KIT - Kalaignarkarunanidhi Institute of Technology

(An Autonomous Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (CSE, ECE, EEE & MECH)
An ISO 9001 : 2015 Certified Institution

Coimbatore - 641 402.

REGULATIONS, CURRICULUM & SYLLABUS - 2023

(For Students admitted from the Academic Year 2023-24 and onwards)

I to IV Semester

Bachelor of Technology in Biotechnology

Department of Biotechnology

Vision and Mission of the Department

Vision

◎	To offer quality education and research in the field of Biotechnology and to foster technologically competent and socially responsible professionals.

Mission

◎	Providing quality education in Biotechnology towards students' career aspirations through well-equipped laboratories and training Programs.
◎	Collaborating with industries and premier institutions to make the students competitive and industry ready professionals.
◎	Cultivating research outlook, entrepreneurial attributes, interpersonal skills, moral values and societal commitments among students.

Program Educational Objectives (PEO's)

PEO 1	Graduates will be successful professionals in industry, skilled researchers, or globally competitive entrepreneurs.
PEO 2	Graduates will possess critical thinking skills to solve problems in Biotechnology and allied fields.
PEO 3	Graduates will demonstrate a lifelong commitment to learning in their professional careers.

Program Outcomes (PO's)

After the successful completion of the U.G. Program in Biotechnology, graduates will be able to:

PO 1	**Engineering Knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem Analysis :** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design / Development of Solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4	**Conduct Investigations of Complex Problems :** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage :** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The Engineer and Society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and Sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and Team Work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication :** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project Management and Finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Lifelong Learning :** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO's)	
After the successful completion of the U.G. Program in Biotechnology, graduates will be able to :	
PSO 1	Identify and solve emerging problems in Biotechnology and allied fields.
PSO 2	Support fundamental and translational research in applied and interdisciplinary Biotechnology.

BoS Chairman

UG Regulations

1. SHORT TITLE AND COMMENCEMENT

- These Regulations shall be called the "KIT-Kalaignarkaraunanidhi Institute of Technology, Coimbatore, Regulations for the Award of B.E. / B.Tech., Degree".
- They have been evolved, drafted and implemented after deliberations in and approvals from UGC, Anna University and Academic Council of the Institute, and are subject to changes/ modifications from time to time; (major modifications at a frequency of FOUR years in synchronization with the curriculum structure revision and minor changes as and when applicable).
- The latest / first version shall be applicable for the students enrolling for B.E. / B.Tech degree Program at this Institution from the Academic year 2023-24 and onwards.
- The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already undergoing the Program) as may be decided by the Academic Council.

2. PREAMBLE

The regulations prescribed herein have been made by KIT, an autonomous institution, approved by AICTE, New Delhi and affiliated to the Anna University, Chennai, to facilitate the smooth and orderly conduct of its academic Programs and activities at the B.E/B.Tech., level. It is expected that the regulations will enable the students to take advantage of the various academic opportunities at the Institute and prepare themselves to face the challenges in their professional careers ahead. It may be noted that :

a. The provision made herein shall be applicable to all the B.E/ B.Tech. Programs offered at the institution, at present.

b. They shall also be applicable to all the new B.E /B.Tech. Programs which may be started in the future.

c. Academic and non-academic requirements prescribed by the Academic Council have to be fulfilled by a student for eligibility towards award of B.E. / B.Tech. Degree.

3. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In this Regulations, unless the context otherwise requires :

Table - 1 : Preliminary Definitions and Nomenclature

Sl. No.	Name	Definition
1.	**Program**	Refers to Degree Program that is B.E. / B.Tech.
2.	**Branch**	Refers to branch or specialization of B.E./B.Tech. Program, like Computer Science and Engineering, Mechanical Engineering, etc.,
3.	**Course**	Refers to a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, etc.,

4.	**Principal / Head of the Institution**	Refers to the authority of the institution who is responsible for all academic activities, for the implementation of relevant rules and regulations.
5.	**Controller of Examinations (CoE)**	Refers to the authority of the college who is responsible for all activities of the Examinations.
6.	**Head of the Department (HoD)**	Refers to the Head of the Department concerned.
7.	**University**	Refers to Anna University, Chennai
8.	**KIT**	Refers to KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore.
9.	**Curriculum**	Refers to the various components / courses studied in each Program that provide appropriate outcomes (knowledge, skill and behavior / attitude) in the chosen branch of study.
10.	**L - T - P - C**	Refers to Lecture, Tutorial, Practical and Credits respectively.
11.	**Program Coordinator**	Refers to the coordinator of the Program concerned. He / she acts as interface between Program and key stakeholders, students, faculty and employer. He/She is responsible for planning the academic activities of the Program along with the course coordinator(s) and the HoD. He/She also prepares, evaluates and analyses the attainment of the Program outcomes along with Program Advisory Committee.
12.	**Faculty Advisor**	The Faculty Advisor is responsible for providing general advice on the Academic matters, monitor the attendance and academic performance of the students and counsel them periodically. If necessary, the Faculty Advisor may also inform the parents about the progress/ performance of the students concerned through HoD.
13.	**Course Coordinator**	Course Coordinator is responsible for teaching the course, evaluating and analysing the performance of the students. The students is also responsible for the assessment of the Course Outcomes / Program Outcomes / Program Specific Outcomes. They can also recommend to organize workshops / seminars/guest lectures / industrial visits to meet the Course Outcomes and Program Outcomes.

14.	**Class committee**	Class committee for each semester of a Program comprises of HoD, Program Coordinator, Faculty Advisor, Course Coordinators (as applicable) and Student Representatives.
15.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned(For details refer Appendix V)
16.	**Department Evaluation Committee (DEC)**	The committee included HoD (need basis), senior faculty member(s) of department from various levels, class advisor, Mentor of the students. (For details refer Appendix V)
17.	**CIA**	Refers to Continuous Internal Assessment.
18.	**ESE**	Refers to End Semester Examination
19.	**CBCS**	Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve their target number of credits by using their choice both in terms of pace and sequence of courses. The students are given the privilege to choose any course as an elective which they have not studied before.
20.	**GPA**	Refers to Grade Point Average
21.	**CGPA**	Refers to Cumulative Grade Point Average
22.	**CEC**	Refers to Career Enhancement Courses
23.	**PCC**	Refers to Professional Certificate Courses
24.	**VAC**	Refers to Value Added Courses

4. ADMISSION

4.1 B.E. / B.Tech. Degree Program (I Semester)

The Candidates should have passed the Higher Secondary Examinations of (10+2) Curriculum (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any examination of any other University or authority accepted by the Syndicate of Anna University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

4.2 Lateral Entry Admission

The candidates who possessed the Diploma in Engineering / Technology awarded by the State Board of Technical Education, TamilNadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech., as per the rules fixed by Government of TamilNadu.

