per the respective curriculum) in order to get the above certification program.

20 ELIGIBILITY FOR THE AWARD OF DEGREE

20.1 A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

20.1.1 Successfully earned the required number of total credits as specified in the curriculum of the programme of study within a maximum period of 14 semesters (12 semesters for lateral entry) from the date of admission, **including break of study**.

20.1.2 Successfully completed the requirements of the enrolled professional development activity through various institute level clubs or department level membership in societies.

20.1.3 No dues to the Institution, Library, Hostel, etc.

20.1.4 No disciplinary action pending against him/her.

20.2 The award of the degree must have been approved by the Institution.

21 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

21.1 The students admitted in the following B.Tech. programmes can graduate with a minor degree, which is optional, along with a major degree.

21.2 The eligibility for choosing the minor degree is given as below:

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)	Offering Dept.
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engg. Electronics and Instrumentation Engg.	CSE
2.	Block Chain		CSE
3.	Cyber Security		IT
4.	Data Science		CSE
5.	Internet of Things (IoT)		ECE

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)	Offering Dept.
6.	Virtual & Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engg. Electronics and Instrumentation Engg. Electronics and Communication Engg.	CSE
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engg.	IT
8.	Robotics	Artificial Intelligence and Data Science Computer Science and Engg. (AIML) Computer Science and Engg.(CS) Computer Science and Engg.(IoT) Computer Science and Engineering Information Technology Civil Engineering Biotechnology Electrical and Electronics Engg. Electronics and Instrumentation Engg.	Mech.

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)	Offering Dept.
9.	3D Printing	Artificial Intelligence and Data Science Computer Science and Engineering Computer Science and Engg. (AIML) Computer Science and Engg. (CS) Computer Science and Engg. (IoT) Information Technology Biotechnology Electrical and Electronics Engg. Electronics and Instrumentation Engg. Electronics and Communication Engg.	Mech.
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering Computer Science and Engg.(AIML) Computer Science and Engg.(CS) Computer Science and Engg. (IoT) Information Technology Civil Engineering Biotechnology Electronics and Communication Engg.	EEE
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering Computer Science and Engg. (AIML) Computer Science and Engg. (CS) Computer Science and Engg. (IoT) Computer Science and Engineering Information Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering	EIE

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)	Offering Dept.
		Biotechnology Electronics and Communication Engg.	
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science and Engg. (AIML) Computer Science and Engg. (CS) Computer Science and Engg. (IoT) Computer Science and Engineering Information Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Biotechnology Electrical and Electronics Engg. Electronics and Instrumentation Engg. Electronics and Communication Engg.	Civil
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science and Engineering Computer Science and Engg. (AIML) Computer Science and Engg. (CS) Computer Science and Engg. (IoT) Information Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical and Electronics Engg. Electronics and Instrumentation Engg. Electronics and Communication Engg.	Life Sciences

21.3 A student shall earn an additional 18 to 20 credits for the award of a minor degree.

21.4 A student shall be awarded a minor degree only when he / she completes the requirements for the award of major degree stipulated in the respective programme.

22 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

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B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

B.TECH. BIOTECHNOLOGY

CURRICULUM & SYLLABI, REGULATIONS 2025

(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	ENE 1181	English for Engineers	3	0	0	3
2	BSC	MAE 1182	Mathematics for Biotechnology	3	1	0	4
3.	BSC	CHE 1182	Biomolecules and Organic Chemistry	3	0	2	4
4.	ESC	GEE 1101	Engineering Graphics	2	0	2	3
5.	ESC	GEE 1102	Design Thinking	3	0	0	3
6.	ESC	GEE 1103	Digital Manufacturing and Fabrication Laboratory	0	0	2	1
7.	ESC	GEE 1104	Programming for Problem Solving	2	0	2	3
8.	ESC	GEE 1105	Environmental Sciences (MNC – I)	2	0	0	0
			Credits				**21**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHE 1181	Engineering Physics	3	0	2	4
2.	ESC	GEE 1203	Basic Electrical & Instrumentation Engineering	2	0	2	3
3.	PCC	BTE 1201	Basics of Genetics	3	0	0	3
4.	PCC	BTE 1202	Biochemistry	3	0	0	3
5.	PCC	BTE 1203	Biochemistry Laboratory	0	0	3	1
6.	PCC	MAE 1284	Biostatistics	3	1	0	4
7.	HSC	GEE 1205	Universal Human Value (Humanities-I)	2	0	0	2
			Credits				**20**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HS		Humanities Elective II	3	0	0	3
2.	PCC	BTE 2101	Microbiology	3	0	0	3
3.	PCC	BTE 2102	Cell and Molecular Biology	3	0	0	3
4.	PCC	BTE 2103	Fundamentals of Chemical Engineering	4	0	0	4
5.	PCC	BTE 2104	Analytical Techniques	3	0	0	3
6.	PCC	BTE 2105	Microbiology Laboratory	0	0	3	1
7.	PCC	BTE 2106	Analytical Techniques Laboratory	0	0	3	1
8.	PCC	BTE 2107	Molecular Biology Laboratory	0	0	3	1
9.	PCC	BTE 2108	Yoga and Alternative Medicine**	0	0	2	1
10.	HS	BTE 2109	Technical Seminar & Scientific Communication	0	0	2	2
11.	MNC	GEE 2102	Indian Constitution (MNC-II)	2	0	0	0
12.	SKILL-Exit	BTE 2110	Python Programming for Biologists *	2	0	2	3
			Credits				**22**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	BTE 2201	Plant and Animal Biotechnology	3	0	0	3
2.	PCC	BTE 2202	Bioinformatics & Cheminformatics	3	0	0	3
3.	PCC	BTE 2203	Immunotechnology	3	0	0	3
4.	PCC	BTE 2204	Plant/Animal Biotechnology Laboratory	0	0	3	1
5.	PCC	BTE 2205	Bioinformatics Laboratory	0	0	3	1
6.	PCC	BTE 2206	Immunotechnology Laboratory	0	0	3	1
7.	PEC		Program Elective I	3	0	0	3
8.	OEC		Open Elective I (Suggested to pursue through MOOC including foreign languages)	3	0	0	3
9.	PROJ	BTE 2207	Mini Project - I	0	0	4	2
10.	HS	GEE 2201	Soft Skills - II	0	0	2	1

11.	MNC	GEE 2202	IKS Course (MNC -III)	2	0	0	0
12.	SKILL-Exit		SPSS / Excel for Data Analysis in Biotechnology *				3
			Credits				**21**

* (Applicable only for Exit category)

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	BTE 3101	Good Manufacturing and Laboratory Practice	2	1	0	3
2.	PCC	BTE 3102	Bioprocess Engineering	3	0	0	3
3.	PCC	BTE 3103	Enzyme Technology	3	0	0	3
4.	PCC	BTE 3104	Systems Biology & Modelling	3	0	0	3
5.	PCC	BTE 3105	Bioprocess Engineering Laboratory	0	0	3	1
6.	PCC	BTE 3106	Enzyme Technology Laboratory	0	0	3	1
7.	PEC		Professional Elective II	3	0	0	3
8.	PEC		Professional Elective III	3	0	0	3
9.	HS	GEE 3101	Soft Skills – III	0	0	2	1
10.	PROJ	BTE 3107	Internship I [$]	0	0	0	1
			Credits				**22**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HS	MSE 3181	Fundamentals of Entrepreneurship	2	0	2	3
2.	PCC	BTE 3201	Food Biotechnology	3	0	0	3
3.	PCC	BTE 3202	Fermentation Technology and Bioreactor Design	3	0	0	3
4.	PCC	BTE 3203	Fermentation Technology Laboratory	0	0	3	1
5.	PCC	BTE 3204	Food Biotechnology Laboratory	0	0	3	1
6.	PCC	BTE 3205	Research Design, Statistics, and Scientific Writing	0	0	3	1
7.	PEC		Professional Elective IV	3	0	0	3

8.	PEC		Professional Elective V	3	0	0	3
9.	OEC		Open Elective II	3	0	0	3
10.	HSC	GEE 3201	Soft Skills – IV	0	0	2	1
			Credits				**22**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	BTE 4101	Data Analysis and Simulations	3	0	2	4
2.	PCC	BTE 4102	Artificial Intelligence for Biotechnology	3	0	2	4
3.	PEC		Professional Elective VI	3	0	0	3
4.	PEC		Professional Elective VII	3	0	0	3
5.	PEC		Professional Elective VIII- MOOC	3	0	0	3
6.	OEC		Open Elective III - MOOC	-	-	-	3
7.	PROJ	BTE 4103	Mini Project - II	0	0	6	3
8.	PROJ	BTE 4104	Internship II [$]	-	-	-	1
			Credits				**24**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	BTE 4201	Capstone Project	-	-	18	9
			Credits				**9**

Overall Credits – 162

[$] 15 days of Industrial training during the summer vacation of second year and third year. The credit will be awarded in the 5th and 7th semester.

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Group	Course Code	Course Title	L-T-P-C
			SEMESTER IV	
1.	PE	BTEX 01	Structural Biology	3-0-0-3
2.	PE	BTEX 02	Bio-Organic Chemistry	3-0-0-3
3.	PE	BTEX 03	Bio-Physics	3-0-0-3
4.	PE	BTEX 04	Big Data Analytics for Biotechnology	2-1-0-3
5.	PE	BTEX 05	Python Programming for Biologists	2-1-0-3
6.	PE	BTEX 06	SPSS / Excel for Data Analysis in Biotechnology	2-1-0-3
			SEMESTER V	
1.	PE	BTEX 07	Medical Biotechnology	3-0-0-3
2.	PE	BTEX 08	Recombinant DNA Technology	3-0-0-3
3.	PE	BTEX 09	Cancer Biology	2-1-0-3
4.	PE	BTEX 10	Genome Editing	1-1-2-3
5.	PE	BTEX 11	Biosimilars Technology	1-1-2-3
6.	PE	BTEX 12	Machine Learning for Biological Data	1-1-2-3
7.	PE	BTEX 13	Developmental Biology	3-0-0-3
8.	PE	BTEX 14	Tissue Engineering	1-1-2-3
9.	PE	BTEX 15	Drug Design and Development	2-1-0-3
10.	PE	BTEX 16	Biosafety and Bioethics	2-1-0-3
			SEMESTER VI	
1.	PE	BTEX 17	Synthetic Biology & BioCAD	2-1-0-3
2.	PE	BTEX 18	Intellectual Property Rights	2-1-0-3
3.	PE	BTEX 19	Nano-biotechnology	2-1-0-3
4.	PE	BTEX 20	Pharmaceutical Biotechnology	2-1-0-3
5.	PE	BTEX 21	Molecular and Cellular Diagnostics	2-1-0-3
6.	PE	BTEX 22	Molecular Pathology	2-1-0-3
7.	PE	BTEX 23	Waste Management and Upcycling	2-1-0-3

8.	PE	BTEX 24	Stem-Cell Technology	2-1-0-3
9.	PE	BTEX 25	Gene Expression and Transgenics	2-1-0-3
10.	PE	BTEX 26	Green Biotechnology and Pollution Abatement	3-0-0-3

SEMESTER VII

1.	PE	BTEX 27	Biomedical Design Thinking & Innovation Studio	2-1-0-3
2.	PE	BTEX 28	Rational Drug Discovery	2-1-0-3
3.	PE	BTEX 29	State-of-the-art Imaging	2-1-0-3
4.	PE	BTEX 30	Precision Medicine and Wellness	2-1-0-3
5.	PE	BTEX 31	Industrial Biotechnology	2-1-0-3
6.	PE	BTEX 32	Chemical Reaction Engineering	2-1-0-3
7.	PE	BTEX 33	Bioseparation Technology	2-1-0-3
8.	PE	BTEX 34	Proteomics and Genomics	2-1-0-3
9.	PE	BTEX 35	Biomedical Instrumentation	2-1-0-3
10.	PE	BTEX 36	Material Science	2-1-0-3
11.	PE	BTEX 37	Healthcare Biotechnology	2-1-0-3
12.	PE	BTEX 38	Molecular Farming	2-1-0-3
13.	PE	BTEX 39	Transport Phenomena in Bioprocess	2-1-0-3
14.	PE	BTEX 40	Vaccine Technology	3-0-0-3
15.	PE	BTEX 41	Drug Formulation and Drug Delivery	3-0-0-3
16.	PE	BTEX 42	Regulatory Affairs for Biotechnology	3-0-0-3
17.	PE	BTEX 43	Digital Health & Wearable Biosensors	2-1-0-3
18.	PE	BTEX 44	Entrepreneurship Bootcamp (Startup in Biotech)	2-1-0-3
19.	PE	BTEX 45	Biological Logic and Computation	3-0-0-3
20.	PE	BTEX 46	Quantum Biology	3-0-0-3
21.	PE	BTEX 47	Molecular Modelling and Simulation	3-0-0-3

SEMESTER I

ENE 1181	ENGLISH FOR ENGINEERS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To develop students' listening skills through exposure to diverse media and enhance comprehension and contextual understanding.

COB2: To enable students to speak effectively in a range of informal and formal contexts.

COB3: To make them analyze academic and technical texts using structured reading techniques.

COB4: To enable them to produce organized, purposeful writing for academic and technical use.

COB5: To equip students with appropriate use of grammar, and technical and academic vocabulary.

MODULE I **L: 10**

L: Listening to short audio-formal & informal conversations - Select episodes from *Learn English Podcasts*, British Council

S: Self Introduction - Present, Past, and Future framework (suggested by Harvard Business Review)

R: Process of reading: Skimming & Scanning, SQ3R

W: Technical Writing- Developing hints, Paragraph Writing (technical)

Grammar & Vocabulary: Prefixes & Suffixes, Articles, Present tense, Prepositions, Subject – Verb Agreement

MODULE II **L: 10**

L: Listening to podcasts - 1. "The impact of online abuse" from *Tech Life,* BBC sounds, 2. How can AI support designers? from*Technology Podcast*.

S:Telephonic conversations (Enquiring& Complaining)

R: Reading long technical texts - Comprehension passages - Select articles from *IEEE Spectrum*, *Techcrunch.com*

W: Jumbled sentences, Process description– Interpretation of Flow chart,Bar chart, Dialogue writing

Grammar & Vocabulary: Transition words, Past tense, Conjunctions, Wh /Yes or No questions, Modal verbs

MODULE III **L: 9**

L: Listening to TED / INK Talks - 1. “The next computer? Your glasses” - ShahramIzadi (TED Talk) 2. “The Society is our Lab” - Sanjay Podder (INK Talk)

S:Extempore-One minute presentation

R: Reading biography (Extracts from ‘Profiles’, The Hindu,

Sunday Edition) / Autobiography / Fiction & Note- making

W: Letter seeking permission for Industrial Visit / symposium, Letter of invitation

Grammar & Vocabulary: Homonyms, Degrees of comparison, Future tense

L: 8

MODULE IV

L: Listening to debates & discussions - 1. “Hydrogen vs Battery: The Future of Our Transport”, ”2. “Saudi Arabia’s Economic Shift to Green Energy” from *The Gen-Z Debate* Podcast.

S: Group presentation on general topics

R: Reading magazines and articles (extracts from ‘Sci-Tech’, The Hindu, Sunday Edition)

W: Report writing (Industrial visit report), Argumentative writing

Grammar & Vocabulary: Active, Passive & Impersonal passive

voice, Phrasal verbs

L: 8

MODULE V

L: Listening to famous speeches - 1. “Commencement Address at Stanford University” by Steve Jobs 2. “The Voice of Women” by Tejaswini Manogna

S: Debates on Contemporary issues

(Agreeing & Disagreeing)

R: Blogs - Articles on Technology, Workforce and Industries from *Deloitte Insights*

W: Book Reviews, Product reviews: Select reviews from “theverge.com”

Grammar & Vocabulary: If clauses, Idioms & Phrases

L: 45 ; Total Hours: 45

TEXT BOOKS:

1. Course material by the Department of English

REFERENCES:

Books:

1) Bailey, Stephen. *Academic Writing: A Practical Guide for Students*. New York: Routledge, 2011.
2) Dutt, P. Kiranmai & Rajeevan, Geeta. *Basic Communication Skills*. Foundation Books, 2013
3) Firth, Matt, Sowton, Chris, et al. *Academic English: An Integrated Skills Course for EAP*. Cambridge University Press, Cambridge, 2012.
4) Perry, Carol Rosenblum. *The Fine Art of Technical Writing*. Create Space Independent Publishing Platform, New Delhi, 2011.
5) Raman, Meenakshi & Sharma, Sangeeta. *Professional English*. Oxford University Press, First Edition, 2018.
6) *Using English: A Coursebook for Undergraduate Engineers and Technologists*. Orient Black Swan Limited, Hyderabad, 2015.

Podcasts:

1) BBC Sounds - Tech Life - available episodes. (n.d.). BBChttps://www.bbc.co.uk/sounds/brand/p01plr2p
2) Podcasts | LearnEnglish. (n.d.). LearnEnglish.https://learnenglish.britishcouncil.org/general-english/audio-series/podcasts
3) Podcasts from The Verge | The Verge.https://www.theverge.com/podcasts
4) *Saudi Arabia's economic shift to green energy*. (2022, July 29). Spotify. https://open.spotify.com/episode/2vjpyVMPjxEswgPxiSoG25
5) Technology Podcast. (n.d.). Thoughtworks.https://www.thoughtworks.com/en-in/insights/podcasts/technology-podcasts
6) *The Gen-Z debate*. (n.d.). Spotify. https://open.spotify.com/show/0ngu1Ihegit2yGWl7c575T

Reviews:

1) Reviews. (2001, May 24). The Verge. https://www.theverge.com/reviews

Famous Speeches:

1) Stanford. (2008, March 8). *Steve Jobs' 2005 Stanford Commencement Address* [Video]. YouTube.https://www.youtube.com/watch?v=UF8uR6Z6KLc
2) *TejaswiniManogna: The Voice of Women*. (2025, May 25). Spotify. https://open.spotify.com/episode/3s4v8SzuDQgKpf0tCEuZQP

Ted / Ink Talks:

1) Izadi, S. (n.d.). *The next computer? Your glasses* [Video]. TED Talks.https://www.ted.com/talks/shahram_izadi_the_next_computer_your_glasses
2) *The society is our lab - INK Talks.*(2021, December 20). INK Talks. https://inktalks.com/talks/the-society-is-our-lab/

Others (Websites & Articles for Reading Skills)

1) Business insights, analysis & perspectives | Deloitte Insights. (n.d.). Deloitte Insights. https://www2.deloitte.com/us/en/insights.html
2) Datta, S. (n.d.). Latest The Hindu Profiles News, Photos, Latest News Headlines about The Hindu Profiles-The Hindu. The Hindu. https://www.thehindu.com/topic/the-hindu-profiles/
3) IEEE Spectrum.https://spectrum.ieee.org/
4) Mukunth, V. (n.d.). Sci-Tech News | latest technological developments. The Hindu.https://www.thehindu.com/sci-tech/
5) TechCrunch. | Startup and technology news.https://techcrunch.com/
6) Wojnicki, A. (2022, August 2). *A simple way to introduce yourself*. Harvard Business Review. https://hbr.org/2022/08/a-simple-way-to-introduce-yourself

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Comprehend and interpret a variety of English audio sources.