(OR)

The candidates who possess the Degree in Science (B.Sc.,) (10+2+3 stream) with Mathematics as a subject at the B.Sc. Level are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. Such candidates may be two additional Engineering subject(s) in the third and fourth semesters as prescribed by the AEC, if necessary

4.3 Re - admission

Students, who have discontinued for reasons other than disciplinary action, may be readmitted as per guidelines given by DoTE, Government of Tamil Nadu and Anna University. DEC shall study and recommend on the exception and addition of courses to be registered for, by the student concerned during re-admission. The details shall be forward to AEC for approval and the committee's decision shall be final.

The eligibility criteria shall be as prescribed by Anna University, Chennai and Government of Tamil Nadu from time to time.

5. PROGRAMS OFFERED

5.1 A student may be offered admission to any one of the branches of study approved by the Authorities. Degree Program affiliated to Anna University, under CBCS for students admitted from 2023 onwards in the following branches of Engineering and Technology as in Table 1..

Table 1. List of B.E. / B.Tech. Programs offered

B.E.	B.Tech.
Aeronautical Engineering	Agricultural Engineering
Biomedical Engineering	Artificial Intelligence and Data Science
Computer Science and Engineering	Bio Technology
Electronics and Communication Engineering	Computer Science and Business Systems
Electrical and Electronics Engineering	
Mechanical Engineering	
Computer Science and Engineering (Artificial Intelligence and Machine Learning)	

5.2 In addition to the regular four years B.E./B.Tech Programs, the following are offered by the Institution :

5.2.1 B.E. / B.Tech with Honors

Students can earn, BE/BTech degree with honors in the chosen discipline of Engineering by opting for six additional courses across the list of professional electives / verticals offered by their parent department.

5.2.2 B.E. / B.Tech Honors (with specialization)

Students can earn, B.E. / B.Tech degree, honors (with specialization) in the chosen discipline of Engineering by opting for six additional courses from one of the verticals offered by their parent department.

5.2.3 B.E. / B.Tech with minor degree

Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering can earn, B.E. / B.Tech with minor degree by opting for six additional courses from one of the verticals offered by the department other than their parent Department.

6. ACADEMIC STRUCTURE OF PROGRAMS

6.1 Medium of Instruction

The medium of instruction for the entire Program will be English.

6.2 Categorization of Courses

The B.E / B.Tech Programs shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training/industrial training, project work, soft skills, internship, etc., that have been approved by the respective Board of Studies and Academic Council of the College. All the Programs have well defined Program Outcomes (PO), Program Specific Outcomes (PSO) and Program Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows :

i. **Humanities and Social Sciences including Management (HSMC)** Courses include Technical English, Communication skills, Humanities and Management.

ii. **Basic Sciences (BS)** Courses include Mathematics, Physics, Chemistry, etc.

iii. **Engineering Sciences (ES)** Courses include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer, etc.

iv. **Professional Core (PC)** Courses include the core courses relevant to the chosen specialization/branch of study.

v. **Professional Elective (PE)** Courses include the elective courses relevant to the chosen specialization/ branch of study.

vi. **Open Elective (OE)** Electives from other technical and/or emerging courses are given as a separate list of Elective Courses offered by the Engineering / Science Departments and a student can choose a Course as Open Elective from the above list of Courses.

vii. **Career Enhancement Courses (CEC)** include Project, Industrial Training / Practical Training/ Internship/ Summer Projects / Seminars /Professional Practices /Case Study, Value added courses.

viii. **Mandatory Courses (MC)** include Environmental Science and Engineering, Induction Program, Constitution of India, Essence of Indian traditional language.

*Minor variations are allowed as per the need of the respective discipline.

6.3 Curriculum

The curriculum will comprise courses of study as given in respective department in accordance with the prescribed syllabi. The hours / week listed in syllabus for each of the course refer to periods/week. The curriculum consists of (a) Basic Sciences, (b) Humanities and Social sciences (c) Engineering Sciences (d) Professional cores (e) Professional electives (f) Open electives (g) Employability Enhancement courses (h) Mandatory courses and (i) Induction Program and as per AICTE guidelines.

6.4 Electives

Every student shall opt for electives from the list of electives of the respective degree Program in consultation with the Tutor, Program Co- ordinator and the HoD. A student shall undergo two open elective courses and six professional elective courses. Professional electives will be offered from 5th semester to 8th semester. Minimum number of credits to be earned for open elective courses is 6. Minimum number of credits to be earned for professional elective courses is 18. Open electives are the elective courses offered by a department for students of other branches and professional electives are courses offered by a department to the students of their own branches only.

6.5 Project Work

Every student shall be required to undertake a suitable project in industry / research organization / department in consultation with the Head of the Department and the faculty guide and submit the project report thereon at the end of the semester in which the student registered, on date announced by the College / Department. A student shall register for the Project Work I in the 7^{th} semester and for Project Work II in the 8^{th} semester.

6.6 Induction Program

All students shall undergo induction Program in the first semester for a duration of three weeks as per the guidelines of All India Council for Technical Education (AICTE). A student completing the induction Program will be awarded completed grade and only the students who complete the induction Program shall be considered as eligible for award of degree subject to satisfying other conditions. A student who does not complete the induction Program in the first semester shall Redo the same in the subsequent semesters.

6.7 Number of credits per semester

Curriculum of a semester shall normally have a blend of theory Courses and practical Courses. In addition, Career Enhancement Course(s) may also be included. Each course may have credits assigned as per clause 5.8. However, the total number of credits per semester shall not exceed 36 (including CEC, credit transfer from SWAYAM/NPTEL courses, re-registration courses, courses registered for honors/honors with specialization/minor degree, and excluding Value Added courses, reappearance courses).

6.8 Credit Assignment

Each course offered is given a L-T-P-C structure, depending on the number of Lecture (L), number of periods for Tutorial periods (T), number of periods for practical (P), C- credits required for an efficient teaching – learning process. A student is expected to put-in his / her own efforts in proportion with periods spent in classroom, as defined in L-T-P-C structure. On successful completion of the course a student is said to have earned a specified number of credits defined for each course. Each course is assigned certain number of credits based on the following table :

Table 2 : Credit Assigned

Contact period per week	Credits
1 Lecture (L)	1
1 Tutorial Period (T)	1
1 Practical Period (P)	
(Laboratory Periods / CEC / Projects)	1 / 2

6.9 CAREER ENHANCEMENT COURSES (CEC)

6.9.1 Industrial Training / Practical Training/ Internship/ Summer Projects / Seminars / Professional Practices / Case Study.