CO2: Perform effectively in self-introductions, discussions, debates, and collaborative speaking activities.

CO3: Extract relevant information and evaluate content from technical and academic texts using reading strategies.

CO4: Construct academic and technical documents with clarity and coherence.

CO5: Use appropriate vocabulary and grammar in oral and written tasks.

Board of Studies (BoS):
18th BoS of the Department of English held on 04.06.2025

Academic Council:
24th AC held on 26.08.2025.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	M	-	-	-	-	-	-	H	-	-	-	-
CO3	-	M	-	-	-	-	-	L	-	-	-	-	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CO5	M	-	-	-	-	-	-	-	-	-	-	-	-	-

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement:

The course equips the students with relevant academic and technical communication skills to gain quality employment and entrepreneurial opportunities.

MAE 1182	MATHEMATICS FOR BIOTECHNOLOGY	L	T	P	C
SDG: 4		3	1	0	4

COURSE OBJECTIVES:

COB1: To introduce matrix techniques of eigenvalues, eigenvectors and Cayley Hamilton theorem in practical problems

COB2: To develop ability in the concepts of limits, continuity, and differentiation for single and multivariable functions.

COB3: To gain the ability to perform and apply the double.

COB4: To equip students with fundamental techniques for solving first and second order ordinary differential equations and to enable them to apply in modeling.

COB5: To familiarize problem solving techniques using Numerical methods in computational biology.

MODULE I MATRICES 9 + 3

Matrix operation – Determinant – Rank of matrix – Solution of systems of linear equations by Cramer's rule – Characteristic equation – Eigenvalues and eigenvectors – Cayley Hamilton Theorem (without proof) – Problems and applications.

MODULE II DIFFERENTIAL CALCULUS 9 + 3

Differentiability – Derivative rules – Partial derivatives – Total differentiation – Differentiation of implicit functions – Jacobian - Maxima and Minima of function with two variables – Constrained optima by Lagrange's multiplier method.

MODULE III INTEGRAL CALCULUS 9 + 3

Basic Integrations – Integration by parts and integration using partial fractions – Definite integral – Double integrals – Area as double integral

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 9 + 3

First order ordinary differential equations – Methods of variable separable, substitution and integrating factor – Higher order ordinary differential equations – Second order linear differential equations with constant coefficients – Method of variation of parameters.

MODULE V NUMERICAL METHODS 9 + 3

Solutions of algebraic and transcendental equations – Fixed point iteration method –

Newton Raphson's method – Solutions of system of linear equations – Gauss Jordan method – Gauss Seidel method – Numerical solutions of ordinary differential equations – Euler's method – Runge Kutta method of fourth order.

L – 45; T – 15; TOTAL HOURS: 60

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons (Asia) Pvt Ltd., 2011 (reprint 2024).
2. B. S. Grewal, "Higher Engineering Mathematics", 45th Edition, Khanna Publishers, New Delhi, 2024.
3. B. S. Grewal, "Numerical Methods in Engineering and Science", 11th Edition, Khanna Publishers, New Delhi 2013.

REFERENCES:

1. Erin N. Bodine, Suzanne Lenhart, Louis Gross, "Mathematics for the Life Science", Princeton University Press, 2014.
2. Ramana B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2017.
3. T. Veerarajan, "Engineering Mathematics", 6th Edition, Tata McGraw Hill Publishing Co., New Delhi, 2018.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", 2nd Edition, S. Chand Publisher, 2003 (reprint 2005).

COURSE OUTCOMES: At the end of the course students will be able to

CO1: apply matrix techniques to solve practical problems.

CO2: compute derivatives and apply them to analyze functions, including optimization using partial derivatives and Lagrange multipliers.

CO3: evaluate definite integrals, double integrals and apply in biotechnology-related problems.

CO4: solve first and second order ordinary differential equations using appropriate analytical methods and apply these solutions to real world problems in science and engineering.

CO5: implement numerical methods to solve equations and ordinary differential equations that arise in computational models of biological systems.

Board of Studies (BOS):
17th BOS of Department of Mathematics and Actuarial Science held on 23.06.2025.

Academic Council:
24th AC held on 26.08.2025.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M											L		
CO2	H	H											M		
CO3	H	H											L		
CO4	H	H											L		
CO5	H	H											M		

* **Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4 – Quality Education: Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning various mathematical tools will lead to knowledge of applications in the field of biotechnology that are crucial for healthcare innovation.

CHE 1182	BIOMOLECULES AND ORGANIC	L	T	P	C
SDG: 4	CHEMISTRY	3	0	2	4

COURSE OBJECTIVES:

COB1: To introduce the basic structure and functions of biomolecules.

COB2: To understand the principles of organic chemistry relevant to biological systems.

COB3: To correlate the chemical behaviours of organic compounds with biological activity.

COB4: To provide hands-on experience with basic analytical and biochemical techniques.

COB5: To translate the structural features into biological functions

COB6: To identify the chemical modifications that mimic biological properties

MODULE I CARBOHYDRATES 9

Nomenclature and Classification of carbohydrates: monosaccharides, disaccharides, oligosaccharides, and polysaccharides. Physicochemical properties of glucose, fructose, sucrose, starch, cellulose. Mutarotation, reducing properties, and derivatization, Industrial and biotechnological relevance

MODULE II AMINO ACIDS AND PROTEINS 9

Classification, structure and properties of amino acids, Peptide bond formation, pH and isoelectric point, Levels of protein structure (primary, secondary, tertiary and quaternary), Protein denaturation, Biological functions of protein in enzymes, signalling and structural biology

MODULE III LIPIDS AND MEMBRANES 9

Definition and major classes of storage lipids and structural lipids, Fatty acids structure and functions, Essential fatty acids, triglycerides, phospholipids, glycolipids, Lipid bilayers, micelles, liposomes, Membrane structure, fluid mosaic model, Role in signalling, transport, and energy storage.

MODULE IV – NUCLEIC ACIDS **9**

Structure of DNA and RNA: purines, pyrimidines, Nucleosides, nucleotides, Structure of A,B,Z types of DNA, Types of RNA, tRNA structure and functions, Watson-Crick base pairing, Chargaff's rules, denaturation and renaturation, Applications in biotechnology (PCR, cloning)

MODULE V – FUNDAMENTALS OF ORGANIC CHEMISTRY

Bonding, hybridization, resonance, aromaticity, Stereochemistry (enantiomers, diastereomers, chirality), Functional groups: alcohols, amines, carboxylic acids, esters, etc, Mechanisms of nucleophilic substitution and electrophilic addition, Reaction mechanisms relevant to biochemical transformations

PRACTICALS:

List of Experiments:

1. Identification of carbohydrates (Molisch, Benedict's, Barfoed's tests)
2. Tests for proteins and amino acids (Biuret, Ninhydrin, Xanthoproteic)
3. Extraction and quantification of lipids from seeds (Soxhlet method or TLC)
4. Determination of saponification value / acid value of lipids
5. Estimation of DNA using Diphenylamine method
6. Estimation of RNA using Orcinol method
7. pH titration curves of amino acids
8. Qualitative tests for functional groups in organic molecules
9. Melting point determination of organic solids
10. Simple synthesis: e.g., aspirin or methyl orange (demonstration of esterification)

L – 45; P – 30; Total Hours – 75

TEXTBOOKS:

1. Lehninger Principles of Biochemistry, 8th Edition, David L.Nelson, Michael M. Cox, W.H.Freeman & Co Ltd publication, ISBN-13 978-1319381493

2. Organic Chemistry, 7th Edition, Robert Thomton Morrison, Robert Neilson

Boyd, Pearson Publication, ISBN-10 9788131704813

REFERENCES

1. Biochemistry,7th Edition, Satyanarayana, Chakrapani, CBS Publishers, ISBN-10-8131269418
2. Vogel's Textbook of Practical Organic Chemistry, Brian S.Furniss, Antony J.Hannaford, 5th Edition, Pearson Publisher, ISBN-10-8177589571
3. An Introduction to Practical Biochemistry, 3rd Edition, David T Plummer, McGraw Hill Publisher, ISBN-10-9780070994874

COURSE OUTCOMES (COs)

By the end of this course, students will be able to:

CO1: Classify and describe the structure and function of major biomolecules.

CO2: Understand basic principles of organic chemistry relevant to biological function.

CO3: Analyze chemical behavior of molecules through functional group reactivity.

CO4: Conduct qualitative and quantitative analysis of biomolecules in the lab.

CO5: Correlate theoretical knowledge with biotechnology applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CO4	H	-	-	H	H	-	-	-	-	-	-	-	-	-	-
CO5	H	H	H	H	-	-	-	-	H	-	-	-	-	-	-

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and always promote learning opportunities.

GEE 1101	ENGINEERING GRAPHICS	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

COB1: To develop basic skills in engineering drawing and orthographic projection using BIS standards, covering projections of points, lines, and planes in different quadrants.

COB2: To visualize and construct orthographic projections of regular solids.

COB3: To impart the ability to generate sectional views and determine the true shape of sections, by enhancing interpretation of internal features.

COB4: To introduce isometric projections by creating isometric views of regular solids and frustums using isometric axes and scale.

COB5: To familiarize with the basics of Computer-Aided Drafting and Design (CADD), and to draw orthographic projection views of simple machine parts.

MODULE I	INTRODUCTION TO ENGINEERING DRAWING AND ORTHOGRAPHIC PROJECTION OF POINTS, STRAIGHT LINE AND PLANES	L: 08	T: 0	P: 10

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions -Scale - Orthographic projection – first angle, second angle, third angle and fourth angle projections - Orthographic projection of points in all quadrants - Projection of straight lines inclined to both reference planes in first quadrant - Projection of plane lamina inclined to both reference planes in first quadrant.

MODULE II	ORTHOGRAPHIC PROJECTION OF REGULAR SOLIDS	L: 06	T: 0	P: 06

Orthographic projections of solids in first quadrant: Axis inclined to one reference plane -prism, pyramid, cone, and cylinder only– change of position method.

MODULE III	SECTIONAL VIEWS OF RIGHT REGULAR SOLIDS	L: 05	T: 0	P: 04

Section of solids: prism, pyramid, cone and cylinder– sectional view – true shape of section- cutting simple position solids – section plane inclined to one reference plane only.

MODULE IV	ISOMETRIC PROJECTIONS	L: 05	T: 0	P: 04

Principle of isometric projection: isometric scale – isometric axes- isometric projection and view of prism, pyramid, cylinder, cone, frustums and combination of simple solids.

MODULE V	OVERVIEW OF COMPUTER GRAPHICS AND CADD	L: 06	T: 0	P: 06

Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software such as: The menu system, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), drawing area, dialog boxes and windows, shortcut menus, command line, status bar, zoom as used in CAD, select and erase objects. - Sketching orthographic views of simple solids and machine parts as per first angle projection

L – 30; P – 30; Total Hours: 60

TEXT BOOKS:

1. N.D. Bhatt, “Engineering Drawing”, Charotar Publishing house, 54th Edtion, 2023.
2. Venugopal. K, and V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Ltd., Publication, Chennai, Edition 15th, 2018.

REFERENCES:

1. K.V. Natarajan, “A text book of Engineering Graphics”, Dhanalakshmi publishers, Chennai, 31st Edition, 2018.
2. Agrawal B. & Agrawal C. M., “Engineering Graphics”, TMH Publication, 2017.
3. Jeyapoovan, T., “Engineering Graphics using AutoCAD”, Vikas Publishing

House Pvt. Ltd., New Delhi, 7th Edition 2014.
4. AutoCAD Software Theory and User Manuals
5. Engineering graphics You tube Lecture videos link: https://www.youtube.com/user/BSAUNIV/videos
6. Alternative NPTEL / SWAYAM course: (1.) Prof. Nihar Ranjan Patra of IIT Kanpur on Engineering Graphics and (2.) Prof. Rajaram Lakkaraju of IIT KGP on Engineering Drawing and Computer Graphics

COURSE OUTCOMES:

After completion of the course, the students should be able to

CO1: Apply BIS standards and conventions to create basic engineering drawings, including projections of points, lines, and planes in various quadrants.

CO2: Construct orthographic projections of regular solids with axes inclined to one reference plane using appropriate methods.

CO3: Interpret and draw sectional views of solids and determine the true shape of sections for given cutting plane conditions.

CO4: Create isometric projections and views of regular solids and frustums using isometric principles and scale.

CO5: Use CAD software tools to generate accurate orthographic views of simple machine parts following first-angle projection standards.

Board of Studies (BoS):
25th BoS of Mechanical held on 09.07.2025.

Academic Council:
24th AC held on 26.08.2025

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

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Understanding various industrial standards for technical drawing and applying orthographic projections to represent simple solids support the development of innovative designs, contributing to sustainable industrialization.

GEE 1102	DESIGN THINKING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart the basics of design thinking and train the students in identifying the opportunity to develop innovative solutions for problem faced by the society

COB2: To introduce the tools of empathy and inculcate the problem definition phase of design thinking

COB3: To acquaint the idea generation methods used for solving engineering problems

COB4: To develop the culture of making prototype from design concepts

COB5: To familiarize the role of innovation and patents in engineering

MODULE I INTRODUCTION TO DESIGN THINKING **L: 09 T: 0 P: 0**

Importance of design in engineering – Evolution of products – Difference between product, process, system and software – Origin and relevance of design thinking – Stages of design thinking - Customer centric design - Development of user persona – Opportunity and problem identification.

MODULE II PROBLEM DEFINITION **L: 10 T: 0 P: 0**

Empathy: Tools and methods, empathy map, customer journey mapping – Define: Tools used in define phase, 5-WHY method, fish bone diagram, importance of problem framing, Point Of View (POV) statement. Case studies for empathy and problem definition.

MODULE III IDEATION **L: 09 T: 0 P: 0**

Idea generation: Tools and methods – Bench marking, Brainstorming, idea affinity maps, 6-3-5 method, Mind mapping, SCAMPER, Co-design - Case studies on ideation.

MODULE IV PROTOTYPING AND TESTING **L: 09 T: 0 P: 0**

Types of prototypes: Prototype fidelity, Evolutionary vs Throwaway prototypes, Minimum Viable Prototype, Sketch models, Story boards, Digital prototypes, working prototypes, 3D printed prototypes – User testing with prototypes – Test the design feasibility, capability and usability - Value proposition canvas.

MODULE V INNOVATION **L: 08 T: 0 P: 0**

Creativity and innovation – Role of innovation in Engineering – incremental innovation – Break through innovation - scientific approach to driving innovation – Intellectual property rights – Startups - case studies on innovative products and startups.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Tim Brown, “Change by Design”, HarperCollins, 2019.
2. Nigel Cross, “Design Thinking”, Berg Publishers, 2011.

REFERENCES:

1. Tom Kelley, “The Art of Innovation”, Profile Books Ltd, London, 2016
2. E. Balagurusamy, “Design Thinking”, McGraw Hill, First Edition, 2024
3. Clive L. Dym, Patrick Little, and Elizabeth J. Orwin, “Engineering Design: A Project Based Introduction”, 4th Edition, Wiley, 2014.
4. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.
5. Eppinger, S. and Ulrich, K., “Product design and development”. McGraw-Hill, 7th Edition 2020.

COURSE OUTCOMES:

On completion of the course, students should be able to

COB1: Explain the basic concepts of design thinking and identify the opportunity for developing innovative solutions for the problem faced by the society

COB2: Empathize to collect customer needs and write problem statement based on design thinking principles

COB3: Generate innovative ideas for solving engineering problems using the tools and methods of design thinking

COB4: Develop and test simple prototypes to verify design viability

COB5: Apply innovative approaches to engineering problems and provide design solutions

Board of Studies (BoS):
25th BoS of Mechanical held on 09.07.2025.

Academic Council:
24th AC held on 26.08.2025

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

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 9: Industry, Innovation & Infrastructure.

The holistic understanding of Engineering design, Design thinking, Prototypes and Creativity and innovation.
Our industries and infrastructure must be upgraded to meet future challenges. In order to achieve this, we must promote innovative, sustainable technologies while also ensuring equal and universal access to information and financial markets.

GEE 1103	DIGITAL MANUFACTURING AND	L	T	P	C
SDG: 8, 9	FABRICATION LABORATORY	0	0	2	1

COURSE OBJECTIVES:

COB1: To familiarize with the plumbing and sanitary fixtures in a building.

COB2: To understand the materials used in construction, its functions and the structural elements in buildings.

COB3: To provide hands-on experience in fundamental manufacturing processes, including various welding techniques and traditional foundry operations, enabling students to understand material joining and shaping.

COB4: To introduce modern manufacturing technologies like additive manufacturing (3D printing) fostering diverse fabrication methods.

COB5: To provide hands-on experience on basic electrical wiring systems and to ensure safe and effective electrical installations.

COB6: To introduce the active and passive electronic components, wire up simple electronic circuits and test them.

LIST OF EXPERIMENTS:

CIVIL ENGINEERING PRACTICE:

1. Plumbing: Components and tools used in residential plumbing work – Plumbing layout of a typical building – Types of pipes and connection details – plumbing arrangement for washroom and kitchen.
2. Masonry and Concrete: Materials for cement mortar and concrete –Types of wall materials and their arrangement.
3. Steel rebar for construction – Types and properties.
4. Building Frame: Elements of building frame – Typical Load transfer arrangement – Model Making: Foundation, beam and Column.

MECHANICAL ENGINEERING PRACTICE:

1. Introduction to various weld joints. Fabrication of a simple structures using Lap / Fillet Joints using Arc Welding – Gas cutting (Demo)
2. Foundry operations such as sand mold preparation for simple Engineering components.

3. Group exercises in 3D Printers.
4. Joints using Drilling – Study exercise.

ELECTRICAL ENGINEERING PRACTICE:

1. Domestic Wiring
2. Staircase Wiring
3. Measurement of Earth Resistance

ELECTRONICS ENGINEERING PRACTICE:

1. Identifications and symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Design and testing of electronic circuits using active and passive electronic components.

P – 30; Total Hours:30

TEXT BOOKS

1. S.Gowri and T.Jeyapoovan, “Engineering Practices Lab Manual – Civil, Mechanical, Electrical, Electronics included”, Vikas Publishing, 5th Edition, 2019.

REFERENCES:

1. SubhransuSekhar Dash &K.Vijayakumar, “Electrical Engineering Practice Lab Manual”, Vijay Nicole Imprints Private Ltd., First Edition, 2013.
2. Raghbir Singh Khandpur, “Printed Circuit Boards: Design, Fabrication, and Assembly”, Tata McGraw-Hill Education, 2005.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: To recognize the materials used in construction, its functions, and load transfer arrangement of structural elements in a residential building.

CO2: To identify the plumbing and sanitary fixtures, and its arrangement in a residential building.

CO3: Identify and differentiate various weld joint types and demonstrate proficiency in fabricating simple structures using arc welding for lap and fillet joints.

CO4: Demonstrate an understanding of additive manufacturing principles and applications.

CO5: Identify active and passive electronic components and Wire up simple electronic circuits, solder the components and test.

CO6: Apply electrical wiring diagrams to construct domestic and staircase wiring systems

Board of Studies (BoS):
25th BoS of Department of Mechanical Engineering held on 09.07.2025.