The students may undergo industrial training/Internship if mandated in the curriculum for periods as specified in the curriculum during the summer/winter vacation, the training being taken on a continuous basis for the periods mentioned. The industry / organization is to be selected with the approval of the Department Evaluation Committee (DEC). The students may undergo Internship at a Research organization / University/ Industry (after due approval from the Head of the Institution) for the period prescribed in the curriculum during the summer / winter vacation, in lieu of Industrial training

The Industrial training/ Practical Training/ Internship/ Summer Projects / Seminars / Professional Practices / Case Study which is successfully completed by the student in a particular semester during the course of study is eligible for including in the grade sheet in the immediate next semester by registering it. The final year project period at industry / research organization will not be considered as industrial Training/internship.

6.9.2 Industrial Visit

Every student is required to go for at least one Industrial visit every year starting from the second year of the Program subject to the approval of the Head of the Department and Principal. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

6.9.3 Professional Certificate Courses

Students have to undergo one credit courses offered by experts from industry / research organizations and approved by academic council. Students can register such courses from

his/her second year of study as and when these courses are conducted by the Departments. A student can also permitted to register for these courses of other Departments.

If a student does not successfully complete the registered industry supported one credit courses in a semester, the registration of that course will be considered as withdrawn. Further, it will not be treated as arrear and if he / she wishes, he/she can re-register for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently.

6.9.4 Online Courses offered through SWAYAM / NPTEL

Students may be permitted to register maximum of two online courses, subject to a maximum of six credits, registered through SWAYAM instead of Professional/Open Elective Courses (For Honors / Honors with Specialization / Minor degree, additional two SWAYAM / NPTEL online courses with 3 credits each, are permitted for credit transfer) of regular B.E/B. Tech Program with the approval of BOS through DEC. The online course of minimum 3 credits can be considered instead of one Professional / Open elective course.

DEC finalizes the courses to be permitted for credit transfer through SWAYAM / NPTEL prior to the commencement of the semester. The courses selected through the SWAYAM/ NPTEL may not be necessarily the courses which are offered in the list of Professional/Open Elective courses, as part of the curriculum.

The Committee also intimates the students about the selected courses prior to the commencement of the semester, identify and designate a Course Coordinator for the online course(s) offered. The Course Coordinator guides the students throughout the course, submits the certificates and marks earned by the students to the office of the CoE during credit transfer request by the student.

The student has to register for the credit transfer of the online course during the course registration. The online course(s) which is/are successfully completed by the student in a particular semester during the course of study is eligible for credit transfer in the immediate next semester by registering it (i.e. an online course is eligible for credit transfer in the immediate next semester only)

6.9.5 Soft Skills

Every Student is required to go for soft skill courses during first year of study. The soft skill course includes the communication skill, interpersonal skill and career development courses, etc. (Non Credit).

6.9.6 Value added courses

Value added courses shall be offered by the Department with the prior approval from BoS. The credits earned through value added course shall be over and above the total credit requirement prescribed in the curriculum for the award of degree. Students can earn maximum of six credits from a value added courses subject to maximum of one value added course per semester. The permitted credit structure for a value added course is 3. Industry offered and skill development courses shall be considered under this category. These value added courses can also be undergone through online platform approved by the Board of Studies through

DEC. The course(s) (if pursued through online mode) which is/are successfully completed by the student in a particular semester during the course of study is eligible for including in the grade sheet in the immediate next semester by registering it.

Students may be permitted to register maximum of one value added course, subject to the maximum of three credits registered through, value added course.

Instead of one professional /open elective courses of regular B.E/B.Tech. Program with the approval of Bos through DEC. The value added course of minimum 3 credits can be considered instead of one professional /open elective course.

6.9.7 Course Numbering Scheme

Each course is denoted by a unique code consisting of 9 alphanumeric characters. The details of the numbering scheme are in APPENDIX A.

6.9.8 Credit Requirement for Programs

The total number of credits that a student earns during the period of study is called the total credits. For the successful completion of the B.E/B.Tech Program, a regular student must earn 169 credits (varies with the Program) in minimum of eight semesters, while a lateral-entry student must earn 127 credits in a minimum of six semesters.

7. DURATION OF THE PROGRAMS

A student is normally expected to complete the B.E / B.Tech. Program in 4 years i.e 8 semesters, but in any case (including authorized break of study on one year) not more than 7 years i.e. 14 Semesters (vide clause 18).

A Lateral entry student is normally expected to complete the B.E. / B.Tech Program in 3 years (6 semesters), but in any case (including authorized break of study of one year) not more than 6 years i.e. 12 semesters. The duration of B.E. / B.Tech Program for a lateral entry student shall be three academic years with semester pattern. The courses of study for the lateral entry Diploma candidates shall be in accordance with the prescribed syllabus of third to eighth semesters of the full time four year B.E. / B.Tech. Degree Program of the respective branches. The courses of study for the lateral entry science graduates shall be in accordance with the prescribed syllabi of the full time four year B.E. / B.Tech. Degree Program of the respective branches. The additional courses offered will be decided by the respective Chairman, Board of Studies.

Each semester normally consists of 90 working days, including test or 450 hours or 540 periods of each 50 minutes duration. The HOD shall ensure that every course coordinator imparts instruction as per the number of contact periods specified in the syllabus covering the full content of the syllabus for the course being taught.

The total duration for completion of the Program reckoned from the commencement of the first semester to which the student was admitted shall not exceed the maximum duration specified

Due to Pandemic / Abnormal situations the Scheme of Examinations and Evaluation will be followed as per the guidelines issued by the Government of Tamil Nadu and Anna University, Chennai.

The total period for completion of the Program reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in this clause irrespective of the period of break of study in order that he/she may be eligible for the award of the degree

For the purpose of regulations, the academic year will be divided into two semesters, the odd semester normally spanning from June to November and the even semester from December to May.

8. COURSE REGISTRATION

Each student, on admission shall be assigned to a Faculty Advisor, who shall advice and counsel the student about the details of the academic Program and the choice of courses considering the student's academic background and career objectives.

In the first semester of study, each student on admission shall register for all the courses prescribed for the first semester in the curriculum.