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3				3				2				
CO2	3				3				2				
CO3	3				3				2				
CO4	3				3				2				
CO5	3				3				2				
CO6	3				3				2				

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Equips individuals with practical skills like welding, basic wiring, and electronic circuit for a stable and sustainable livelihood.

Develops essential infrastructure maintenance skills such as plumbing, and masonry, for resilient and functional buildings and sanitation systems.

GEE 1104 PROGRAMMING FOR PROBLEM SOLVING L T P C

SDG: 4 2 0 2 3

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of computing systems, software, hardware, and programming language evolution.

COB2: To equip students with problem-solving skills using algorithms, flowcharts, and design strategies.

COB3: To enable students to write structured C programs using variables, operators, control structures, and modular programming with functions.

COB4: To gain skills to work with arrays, strings, structures, and unions for solving data manipulation problems.

COB5: To provide an understanding of pointers, memory access, file operations, and advanced C programming constructs.

MODULE I COMPUTATIONAL THINKING AND PROBLEM SOLVING **7**

Fundamental of Computing System-History of computing – Hardware – Software – Languages – Machine - Assembly - High-level - Language Translators – Compiler – Interpreter - Linker - Loader – Program Execution – Design - Flowchart – Algorithm – Design techniques - Divide and conquer- Brute Force – Greedy algorithms - Dynamic Programming.

MODULE II FUNDAMENTALS OF PROGRAMMING USING C **8**

Introduction to C Programming-Structure of C Program- Applications of C language- Data Types - Variables - Constants - Keywords - Operators: Precedence and Associativity – Expressions - Input and Output operations – Decision making – Branching – Looping statements.

MODULE III ARRAYS AND FUNCTIONS **8**

Arrays – One dimensional array - Two and multidimensional array – Strings - String operations – Functions - Category of Functions – Call by value – Call by reference – Recursion - Structures - Unions.

MODULE IV POINTERS AND FILE MANAGEMENT 7

Pointers - Pointer Arithmetic - Pointers and Arrays - Pointers and Strings - Pointers and Functions - File Handling – File Operations - Command Line Arguments - Preprocessor Directives - Enumerated Data Types and Typedef.

PRACTICALS 15

1. I/O statements and operators
2. Decision Making statements
3. Looping statements
4. Single and Two dimensional Arrays
5. String Operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function
7. Recursion
8. Structures and Unions
9. Pointers
10. File operations in C using standard I/O functions

L – 30; P- 30;Total Hours – 60

TEXT BOOKS:

1. E. Balagurusamy, *Programming in ANSI C*, 9th edition. New Delhi, India: McGraw-Hill Education India, ISBN-13: 978-9355326720, 2024.
2. Y. Kanetkar, “Let Us C: Authenticate guide to C Programming Language”, 20th edition. New Delhi, India: BPB Publications, ISBN-13 978-9355515513, 2024.
3. Thomas H. Cormen, Charles E. Leiserson , Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, 4th edition, ISBN-13: 9780262046305, 2022.
4. Nell Dale and John Lewis, “Computer Science Illuminated”, 7th edition, Jones and Bartlett Learning , ISBN-13:9781284155617, 2020.

REFERENCES:

1. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, 2nd Edition, Pearson Education, ISBN-13:9789332549449, 2015.

2. Ashok. N. kamthane, “Computer Programming”, 1st Edition, Pearson Education, ISBN-13: 9788131704486, 2007.

COURSE OUTCOMES: The students who complete this course will be able to

CO1: Describe the fundamental components of a computing system, evolution of programming languages, and program execution process..

CO2: Develop algorithms and flowcharts using standard problem-solving strategies such as divide and conquer, greedy, brute force, and dynamic programming.

CO3: Write programs in C using basic syntax, data types, operators, control structures, and functions including recursion.

CO4: Implement arrays, strings, structures, and unions to solve real-world programming problems.

CO5: Apply the concepts of pointers, file handling, command-line arguments, and preprocessor directives for efficient C programming.

Board of Studies (BoS) : 25th BoS of CSE held on 07.07.2025

Academic Council: 24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	3	-	2	3	1	1
CO2	3	3	2	2	1	-	-	-	3	-	2	3	2	3
CO3	3	3	3	2	2	-	-	-	3	2	2	2	3	3
CO4	3	3	3	2	2	3	-	-	3	2	2	2	3	3
CO5	3	3	3	2	3	-	-	-	3	2	2	1	3	3

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 4: Quality Education focuses on ensuring inclusive and equitable quality education and promoting lifelong learning opportunities.

Statement: Equipping students with essential programming skills in C programming fosters computational thinking, problem-solving abilities, and software development proficiency that are foundational for lifelong learning and future-ready employment in the digital economy.

GEE 1105	ENVIRONMENTAL SCIENCES	L	T	P	C
SDG: 3, 6, 13, 14, 15		2	0	0	0

COURSE OBJECTIVES: To make the student conversant with the

COB1: various natural resources, availability, utilisation and its current scenario.

COB2: diverse ecosystems and its function, importance of biodiversity, its values, threats and conservation.

COB3: types of pollutants and its impacts on the environment and the effects of natural disasters.

COB4: impacts of human population, human health, diseases and immunisation for a sustainable lifestyle.

MODULE I Natural Resources L: 8 T: 0 P: 0

Introduction to Environmental Science - Lithosphere, hydrosphere and atmosphere – Biosphere - Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems: (a) Land resources: soil erosion and desertification (b) Forest resources: deforestation (c) Water resources: conflicts over water, dams: benefits and problems, effects on forest and tribal people, rain water harvesting (d) Mineral resources: environmental effects of extracting and using mineral resources and mining (e) Food resources: changes caused by agriculture and overgrazing, effects of modern agriculture (f) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources.

Case Studies: Case studies in the current scenario in TN/India/across the world

MODULE II Ecosystems and Biodiversity L: 7 T: 0 P: 0

Ecosystems - Concept of an ecosystem and types: Terrestrial Ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem; Aquatic fresh water ecosystems: Ponds and lakes, rivers and streams; Aquatic salt water ecosystems: oceans and estuaries - Food chains, food webs - Energy flow in the ecosystem - Ecological pyramids - Ecological succession - Biodiversity and its conservation: Types: genetic, species and ecosystem diversity - Values of biodiversity - Invasive, endangered, endemic and extinct species - Hot sports of biodiversity and Red

Data book - Threats to biodiversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Case Studies: Case studies in the current scenario in TN/India/across the world

MODULE III Environmental Pollution and Disaster Management **L: 8 T: 0 P: 0**

Carbon foot prints - greenhouse effect, global warming and ozone layer depletion - Sources, cause, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear Hazards (g) ill-effects of fireworks and upkeep of clean environment - Types of fire and fire extinguishers - Solid waste Management: types, collection, processing and disposal of urban waste, industrial waste, e-waste and biomedical wastes - Disaster management: flood, drought, cyclone, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

Case Studies: Case studies in the current scenario in TN/India/across the world

MODULE IV Human Population, Health and Social Issues **L: 7 T: 0 P: 0**

Human Population, Population growth and population explosion - Population pyramid among nations - Human Rights and NHRC - Value Education - Environment and human health: air-borne, water borne, infectious diseases, contagious diseases and immunisation (all types of vaccines), covid-19 and bioweapons - Risks due to chemicals in food and water, endocrine disrupting chemicals, cancer and environment - Sustainable development and SDG - Resettlement and rehabilitation of people - Programme for Family, Women and Child welfare.

Case Studies: Case studies in the current scenario in TN/India/across the world

L – 30; T – 0; P – 0; Total Hours: 30

TEXT BOOKS:

1. Erach Bharucha, Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt. Ltd., Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, Sri Krishna

Publications, Tamil Nadu, India, 2018.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International Pvt. Ltd., New Delhi, India, 2009.

REFERENCES:

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersy, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.
4. Waste to Resources: A Waste Management Handbook, The Energy and Resources Institute, 2014.
5. https://www.teriin.org/article/e-waste-management-india-challenges-and-opportunities.
6. https://green.harvard.edu/tools-resources/how/6-ways-minimize-your-e-waste.
7. https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html.
8. https://tspcb.cgg.gov.in/Shared%20Documents/Guidelines%20for%20Management%20of%20Healthcare%20Waste%20Waste%20Management%20Rules,%202016%20by%20Health%20Care%20Facilities.pdf.

COURSE OUTCOMES: The student will be able to

CO1: analyse the current scenario of various natural resources and their depletion and suggest remedies to curb the exploitation.

CO2: identify food chains and web and its function in the environment, assess the impacts on the biodiversity and propose solutions to conserve it.

CO3: analyse the types and impacts of pollutants in the environment and propose suitable methods to alleviate the pollutants and the natural disasters.

CO4: assess on the impact of human population and the health related issues and immunisation practices and sustainable developments for a healthy life.

Board of Studies (BoS):
14th BoS of Chemistry held on 17.07.2025

Academic Council:
24th AC held on 26.08.2025

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

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 3: Good Health and Well-Being	Ensure healthy lives and promote well-being for all at all ages
SDG 6: Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 13: Climate Action	Take urgent action to combat climate change and its impacts
SDG 14: Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG 15: Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Statement:

Natural resources, land and water ecosystems, biodiversity and its degradation, pollution and its management to have a sustainable environment.

SEMESTER II

PHE 1181	ENGINEERING PHYSICS	L	T	P	C
SDG: 4		3	0	2	4

COURSE OBJECTIVES:

COB1: To understand the importance of mechanics and properties of matter.

COB2: To familiarize the concepts of electromagnetic waves.

COB3: To introduce the fundamentals of optics and lasers to students

COB4:.To analyze the acoustics of buildings and applications of ultrasonics.

COB5: To correlate the quantum mechanics principles and its impact in its application

MODULE I PROPERTIES OF MATTER AND MECHANICS **L- 9 T- 0 P- 0**

Elasticity – Hooke's Law-Elastic Moduli-Stress-strain diagram – Factors affecting elasticity – Poisson's ratio - Twisting couple on a wire – Shaft – Torsion pendulum – Bending moment - Depression on a cantilever – Young's modulus by cantilever Uniform and non-uniform bending – I Shape Girders-Viscosity. M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – compound pendulum –Introduction to nonlinear oscillations

MODULE II ELECTROMAGNETIC WAVES **L- 9 T - 0 P - 0**

Nature of electromagnetic waves- Properties of EM waves-Coulomb's law, Gauss's law and applications, Electrostatic potential–Biot-Savart Law and its Applications, Ampere's circuital Law – Applications- Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations – free space - Concept of displacement current- Various types of waves in EM- spectrum -Applications of EM waves.

MODULE III OPTICS AND LASERS L- 9 T - 0 P- 0

Refractive index-refraction through different media-diffraction (Fresnel and Fraunhofer) and polarization –double refraction–Nicol prism- Interference-Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet-Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: Nd:YAG laser –CO_2 laser and semiconductor laser - Applications : Laser Materials Processing – Holography-Medical applications.

MODULE IV ACOUSTICS & ULTRASONICS L-9 T-0 P-0

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine's formula for reverberation time - Absorption coefficient and its measurement - Factors affecting the architectural acoustics and their remedy-Sound absorbing materials - Introduction to Ultrasonics - Properties - Production methods – Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics –Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow - Ultrasonic Flaw detector.

MODULE V QUANTUM PHYSICS L-9 T-0 P-0

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –– Dual nature of matter – de-Broglie wavelength – Theory of Compton's effect – Davison and Germer experiment- Schrodinger wave equation – Time independent and time dependent wave equation-Physical significance of wave function –– Particle in one dimensional box – Introduction to Quantum computing

PRACTICALS **P : 30**

List of Experiments

1. Determination of rigidity modulus of the given wire using Torsional pendulum.
2. Determination of acceleration due to gravity using compound pendulum.
3. Determination of Young's modulus of the beam by uniform / non-uniform bending method.
4. Determination of Young's modulus of the beam by cantilever method.
5. To determine the frequency of an electrically maintained tuning fork using a vibration generator. (Melde's experiment)
6. Determination of thickness of a thin wire / sheet using Air Wedge method.
7. Determination wavelength of spectral lines of mercury source using spectrometer grating method.
8. Determination of wavelength of laser light using semiconductor laser diffraction.
9. Determination of angle of divergence of a laser beam using semiconductor diode laser and He-Ne laser.
10. Determination of particle size of lycopodium powder using semiconductor laser.
11. Determination of Planck's constant using photoelectric effect.
12. Determination of velocity of ultrasonic waves in the liquid using ultrasonic interferometer.
13. Determination of velocity of ultrasonic waves by acoustic grating.
14. Determination of field along the axis of the coil. (Biot-Sawart Law).
15. Verification Ampère's Circuital Law using a long straight current-carrying conductor and measurement of the magnetic field around it.

L – 45; P – 30 ; TOTAL HOURS – 75

TEXT BOOKS:

1. Richard Wolfson, "Essential University Physics", Pearson (2011)
2. Dale Ewen, Neill Schurter, P.E. Gundersen, "Applied Physics", Pearson (2005)

REFERENCES:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. Brij Lal and N. Subramanyam, Properties of Matter, S.Chand & Co, 2003.
3. Brij Lal and N.Subramanyam, Optics and Spectorscopy, S.Chand & Co.,2003.
4. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
5. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.
6. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.

COURSE OUTCOMES:

CO1: grasp the importance of mechanics and the principles of elastic behaviour of materials & apply them to analyze the various substances based on elasticity.

CO2: apply the fundamental principles governing the electromagnetic waves and their impact in technology.

CO3: comprehend the importance & principles of optics and learn the science of lasers and its applications.

CO4: assimilate the ideas of acoustical requirements of buildings, understand principles and generation of ultrasonics and their applications.

CO5: get acquainted with the topics concerning principles of quantum mechanics and correlate the relevance in real time application in devices.

Board of Studies (BoS) :	**Academic Council:**
15th Meeting of BOS held on 18/07/2025	24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	M	L	M	M	M	M	M	L	L	H	M	M
CO2	H	H	M	M	M	M	M	M	M	L	L	H	M	M
CO3	H	H	M	L	H	M	M	M	M	L	L	H	M	M
CO4	H	H	M	M	M	M	M	M	M	L	L	H	M	M
CO5	H	H	M	L	H	M	M	M	M	L	L	H	M	M

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

		L	T	P	C
GEE 1203	**BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING**	**3**	**0**	**2**	**4**
SDG: : 3, 5, 8, 11, 12					

COURSE OBJECTIVES:

COB1: Understand basic electrical concepts, circuits, and measurements relevant to biotechnology laboratories.

COB2: Apply AC and DC principles for the operation of lab and medical instrumentation.

COB3: Explain the working of electrical measuring instruments, sensors, and transducers used in biotechnology.

COB4: Understand the role of power sources, protection systems, and electrical safety in biotechnology facilities.

COB5: Integrate electrical and electronic principles in biosensor signal acquisition and automation systems.

MODULE I DC CIRCUITS & MEASUREMENTS 9

Voltage, current, resistance, and capacitance – Electric circuit elements (R, L, C) – Ohm's law – Kirchhoff's laws – Series and parallel resistive circuits – Voltage and current division – Star–delta transformation – Mesh and nodal analysis – Superposition theorem – Measurement of voltage, current, and power in DC circuits – Moving coil and moving iron instruments – Applications in laboratory instrumentation

MODULE II AC CIRCUITS & MEASUREMENTS 9

Sinusoidal quantities – RMS, average, and peak values – Single-phase RL, RC, RLC circuits – Complex impedance – Phasor diagrams – Power factor and power measurement – Resonance in RLC circuits – Three-phase balanced systems (star and delta connections) – Fuse and MCB protection – Digital multimeter, CRO basics, and their use in biomedical electronics.

MODULE III ELECTROMAGNETISM & ACTUATORS 9

Principle of electromagnetic induction – Applications in biotechnology equipment – DC motors (basic working, EMF and torque concepts, speed control for lab equipment) – Stepper and BLDC motors in automation and analytical devices – Magnetic field sensors in biotech instrumentation.

MODULE IV POWER SOURCES & SAFETY 9

Conventional and renewable power generation (solar, wind, fuel cell, hydro, biogas) with relevance to laboratory energy needs – UPS and battery systems – Electrical safety in wet lab environments – Earthing, circuit breakers, overload protection – Energy-efficient lighting and heating systems

MODULE V SENSORS, TRANSDUCERS & BASIC ELECTRONICS 9

Sensors for temperature (thermocouple, thermistor, RTD), pressure, pH, and flow – Optical sensors for spectroscopy and imaging – Hall effect and piezoelectric devices – Signal conditioning basics – Diodes, rectifiers, and regulated power supplies – Introduction to operational amplifiers and data acquisition in bioprocess control.

PRACTICALS

List of Experiments

1. DC Circuits
    1. Verification of Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL).
    2. Measurement of voltage, current, and power in DC circuits.
2. AC Circuits
    1. Resonance in RLC series circuits.
    2. Measurement of voltage, current, power, and power factor in single-phase and three-phase AC circuits.
3. DC Machines
    1. Magnetization characteristics of a DC generator.
    2. Load characteristics of a DC shunt motor.
4. AC Machines
    1. Load characteristics of a single-phase transformer.
    2. Load characteristics of a three-phase induction motor.
5. Field Visit
    1. Industrial/site visit to a thermal, hydro, wind, or solar power generation station.

L – 45; P – 30; Total Hours –75

TEXT BOOKS:

1. Edward Hughes, Electrical and Electronics Technology, 12th Ed., Pearson India, 2016.
2. D. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, 1st Ed., McGraw Hill Education, 2017.
3. Cotton H., Electrical Technology, 7th Ed., CBS Publishers, 2007.
4. Del Toro, Electrical Engineering Fundamentals, Pearson Education, New Delhi, 2015.
5. W. H. Hayt & J. E. Kemmerly, Engineering Circuit Analysis, Tata McGraw Hill, 2012.
6. Kulshreshtha D. C., Basic Electrical Engineering, Tata McGraw Hill, 2009.
7. Rajendra Prasad, Fundamentals of Electrical Engineering, Prentice Hall India, 2009.

COURSE OUTCOMES:

CO1: Analyze DC and AC circuits using fundamental laws and theorems.

CO2: Perform electrical measurements using appropriate instruments.

CO3: Understand the basic principles of electromagnetism and its application to small motors and actuators used in lab equipment.

CO4: Describe electrical power sources and apply energy-efficient practices in biotech labs.

CO5: Select and use appropriate sensors, transducers, and basic electronic devices for bioprocess monitoring and control.

Board of Studies (BoS) :
10 th Board of Studies of the School of Life Sciences held on 22.08.2025**.**

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	L	M	M	–	–	–	–	–	–	–	L	–	L
CO2	H	H	L	M	M	–	–	–	–	–	–	–	M	L	L
CO3	H	H	L	–	M	–	–	–	–	–	–	–	M	L	L
CO4	H	H	L	–	M	–	–	–	–	–	–	–	M	L	L
CO5	H	H	L	–	M	–	–	–	–	–	–	–	M	L	L

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 3: Good health and well being. Statement: Understanding of the fundamentals of electrical and electronics systems can help in designing systems to promote good health and well being

SDG 5: Gender equality Statement: Acquiring the interdisciplinary knowledge help overcome the gender barriers in workplace.

SDG 8: Descent work and economic Statement: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 11: Sustainable cities and communities Statement: Understanding the renewable energy sources helps in building sustainable cities and communities.