From the first semester onwards, every student shall enroll for all the courses of the next Semester in the current Semester itself. The enrollment for all the courses of the next semester will commence 10 working days prior to the last working day of the current Semester.

From second semester onwards, the student shall confirm the enrollment by registering for the courses within the first ten working days after the publication of results including revaluation results of the previous semester examinations. However, the student has to register for the courses for which the student has not enrolled, if these are the courses in which the student has failed.

The registration process for the courses offered in the online registration mode in the forthcoming semester, will commence preferably 10 working days prior to the last working day of the current semester.

A department shall offer a course only if a minimum of 10 students register for that course. This minimum number may vary from course to course and shall be specified by the department from time to time.

Students who rejoined the Program after availing permitted Break of Study or Readmitted by DOTE / University need not submit new Enrollment Form, but they have to submit the course registration form. The Transfer and Lateral Entry Students who joined the Program in a particular semester have to submit the course registration form within the first 10 working days after the date of joining.

After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Internal Assessment Marks and appear for the End Semester Examination (ESE) or as specified in the curriculum.

8.1 Credit details for Course Registration

A student has to earn the total credits specified in the curriculum of the respective Program of study, in order to be eligible to obtain the degree. However, if the student wishes, then he/she is permitted to earn more than the total number of credits prescribed in the curriculum.

The number of credits, most students are expected to register for, in a semester, will be about 20 - 30 credits (excluding arrears). so that they complete the Program within the specified duration of the Program. The minimum credits a student can register for, in a regular semester shall be 12 and the maximum credit a student can register is 36 (excluding arrears). Students shall register for project work in the 7th and 8th semester or 8th semester only.

Table 4 : Credit Range

PROGRAM	PRESCRIBED CREDIT RANGE
B.E. / B.Tech. (Regular)	169
B.E. / B.Tech. (Lateral Entry)	127
B.E. / B.TECH (Honours)	(169 / 127) + 18 Credits

8.2 Flexibility to Add / Drop courses

8.2.1 A student has to earn the total number of credits specified in the curriculum of the respective Program of Study in order to be eligible to obtain the degree. However, if a student wishes, he / she is permitted to earn more than the total number of credits prescribed in the curriculum of the Program.

8.2.2 The students shall undergo the eighth semester courses other than the Project Work in the sixth and seventh semesters, provided they do not have current arrears and have a CGPA of 7.50 and above at the end of Semester IV. The Faculty Advisor, HoD, in consultation with the faculty handling the said courses shall forward the proposal to the CoE for approval at least 4 weeks before the commencement of the sixth semester of the Program. Total numbers of credits of such courses shall not exceed 3.

8.2.3 The students should not have standing arrears and have a CGPA of 7.50 and above for registering additional courses. However, the maximum number of credits the student can register in a particular semester cannot exceed 36 credits (Including the CEC, credit transfer from SWAYAM/ NPTEL courses, Re-registration courses, course registered for Honors/Honors with Specialization/ Minor degree and Excluding the courses for which the student has done reappearance registration, value added courses).

8.2.4 From the second to final semesters, the student has the option of dropping existing theory courses in a semester during registration. The total number of credits of such courses shall not exceed 6 per semester. The student is permitted to drop the course(s) within 30 days of the commencement of the academic schedule.

8.3 Reappearance Registration / Re-enrollment Registration

8.3.1 If a student fails in a Theory (except electives) / Theory with Practical component/ Practical course(s), the student shall do reappearance registration for that course in the subsequent semester and attend end semester examination.

8.3.2 If the theory course, in which the student has failed, is a Professional Elective or an Open Elective course, the student may register for the same or any other Professional Elective

or Open Elective Course respectively in the subsequent semesters. Such changes can be done only with due approval by the HoD.

8.3.3 The student who fails in Project work shall register for the same in the subsequent semester, satisfy attendance requirement, earn continuous assessment marks and appear for the ESE.

8.3.4 If a student is prevented from writing ESE due to lack of attendance (overall attendance is below 65%), the student has to rejoin the Program in the next academic year after getting readmission order from DOTE/University. The student shall attend the classes and fulfil the attendance requirements as per clause 8, earn continuous assessment marks and appear for the ESE.

8.3.5 B.E. / B. Tech. (Honours) Specialisation in the same discipline, B.E. / B. Tech. (Hons) and B.E. / B. Tech. minor in other specialization

i. B.E. / B.Tech. Honours (Specialisation in the same discipline) :

a. The student should have earned additionally a minimum of 18 credits from a vertical of the same Program.
b. Should have passed all the courses in the first attempt.
c. Should have earned a minimum CGPA of 7.50.

ii. B.E / B.Tech. Honours

a. The students should have earned additional courses (minimum of 18 credits) from more than one vertical of the same Program.
b. Should have passed all the courses in the first attempt.
c. Should have earned a minimum CGPA of 7.50.

iii. B.E. / B.Tech. (Minor in other specialisation)

The student should have earned additionally a minimum of 18 credits in any one of the verticals of other B.E/B.Tech Programs.

Students can earn maximum of 6 credits in online mode (SWAYAM platform), out of these 18 credits as approved by Board of Studies

B.E. / B. Tech. (Hons) Specialization in the same discipline, B.E / B.Tech. Honors and B.E. / B.Tech. minor in other specialization degree will be optional for students.

For the categories 6.10.1 (i) to 6.10.1(ii), the students will be permitted to register the courses from V Semester onwards provided the marks earned by the students until III semester should be of CGPA 7.50 and above and cleared all the courses in the first attempt.

For the category 6.10.1 (iii), the students will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above.

If a student decides not to opt for Honours, after completing certain number of additional courses, the additional courses studied shall be considered instead of the Professional Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for calculation of CGPA

If a student decides not to opt for Minor, after completing certain number of courses, the additional courses studied shall be considered instead of Open Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet. However, they will not be considered for calculation of CGPA.

9. REQUIREMENTS FOR APPEARING FOR CIA, ESE

9.1 A student who has fulfilled the following conditions shall be deemed to be eligible to appear for the CIA - I, CIA - II, CIA - III and ESE. Ideally, every student is expected to attend all the classes and earn 100% attendance. Students who have earned not less than 75% attendance course wise taking into account the number of periods required for that course as specified in the curriculum. Table 5 illustrates the mandatory attendance requirement for CIA - I, CIA - II, CIA - III and ESE.

Table 4 : Mandatory Attendance Requirement for CIA - I, CIA - II, CIA - III and ESE

Test / Examination Type	Period of Calculation	Minimum % of attendance required
CIA - I	**First Semester** From the date of joining of course to three working days before the start of CIA – I	60%
	Second to Eighth semester From the date of commencement of the class to one week before the start of CIA - I	75%

CIA - II	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to one week before the start of CIA - II	75% (for students maintaining 80% or more attendance between CIA - I and CIA - II, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
CIA - III	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to one week before the start of CIA - III	75% (for students maintaining 80% or more attendance between CIA - II and CIA - III, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
ESE	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to the last day of instruction	75%

Every course coordinator is required to maintain an ATTENDANCE AND ASSESSMENT RECORD' for every semester which consists of attendance marked in each Theory / practical/ EEC class etc, the assessment marks and the record of class work (topics covered), separately for each course handled by the course coordinator. This should be submitted to the HoD periodically (at least two times in a semester) for checking the syllabus coverage and the records of assessment marks and attendance. The HoD will affix his/her signature and date after due verification. At the end of the semester, the record should be verified by the HoD who shall keep this document after the approval from the Principal for five years. The records of attendance and assessment of both current and previous semesters should be available for inspection whenever required.

9.1.1 A student shall normally be permitted to appear for ESE of the course if he / she has satisfied the attendance requirements (vide Clause 8). He /she is eligible to register for ESE in that semester by paying the prescribed fee.

9.1.2 A Candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester. Ideally every student is expected to attend all classes of all the courses and secure 100% attendance. However, in order to give provision for certain unavoidable reasons such as Medical / participation in sports, the student is expected to attend atleast 75% of the classes. Therefore, he/she shall secure not less than 75%.

9.1.3 However, a candidate who secures overall attendance between 65% and 75% in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) / Participation in Sports events may be permitted to appear for the current semester examinationssubjecttotheconditionthatthecandidateshallsubmitthemedicalcertificate/ sports participation certificate attested by the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.

9.1.4 Candidates who secure less than 65% overall attendance and candidates who do not satisfy the clause 8 shall not be permitted to write the ESE and not permitted to move to the next semester. They are required to repeat the incomplete semester in the next academic year, as per the norms prescribed.

9.1.5 The students who are consistently good in academics ONLY be considered for the grant of ODL under Co-curricular activities by the competent authorities. The following activities shall be considered for the sanction of ODL ;

- **Sports and Games :** TIES, Inter Collegiate, Inter Zonal, Inter University, State Level, National Level and Open Tournaments.
- **NCC :** Camps and expeditions, NSS camps
- Cultural Program at State, National and International Level
- **Seminar / Symposia :** Paper presentation/Quiz
- Leadership courses organized by other organizations & Alumni Association activities, Association activities, Placement activities.
- Training programs / Internship at industries and Higher learning Institutions
- Personal damage incurred during the extracurricular activities
- The ODL requisition letter shall be forwarded to the Principal through the HoD of the student by the staff-in-charge of the respective activities before completion of every activity.
- The ODL sanctioned letters shall be submitted to the Department Office. The faculty-in-charge of the department office will check the eligibility for the award of attendance at the end of semester and the same may be submitted to DEC for approval.

9.1.6 The student should register all the courses of current semester and all the arrear courses in the previous semesters. If any student fails to register and pay the examination fees within the due date, he/she shall not be permitted to attend the ESE. However, he/she will be permitted to continue their studies in the next higher semester, provided that the student satisfies the requirements as stipulated in this clause of this regulation.

9.1.7 Those students who are not deemed to have completed the semester with references to the conditions specified above shall undergo the semester again in all the courses in the respective semester during next academic year. He/she shall seek re-admission as per the norms of the affiliating University/DOTE (Directorate of Technical Education).

The days of suspension for a student on disciplinary grounds will be considered as days of absence for calculating the percentage of attendance for each individual course.

10. TEMPORARY BREAK OF STUDY FROM A PROGRAM

10.1 Break of study is normally not permitted. However, if a student intends to temporarily discontinue the Program in the middle of a semester / year for valid reasons (such as Internships, accident or hospitalization due to prolonged ill health) and wishes to re-join the Program in the next academic year, he / she shall apply in advance to the Principal through the HoD, stating the reasons. The application shall be submitted not later than the last date for registering for the ESE. Break of study is permitted only once during the entire period of the degree Program.

10.2 The student permitted to re-join the Program after the break shall be governed by the rules and regulations in force, at the time of re-joining.

10.3 The duration specified for passing all the courses for the purpose of classification of degree(vide clause 17) shall be increased by the period of such break of study permitted

10.4 If a student is detained for want of requisite attendance, academic progress and good conduct, the period spent in that semester shall not be considered as permitted Break of Study and Clause 10 is not applicable for such cases.

11. ASSESSMENT PROCEDURES FOR AWARDING MARKS

All B.E. / B.Tech. Programs consists of different categories of courses as mentioned in table 5. Appearance in ESE is mandatory for all courses excluding the courses for which only continuous assessment is recommended as mentioned in table 5.

Performance in each course of study shall be evaluated based on (i) Continuous assessments throughout the semester and (ii) ESE at the end of the semester. (i.e.) Each course shall be evaluated for a maximum of 100 marks as shown below :

Table 5 : Categories of Courses

S. No.	Category of course	CIA	ESE
1.	Theory	40	60
2.	Theory cum Practical	50	50
3.	Practical	60	40
4.	Project Work	40	60
5.	Online SWAYAM / NPTEL Courses (Optional)	Marks offered by SWAYAM / NPTEL shall be directly considered	
6.	All CEC Courses (Except Practical Courses and Project Work)	100	–
7.	Mandatory Courses (Except Induction Program #)		
8.	Professional Certificate Courses * (Optional)		

Students can earn maximum of 6 credits in online mode (SWAYAM platform), out of these 18 credits as approved by Board of Studies.

B.E. / B. Tech. (Hons) Specialization in the same discipline, B.E. / B.Tech. Honors and B.E. / B.Tech. minor in other specialization degree will be optional for students.

For the categories 6.10.1 (i) to 6.10.1 (ii), the students will be permitted to register the courses from V Semester onwards provided the marks earned by the students until III semester should be of CGPA 7.50 and above and cleared all the courses in the first attempt.

For the category 6.10.1 (iii), the students will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above

If a student decides not to opt for Honours, after completing certain number of additional courses, the additional courses studied shall be considered instead of the Professional Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the grade sheet,however, they will not be considered for calculation of CGPA.

If a student decides not to opt for Minor, after completing certain number of courses, the additional courses studied shall be considered instead of Open Elective courses which are part of the curriculum. If the student has studied more number of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet. However, they will not be considered for calculation of CGPA.