SDG 12: Responsible consumption and production. Statement: Use of right and energy efficient electric and electronic components and devices results is reasonable consumption and production.

BTE 1201	BASICS OF GENETICS	L	T	P	C
SDG: 3		3	0	0	3

COURSE OBJECTIVES:

COB1: Introduce the foundational principles and experimental basis of classical genetics.

COB2: Understand chromosome structure, organization, and their functional roles in heredity.

COB3: Explain genetic linkage, crossing over, and mapping techniques relevant to biotechnology.

COB4: Describe mutations, chromosomal variations, and their biological significance.

COB5: Explore the basics of bacterial genetics and extra-chromosomal inheritance in biotechnology applications.

MODULE I MENDELIAN PRINCIPLES & INTRODUCTION TO GENETICS 9

Historical development of genetics; model organisms for genetic studies; Mendel's experiments – monohybrid and dihybrid crosses; Law of segregation and independent assortment; Test cross and back cross; Chromosomal theory of inheritance; Overview of gene interactions – dominance, incomplete dominance, co-dominance, pleiotropy, and multiple alleles.

MODULE II CHROMOSOME STRUCTURE & ORGANIZATION 9

Structure and organization of prokaryotic and eukaryotic chromosomes; Euchromatin and heterochromatin; Giant chromosomes (polytene, lampbrush); DNA packaging and nucleosome structure; Chromosome banding patterns; Karyotyping and its applications in biotechnology.

MODULE III LINKAGE, CROSSING OVER & MAPPING 9

Genetic linkage and recombination; Cytological basis and molecular mechanism of crossing over; Single, double, and multiple crossing over; Interference and coincidence; Two-point and three-point test crosses; Construction of genetic maps; Somatic cell hybridization and chromosome mapping techniques.

MODULE IV MUTATIONS & CHROMOSOMAL VARIATIONS 9

Types of gene mutations – point, insertion, deletion; Chromosome number variations – aneuploidy, polyploidy; Chromosome structure variations – deletion, duplication, inversion, translocation; Mutation detection techniques; Human cytogenetic abnormalities; Extra chromosomal inheritance – maternal, organelle heredity, and genomic imprinting.

MODULE V MICROBIAL GENETICS & RECOMBINATION 9

Bacterial genetic recombination – transformation, transduction, conjugation; Plasmids and episomes; Fine structure mapping in bacteria; Applications of microbial genetics in biotechnology – cloning vectors, antibiotic resistance studies, and strain improvement.

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. *Principles of Genetics*, 8th Ed., Wiley, 2006.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. *Concepts of Genetics*, 9th Ed., Benjamin Cummings, 2009.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C., Carroll, S.B. *Introduction to Genetic Analysis*, 9th Ed., W.H. Freeman, 2008.

COURSE OUTCOMES:

CO1: Describe Mendel's laws and apply them to predict inheritance patterns.

CO2: Explain chromosome structure, organization, and their relevance in biotechnology.

CO3: Construct genetic maps using linkage and recombination data.

CO4: Classify mutations and chromosomal variations, and relate them to phenotypic changes.

CO5: Discuss microbial genetic transfer mechanisms and their biotechnological applications.

Board of Studies (BoS) :

10 th Board of Studies of the School of Life Sciences held on 22.08.2025**.**

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	–	–	–	–	–	–	–	–	–	–	M	–	L
CO2	H	M	–	–	–	–	–	–	–	–	–	–	M	L	L
CO3	H	H	L	M	–	–	–	–	–	–	–	–	H	M	L
CO4	H	M	–	M	–	–	–	–	–	–	–	–	M	M	L
CO5	H	H	L	M	M	–	–	–	–	–	–	–	H	M	M

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 3: Good Health and Well Being Statement: Understanding of the fundamentals of Genetics of different live organisms can help in maintain systems to promote good health and wellbeing.

BTE 1202	BIOCHEMISTRY	L	T	P	C
SDG: :3, 15		3	0	0	3

COURSE OBJECTIVES:

COB1: Introduce the chemical nature, structure, and biological functions of biomolecules relevant to biotechnology.

COB2: Explain the structure–function relationships of proteins, carbohydrates, lipids, nucleic acids, and enzymes.

COB3: Describe methods for characterization, purification, and analysis of biomolecules.

COB4: Understand the basic principles of bioenergetics and metabolic pathways.

COB5: Relate biochemical principles to applications in biotechnology and allied fields.

MODULE I STRUCTURE OF BIOLOGICAL MACROMOLECULES 9

Levels of structure in proteins, nucleic acids, and polysaccharides – primary, secondary, tertiary, and quaternary structures – relationship between structure and function.

MODULE II CONFORMATIONAL ANALYSIS OF PROTEINS 9

Polypeptide chain geometry – internal rotation angles – Ramachandran plot – forces stabilizing protein structure (hydrogen bonding, hydrophobic interactions, ionic interactions, disulfide bonds) – basics of protein structure prediction

MODULE III CONFORMATIONAL ANALYSIS OF NUCLEIC ACIDS 9

General features of nucleic acid structure – glycosidic bond and rotational isomers – ribose puckering – backbone rotation angles – base pairing, base stacking, and forces stabilizing nucleic acid structures.

MODULE IV METABOLISM OF NUCLEIC ACIDS, POLYSACCHARIDES AND LIPIDS 9

Biosynthesis of nucleotides – de novo and salvage pathways for purines and pyrimidines – regulation and degradation of nucleic acids – biosynthesis and breakdown of starch and glycogen – fatty acid synthesis and β-oxidation – triacylglycerol and phospholipid metabolism – cholesterol biosynthesis, regulation, and therapeutic targets.

MODULE V BIOMEMBRANES, TRANSPORT AND NERVE CONDUCTION **9**

Lipid bilayer organization and membrane proteins – passive, facilitated, and active transport – ion channels and membrane potential – ligand-gated and voltage-gated ion channels – neurotransmitters and synaptic transmission – action potential and nerve conduction – ion channel disorders (e.g., cystic fibrosis) and drug targeting.

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Lehninger, A.L., Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry, 8th Ed., W.H. Freeman, 2021.
2. Berg, J.M., Tymoczko, J.L., Gatto, G.J. Biochemistry, 9th Ed., W.H. Freeman, 2019.
3. Voet, D., Voet, J.G. Biochemistry, 5th Ed., Wiley, 2011.

COURSE OUTCOMES:

CO1: Describe the structure, properties, and functions of amino acids and proteins.

CO2: Explain the structure and biological roles of carbohydrates and lipids.

CO3: Analyze the structure and properties of nucleic acids and their role in information storage and transfer.

CO4: Apply biochemical techniques for the characterization and separation of biomolecules.

CO5: Interpret enzyme kinetics, regulation, and the principles of bioenergetics in biological systems.

Board of Studies (BoS) :
10 th Board of Studies of the School of Life Sciences held on 22.08.2025**.**

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	–	–	–	–	–	–	–	–	–	–	M	L	L
CO2	H	H	L	–	–	–	–	–	–	–	–	–	H	M	L
CO3	H	M	M	–	–	–	–	–	–	–	–	–	H	M	L

CO4	H	M	L	M	–	–	–	–	–	–	–	–	H	H	M
CO5	H	H	L	M	M	–	–	–	–	–	–	–	H	M	M

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 3. Good Health and Well Being Statement: Understanding of the fundamentals of biochemistry of live organisms can help in maintains systems to promote good health and well being.

SDG15: Life on Earth Statement: Biochemistry course gives knowledge about the living and non living and relation with all the levels of life in the earth.

BTE 1203	BIOCHEMISTRY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	3	1

COURSE OBJECTIVES:

COB1: To provide students with practical skills in preparation of biochemical solutions and buffers.

COB2: To train students in qualitative and quantitative analysis of biomolecules.

COB3: To impart knowledge on biochemical estimation methods for carbohydrates, proteins, lipids, amino acids, and nucleic acids.

COB4: To equip students with skills in separation techniques for biomolecules.

COB5: To enable students to perform spectrophotometric analysis for biomolecular quantification.

LIST OF EXPERIMENTS

1. Preparation of solutions: percentage, molar, and normal solutions.
2. pH measurement and preparation of buffers.
3. Determination of wavelength maximum and concentration of a given solution.
4. Qualitative tests for carbohydrates.
5. Quantitative estimation of reducing sugars.
6. Estimation of proteins by Lowry’s method.
7. Estimation of cholesterol by Zak’s method.
8. Estimation of urea by DAM method.
9. Determination of saponification number of lipids.
10. Estimation of amino acids.
11. Separation of amino acids by thin-layer chromatography (TLC).
12. Separation of sugars by paper chromatography.
13. Biochemical estimation of DNA/RNA using spectrophotometer.

P – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Plummer, D.T. An Introduction to Practical Biochemistry, Tata McGraw Hill, 2017.
2. Wilson, K., and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 8th Edition, 2018.

3. Jayaraman, J. Laboratory Manual in Biochemistry, New Age International Publishers, 2011.
4. Boyer, R. Modern Experimental Biochemistry, Pearson Education, 3rd Edition, 2000.
5. Sadasivam, S., and Manickam, A. Biochemical Methods, New Age International Publishers, 2008.

COURSE OUTCOMES:

CO1: Prepare and standardize various biochemical solutions and buffers.

CO2: Perform qualitative and quantitative tests for carbohydrates, proteins, lipids, amino acids, and nucleic acids.

CO3: Apply spectrophotometric techniques for biomolecular analysis.

CO4: Demonstrate separation techniques such as thin-layer and paper chromatography.

CO5: Analyze biochemical parameters for biological and clinical applications.