11.1 Assessment for Theory Courses Including Mandatory Courses

Theory Courses including mandatory courses are to be assessed out of 100 marks, the maximum marks for CIA is fixed as 40 and the ESE carries 60 marks.

The ESE for theory courses including mandatory courses will be of 3 hours duration and shall normally be conducted for a maximum of 100 marks during the Odd and Even Semesters. Every student should appear for the ESE for all the courses excluding the courses for which only continuous assessment is recommended.

A minimum of two tests would be conducted in a day (in the case of tests and they would be of two hours duration each) students will have two hours of coaching session followed by the CIA. In case a student misses the assessment due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National/ International level academic and sports events with prior permission from the HOD, a Reassessment may be given at the end of the semester after getting approval from the HOD through the Course Coordinator concerned.

To arrive the Continuous Assessment Marks, the following guidelines should be followed.

Table 6 : Theory Courses : Continuous Assessment Marks

CIA I (100 Marks)		CIA II (100 Marks)		CIA III (100 Marks)		Total
Individual Assignment / Case Study / Seminar / Mini project	Written Test	Individual Assignment / Case Study / Seminar / Mini project	Written Test	Individual Assignment / Case Study / Seminar / Mini project	Written Test	Continuous Assessment Marks
40	60	40	60	40	60	300*

*The weighted average shall be converted into 40 marks for Internals

A minimum of three CIA will be conducted as a part of continuous assessment during the semester by the respective department. Each Continuous assessment is to be conducted for 100 marks and will have to be distributed in two parts viz., Individual Assignment/Case study/ Seminar/Mini project and Test with each having a weightage of 40% and 60% respectively. The tests shall be in written mode. The total Continuous assessment marks of 300 shall be converted into a maximum of 40 marks and rounded to the next integer.

11.2 Assessment for Practical Courses

For practical including virtual practical Courses, out of 100 marks, the maximum marks for CIA is fixed as 60 and the ESE carries 40 marks.

Every practical exercise / experiment shall be evaluated (as per the rubrics approved by the class committee) based on conduct of experiment / exercise and records. There shall be at least one model test. The criteria for arriving at the CIA marks of 60 is as follows

Table 7 : Practical Courses : Continuous Internal Assessment Marks :

Continuous Assessment (100 Marks)*	
Evaluation of Laboratory experiment, results & Record	Test
75	25

*Continuous Assessment marks shall be converted into 60 marks

The ESE for practical courses shall be of 3 hours duration and normally be conducted for a maximum of 100 marks during the odd and Even Semesters.

11.3 Assessment for Theory with Practical Courses

Weightage of Continuous Assessment and end semester examination marks will be 50% each. The distribution of marks for the theory and laboratory components in the Continuous Assessment and end semester examination for different types of courses are provided in the table 8.

Table 8 : Theory Courses with Practical Component: Continuous Assessment Marks

L	T	P	C	Continuous Internal Assessment			ESE
				I	II	III	
1	0	4	3	Laboratory (15%)	Laboratory (15%)	Theory (20%)	Laboratory only (50%)
1	0	2	2	Laboratory (15%)	Laboratory (15%)	Theory (20%)	Laboratory only (50%)
2	0	2	3	Theory (15%)	Theory (15%)	Laboratory (20%)	Theory (25%) Laboratory (25%)
3	0	2	4	Theory (15%)	Theory (15%)	Laboratory (20%)	Theory (35%) Laboratory (15%)
2	0	4	4	Theory (15%)	Theory (15%)	Laboratory (20%)	Theory (15%) Laboratory (35%)

The procedure for the conduct of Continuous Assessment for theory and laboratory components shall be as per the clause 10.1 and 10.2 respectively. The weighted average shall be converted into 50 marks for Continuous Internal Assessment.

11.4 Assessment for Project Work

The Project work such as mini project and final year project shall be carried out under the supervision of a faculty in the department concerned.

The students who completed their final semester courses (except project work) in advance, shall be permitted to carry out their final semester Project Work for six months in an industry/research organization on the recommendations of the HoD. In such cases the approval should be obtained from the industry concerned, the project work shall be jointly guided by a supervisor of the department and an expert as joint supervisor from the respective organization. The student shall be instructed to meet the supervisor periodically and to attend the review committee meetings and shall submit attendance particulars from the joint supervisor for evaluating the progress

For Project Work, out of 100 marks, the maximum marks for CIA is fixed as 40 and the ESE (Project Report evaluation and Viva-Voce examination) carries 6 0 marks. Project work may be carried out by a single student or a group of students (not exceeding 4).

There shall be three reviews during the semester. The student shall make presentation on the progress made by him / her before the “Project Review Committee”. The total marks obtained in the three reviews shall be reduced for 40 marks and rounded to the next integer. The HoD shall constitute a “Project Review Committee” for each Program. There shall be a minimum of three members in the Review Committee. The Project Guide will be one of the members of the Review Committee.

The student(s) is expected to submit the Project Report on or before the notified date. The ESE for Project Work shall consist of evaluation of the final Project Report submitted by the student(s) of the Project group and viva-voce examination by an external examiner and internal examiner.

The project report shall carry a maximum of 20 marks. The project report shall be submitted as per the approved guidelines as given by the CoE. Same marks shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 40 marks. Marks are awarded to each student of the project group is based on the individual performance in the viva- voce examination.

The CIA and ESE marks for Project Work and the Viva-Voce Examination will be distributed as indicated below.

Table 9 : Project Work : CIA and ESE

Continuous Internal Assessment Marks (40)			End Semester Examinations Marks (60)			
Review I	Review II	Review III	Project Report		Viva-Voce Examination	
10	15	15	Internal	External	Internal	External
			10	10	20	20

The last date for submission of the project report is on the last working day of the semester. If a student fails to submit the project report on or before the specified deadline or the student has submitted the project report but did not appear for the viva-voce examination, it will be considered as fail in the Project Work and the student shall re-register for the same in the subsequent semester.

11.5 Interdisciplinary Project

For the final year Mini/ main project, students may be allowed to do interdisciplinary projects. The interdisciplinary project team consists of 4 members in a Team, consisting 3 students from 3 different branches or 4 students from same branch. First Project Guide shall be allotted from parent department and the second members shall be allotted from the respective domain (other department). The CIA of the project will be carried out by the Interdisciplinary Project Review committee by the respective departments. The Project Reviews, CIA Marks and ESE marks will be same as the Regular Project. Interdisciplinary Project Review Committee will be constituted by the CFRD Head and approved by the principal.

Table 10 : Interdisciplinary Project : Review Committee Constitution

Department X	Project Guide nominated by the HoD
Department Y	One faculty nominated by the respective HoD

The weightage for the project guides and project review committee members to award Continuous Assessment marks is indicated below.

Table 11: Interdisciplinary Project : CIA Marks

Project Guide	Member(s)
50%	50%

The ESE marks will be distributed as indicated below.

Table 12: Interdisciplinary Project : ESE Marks

Report Evaluation (20 Marks)	Viva - Voce (40 Marks)	
External Examiner : 1	External Examiner : 1	External Examiner : 1
20 Marks	20 Marks	10 Marks

Internal and External Examiners are from the two different departments (X & Y) of the students.

11.6 Assessment for Industrial Training / Practical Training / Internship

The Industrial training / Practical Training / Internship shall carry 100 marks and shall be evaluated through CIA only. At the end of Industrial training / Practical Training / Internship, the student shall submit a detailed report including attendance on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three-member Departmental Evaluation Committee constituted by the HoD consisting of Program Coordinator, Faculty Advisor concerned and Senior Faculty. The evaluation report duly signed by the departmental evaulation committee and HoD shall be submitted to the office of the CoE.

11.7 Assessment for Professional Certificate Courses

The Seminar / Case Study shall carry 100 marks and shall be evaluated through CIA only. Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. A three member committee appointed by the Head of the Department, consisting of the course coordinator and two experts from the Department, will evaluate the seminar and at the end of the semester, the marks shall be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper (40%), presentation (40%) and response to the questions asked during presentation (20%).

11.8 Assessment for Value Added Courses

The Value Added Courses shall carry 100 marks and shall be evaluated through Continuous Assessments only. Two assessments shall be conducted during the Semester by the department concerned. The total marks obtained in the tests shall be reduced to100 marks and rounded off to the nearest integer. The HOD may identify a faculty member as Coordinator for the Course. The Departmental Consultative committee consisting of the HOD, staff handling the course, Program Coordinator and a Senior Faculty member nominated by the HOD shall monitor the evaluation process.

The Value Added Courses shall carry 100 marks and shall be evaluated through Continuous Assessments only. Two assessments shall be conducted during the Semester by the department concerned. The total marks obtained in the tests shall be reduced to100

marks and rounded off to the nearest integer. The HOD may identify a faculty member as Coordinator for the Course. The Departmental Consultative committee consisting of the HOD, staff handling the course, Program Coordinator and a Senior Faculty member nominated by the HOD shall monitor the evaluation process. The B.E. /B.Tech. Candidates who enrolled for value added courses have to earn minimum of 75% attendance, failing which the registration for courses will be cancelled.

11.9 Assessment for SWAYAM/NPTEL Courses

The students may be permitted to credit online courses which are offered through SWAYAM/NPTEL platform with the approval of BoS concerned (vide Clause 5.9.4) The course shall carry 100 marks and the marks awarded by the SWAYAM/NPTEL shall be directly considered for grading of the course. No grades shall be awarded for the attendance in the grade sheet for the online course. The attendance requirement as mentioned in Clauses 8 of Regulations 2023 is not applicable for the SWAYAM/NPTEL courses.

11.10 Research Publication

The student can register for the Research Publication as a value added course of respective credits with the approval of BoS concerned. Maximum of two students can form a team under the guidance of a faculty member and complete the publication in SCI / SCI expanded / SCOPUS indexed / UGC Care list. Credits for the publication will be awarded as mentioned in Table 13. The students are not allowed for credit transfer for the research publication. The research publication completed in a semester during the course of study is eligible for including in the grade sheet in the immediate next EVEN / ODD by registering it.

Table 13 : Research Publication : Award of Grade

S. No.	Category of Journal	Credits
1.	One Research Publication in SCI/SCI-Expanded Journal	3
2.	One Research Publication in SCOPUS indexed Journal	2
3.	One Research Publication in UGC Care list Journal	1

12. MARKS DISTRIBUTION

12.1 Question paper pattern

Table 14 : End Semester Examinations

1 Mark (Objective or any type)	2 Marks	13 Marks	Total Marks
15	10	5 (Either or Type)	100
For Mathematics paper only			
2 Marks	16 Marks		Total Marks
10	5 (Either or Type)		100
For Engineering Graphics only			
20 Marks			Total Marks
5 (Either or Type)			100

13. PASSING REQUIREMENTS

13.1 A student who secures not less than 50% of total marks prescribed for the course [CIA + ESE] with a minimum of 45% of the marks prescribed for the ESE, shall be declared to have passed the course and acquired the relevant number of credits. This is applicable for theory, theory with practical component and practical courses (including project work).

13.2 If a student fails to secure a pass in a theory course / theory with practical component / practical course (except electives), the student shall register and appear only for the end semester examination in the subsequent semester. In such case, the CIA marks obtained by the student in the first appearance shall be retained and considered valid for all subsequent attempts till the student secures a pass. However, from the third attempt onwards if a student fails to obtain pass marks (CIA + ESE), then the student shall be declared to have passed the examination if he/she secures a minimum of 50% marks prescribed for the end semester examinations alone.

13.3 If the course, in which the student has failed, is a Professional Elective or Open Elective course, the student may be permitted to register for the same or any other elective course in the subsequent semesters.

If any other Professional Elective or Open Elective course is opted by the student, the previous registration is cancelled and henceforth it is to be considered as a new Professional Elective or Open Elective course. The student has to register and attend the classes, earn the continuous assessment marks, fulfill the attendance requirements as per clause 7 and appear for the ESE.

13.4 If a student fails to secure a pass in project work, the student shall register for the course in the subsequent semester/when offered next and repeat the course (vide clause 7.3.3).

13.5 The passing requirement for the courses which are assessed only through purely internal assessments (CEC courses except Project Work and practical), is 50% of the internal assessment (continuous assessment) marks only

13.6 Valued Answer Script review by the students

All the students are allowed to review their valued answer scripts with the faculty in-charge of the course on the specified date (usually the reopening day). Any discrepancies in the valuation can immediately be brought to the notice of the CoE through concerned HoD.

13.7 Revaluation

A student can apply for revaluation in a theory course within 2 working days from the date of review of valued answer scripts by the students on payment of a prescribed fee along with prescribed application to the CoE through the HoD. The CoE will arrange for the revaluation and the following procedure is followed in awarding Grade Points after revaluation:

i. If there is a change from fail to pass for a Candidate in a Course, Grade Point is awarded as per the applicable (relative/absolute) grading.

ii. If a passed candidate in a course obtains more marks after revaluation, Revised Grading is used only when the candidate gets Higher Grade, otherwise no change in the grade awarded before the revaluation.