Board of Studies (BoS) :
10 th Board of Studies of the School of Life Sciences held on 22.08.2025**.**

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	–	M	–	–	–	–	–	–	–	H	M	L
CO2	H	H	M	–	M	–	–	–	–	–	–	–	H	H	M
CO3	H	M	M	–	M	–	–	–	–	–	–	–	H	H	M
CO4	H	M	L	M	–	–	–	–	–	–	–	–	H	M	M
CO5	H	H	M	M	M	–	–	–	–	–	–	–	H	H	H

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 3. Good Health and Well Being Statement: Understanding of the fundamentals of biochemistry of live organisms can help in maintains systems to promote good health and well being.

SDG15: Life on Earth Statement: Biochemistry course gives knowledge about the living and non living and relation with all the levels of life in the earth.

MAE 1284 **BIOSTATISTICS** **L T P C**

SDG: 4 **3 1 0 4**

COURSE OBJECTIVES:

COB1: To introduce basic statistical concepts for organizing and summarizing biological data.

COB2: To develop skills in analyzing variability and relationships in biological data.

COB3: To explain probability concepts and sampling distributions relevant to biological experiments.

COB4: To introduce statistical hypothesis testing for biological and biomedical data analysis.

COB5: To present experimental design principles and variance analysis for biological experiments.

MODULE I INTRODUCTION TO BIOSTATISTICS AND BIOLOGICAL DATA **9+3**

Role of statistics in biotechnology – Types and classification of biological data – Population and sample – Methods of data collection – Organization of data – Frequency distributions – Data representation: tables, bar diagrams, histograms, stem-and-leaf plots, scatter diagrams – Measures of central tendency: mean, median, mode.

MODULE II DESCRIPTIVE STATISTICS **9+3**

Measures of dispersion: range, variance, standard deviation, coefficient of variation – Skewness and kurtosis (introductory) – Correlation analysis: Karl Pearson's and Spearman's rank correlation – Correlation between substrate concentration and enzyme reaction rate – Simple linear regression – Method of least squares and curve fitting – Regression analysis of bacterial growth.

MODULE III SAMPLING AND ESTIMATION **9+3**

Sampling distributions – Central Limit Theorem – Sampling methods: Random, stratified, cluster, systematic – Sampling variability in blood parameter analysis – Point estimation – Interval estimation – Confidence intervals for mean, proportion, variance – Introduction to bootstrap and re-sampling.

MODULE IV TESTING OF HYPOTHESES 9+3

Statistical hypothesis formulation – Null and alternative hypotheses – Type I and Type II errors – Level of significance and p-value – Tests based on Normal, t, Chi-square, and F distributions – One-sample and two-sample testing – Comparison of mean enzyme activity before and after treatment – Testing independence between genetic traits using Chi-square test.

MODULE V DESIGN OF EXPERIMENTS AND ANALYSIS OF VARIANCE 9+3

Principles of experimental design – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design – One-way and two-way ANOVA – Effect of temperature and pH on enzyme activity using ANOVA.

L – 45; T – 15; P – 0; Total Hours: 60

TEXT BOOKS:

1. Johnson, R. A., Miller, I., & Freund, J. E. (2011). Probability and statistics for engineers. Prentice–Hall.
2. Grewal, B. S. (2018). Numerical Methods in Engineering and Science:(C, C++, and MATLAB). Stylus Publishing, LLC.

REFERENCES:

1. Veerarajan, T. (2008). Probability, statistics and random processes. Tata McGraw–Hill.
2. Gupta, S. C., & Kapoor, V. K. (2020). Fundamentals of mathematical statistics. Sultan Chand & Sons.
3. Singaravelu (2017), Probability and Random Processes, Meenakshi Agency.
4. Gupta S.P (2021), Statistical Methods, Sultan Chand & Co., New Delhi.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: classify, represent, and summarize biological data using descriptive measures.

CO2: analyze dispersion, correlation, and regression in biotechnology datasets.

CO3: apply probability models and sampling concepts to biostatistical problems.

CO4: perform and interpret standard statistical tests in biotechnology studies.

CO5: design experiments and analyze results using ANOVA techniques.

Board of Studies (BOS):

18th BOS of Department of Mathematics and Actuarial Science held on 23.12.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														
CO5														

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 4: Quality Education – Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Statement: Learn and apply biostatistical methods to develop data analysis and decision-making skills essential for quality education and biotechnology applications.

GEE 1205	**UNIVERSAL HUMAN VALUE**	**L**	**T**	**P**	**C**
SDG: 4, 8, 10, 16 &17		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To enable students to grasp the fundamental concepts and significance of value education, fostering positive behavioral changes that enhance their personal growth and professional conduct..

COB1 To examine core human values, the relationship between the self and the body, and how these values can guide ethical behavior in both personal and professional contexts.

COB1 To promote understanding of the principles of harmony within oneself, relationships, families, and society, and how these contribute to a sustainable and balanced life.

COB1 To provide knowledge and insights into the ethical responsibilities of engineers, the significance of engineering ethics, and the importance of leadership and ethical decision-making in the field.

MODULE I INTRODUCTION TO VALUE EDUCATION L: 8

Value Education - Concept, Importance and Need - components of Value Education, Human Rights and Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity - The Basic Human Aspirations, Method to Fulfil the Basic Human Aspirations - Strategies for Transition towards Value - based Life and Profession

MODULE II HARMONY IN THE HUMAN BEING L: 7

Meaning and Relevance of Harmony in Human Beings - Core Human Values - Application of Universal Human Values - Understanding The Human Being as Co-Existence of Self (‘I’) And Body - The Needs of Body vs. Self - Fulfilling the Needs of the Self and Body - Understanding the Relationship between Body and Self - the Activities of the Self and the Body - The Mind as a Key Factor in Fostering Harmony in Human Beings - The Influence of Scriptures on the Formation of Human Values.

MODULE III HARMONY IN THE FAMILY, SOCIETY AND NATURE L: 7

Components of Harmony in the Human Beings – Harmony in The Family: Understanding

Values in Human Relationships - Vision for The Universal Human Order – Harmony in Nature: The Four Orders in Nature - Understanding Harmony in The Society.

MODULE IV THE BASICS FOR ETHICAL CONDUCT OF ENGINEERS L: 8

Why Engineers Should Learn About Ethics - Significance of Engineering Ethics - Senses of Engineering Ethics - Engineering Code of Ethics - Commitment: The Foundation of Professional Success in Engineering - Leadership in Engineering and Industry - The Ethical Implications of Technology.

L – 30; Total Hours: 30

TEXT BOOKS:

1. Anand, R. (2025). Foundation course in universal human values and professional ethics (1st ed.). CBS Publishers & Distributors. ISBN 978-8197982231
2. Maio, G. R. (2016). The psychology of human values. Routledge.
3. Narayan, S. (2015). *Value Education: A Source Book for Teachers and Educators*. Pearson Education India.
4. Kumar, K. (2016). *Human Rights and Value Education*. National Book Trust.
5. Rao, K. S. (2013). *Ethics in Engineering Education: Value-Based Approach*. I.K. International Publishing House.
6. Bhattacharyya, S. (2014). *Education and Value Systems: A Conceptual Approach*. Academic Publishers.
7. Laszlo, E., & Wilbur, J. B. (Eds.). (1971). Human values and the mind of man: Proceedings. Gordon & Breach.

COURSE OUTCOMES:

CO1:Comprehend the components, and significance of value education and be able to apply self-exploration techniques for achieving continuous happiness and prosperity in life and profession.

CO2: Internalize an understanding of universal human values and their role in balancing the coexistence of self and body, while recognizing their interdependencies and resolving conflicts between personal goals and societal needs.

CO3:Cultivate an understanding of the significance of harmony within oneself, in interpersonal relationships, and with nature, and develop the ability to articulate its essential role in fostering balance within human relationships, society, and the environment.

CO4:Gain insights into the ethical conduct required for engineers, including understanding engineering ethics, the significance of professional ethics, and applying ethical decision-making in technological advancements and leadership roles.

Board of Studies (BoS) :
10 th Board of Studies of the School of Life Sciences held on 22.08.2025**.**

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	L	–	–	–	–	M	M	H	–	–	–	M	–	–	–
CO2	L	–	–	–	–	M	M	H	–	–	–	M	–	–	–
CO3	L	–	–	–	–	H	H	H	–	–	–	M	–	–	–
CO4	M	–	–	–	–	H	M	H	M	M	–	M	–	–	–
CO5	L	–	–	–	–	M	M	H	–	–	–	M	–	–	–

* Legend: L – Low (1), M – Medium (2), H – High (3).

SDG 4: Quality Education focuses on value education, which is essential for promoting inclusive and equitable quality education. It emphasizes the development of critical thinking, ethical conduct, and personal growth, all of which are key components of quality education.

SDG 8: Decent Work and Economic Growth highlights the ethical implications of technology that is essential for fostering responsible and ethical behavior in future engineers, and which contributes to decent work and economic growth.

SDG 10: Reduced Inequalities aligns with efforts to reduce inequalities by encouraging ethical behavior, respect for others, and harmonious relationships, which are essential in building inclusive societies.

SDG 16: Peace, Justice, and Strong Institutions promotes peaceful and inclusive societies, access to justice for all, and accountable, effective institutions. It aligns deeply with the principles of value education by emphasizing harmony, ethical conduct, human rights, and social justice.

SDG 17: Partnerships for the Goals integrating ethics into professional education, especially for engineers, students are encouraged to contribute positively to collaborative global efforts in solving complex challenges.

The course syllabus aligns with **SDGs 4, 8, 10, 16 and 17** by focusing on value education, ethics, human rights, harmony, and responsible engineering practices. It contributes to peaceful, just, and inclusive societies through self-awareness, interpersonal harmony, and responsible citizenship aligned with universal human values. These themes are essential for promoting sustainable development, equality, and ethical conduct, which are core elements of the SDGs.