The results will be intimated to the student concerned through the HoD within 5 working days from the last date of application of revaluation. Revaluation is not permitted for practical course, practical component of theory with practical component courses and project work.

13.8 Photocopy

Photo Copies of answer script for theory subjects can be obtained from the office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

13.9 Challenge revaluation

Challenging the revaluation is permitted for those students who have applied for photocopy of answer script. The copy of the answer script is to be valued by a competent authority and the valued script should be submitted to the office of the COE along with prescribed fee for challenging the revaluation within 2 working days after the declaration of the Re-valuation results.

14. AWARD OF LETTER GRADES

14.1 The award of grades will be decided based on relative grading principle. The relative grading is applicable to ONLY those students who have passed the examination as per the passing requirements enumerated above (vide clause 12). For those students who have not passed the examination, Reappearance (U) shall be awarded as shown in the below Table 15.

For those students who have passed the course, the relative grading shall be done. The marks of those students who have passed only shall be considered for relative grading. The evolved relative grading method normalizes the results data using the BOX-COX transformation method and computes the grade range for each course separately and awards the grade to each student. For a given course, if the students' strength is greater than 30, the relative grading method shall be adopted. However, if the students' strength is less than 30 then the absolute grading shall be followed with the grade range as specified below.

Table 15 : Grades and Range of Marks

O	A+	A	B+	B	C	RA
91 - 100	81 - 90	71 - 80	61 - 70	56 - 60	50 - 55	< 50

The performance of a student shall be reported using letter grades, each carrying certain points as detailed below.

Table 16 : Grades and Grade Points

LETTER GRADE	GRADE POINTS	RESULT
O (Outstanding)	10	PASS
A+ (Excellent)	9	
A (Very Good)	8	
B+ (Good)	7	
B (Average)	6	
C (Satisfactory)	5	
U (Re-appearance)	0	RA (Re-appearance)
SA (Shortage of Attendance)	0	RC (Repeat Course)
WD (Withdrawal)	0	EA (Extended Appearance)
AB (Absent)	0	RA (Re-appearance)
WH (Withheld)	0	RA (Re-appearance)

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: “O”, “A+”, “A”, “B+”,“B”, “C”. ‘SA’ denotes shortage of attendance and hence prevented from writing the ESE. ‘SA’ will figure both in the Grade Sheet as well as in the Result Sheet.

“U” denotes that the student has failed to pass in that course. “WD” denotes withdrawal from the exam for the particular course. WH denotes the result withheld for the particular course. The grades U,WD and WH will figure both in the Grade Sheet as well as in the Result Sheet. In both cases, the student has to appear for the ESE.

If the grade U/AB is given to the courses which are evaluated through CIA and ESE, is not required to satisfy the attendance requirements, but has to appear for the end semester examination and fulfill the passing requirements to earn a pass in the respective courses.

If the grade U/AB is given to the courses which are evaluated only through Continuous assessment, the student shall register for the course again in the subsequent semester, fulfill the passing requirements to earn pass in the course. However, attendance requirement need not be satisfied.

15. METHODS FOR REDRESSAL OF GRIEVANCES IN EVALUATION

Students who are not satisfied with the grades awarded in the ESE of Theory for regular and arrear exams can seek redressal as illustrated in Table 17

Table 17 : Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	⊙ Apply for viewing of answer booklet and then apply for revaluation after course expert recommendation	
2.	Challenge of Evaluation	⊙ Apply for viewing of answer booklet and then apply for revaluation after course expert recommendation. ⊙ Next apply for challenge of evaluation	
Note : All applications to be made to COE along with the payment of the prescribed fee.			

Challenge of Evaluation – Flow Process

Table 18 : Challenge of Evaluation – Flow Process

Step 1	A student can make an appeal to the CoE for the review of answer scripts after paying the prescribed fee
Step 2	CoE will issue the viewing of answer scripts to the student
Step 3	The faculty who had handled the subject will evaluate the script and HoD will recommend.
Step 4	A committee consisting of 2 evaluators appointed by CoE will review and declare the result.
Step 5	If the result is in favour of the student, the fee collected will be refunded to the student.
Step 6	The final mark will be announced by CoE.

16. Grading System for Mandatory Courses

Mandatory Courses are courses that are required to be completed to fulfill the degree requirements (e.g. Life skills, Environmental science, etc.). They are normally non – credit based. These courses will not be taken in to consideration for the GPA / CGPA calculations. Each of these courses is assessed continuously and internally for a total mark of 100. The pass mark is 50%. Students, who fail to pass this course, are required to repeat the course, when offered next.

16.1 For mandatory non-credit courses the student must satisfy the minimum attendance requirement & passing criteria as specified for the course. These courses do not carry credits but needs to be completed to fulfill the degree requirements.

16.2 For the mandatory non-credit courses student completing the course will be awarded Pass grade (P) grade and those who fail to satisfy the attendance requirement or fail to satisfy the minimum passing requirement of 50% marks, will be awarded Fail (F) grade and the student must re-register for the course when it is offered next.

16.3 Grade Sheet

After the results are declared, grade sheets will be issued to each student, which will contain the following details:

- The College Name and Affiliating University.
- The list of courses registered during the semester and the grades scored.
- The Grade Point Average (GPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses registered from first semester onwards.
- On completion of a semester, each student is assigned a GPA which is computed as below for all courses registered for, by the student during that semester.
- $GPA = \frac{\sum(C_i \times GP_i)}{\sum C_i}$

where $\mathbf{C_i}$ is the credit for a course in that semester and $\mathbf{GP_i}$ is the Grade Point earned by the student for that course. The **SGPA** is rounded off to two decimals.

The overall performance of a student at any stage of the Degree Program is evaluated by the **C**umulative **G**rade **P**oint **A**verage **(CGPA)** up to that point of time

$$\mathbf{CGPA} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where $\mathbf{C_i}$ is the credit for each course in each of the completed semesters at that stage and $\mathbf{GP_i}$ is the grade point earned by the student for that course. The **CGPA** is rounded off to two decimals.

16.4 Formula for Calculating Percentage

CGPA x 10 = % of Marks

17. ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

i. i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the particular Program within the stipulated time.

ii. Successfully completed the course requirements, appeared for the ESE and passed all the subjects prescribed in all the 8 semesters within a maximum period of 7 years and 6 years in the case of Lateral Entry reckoned from the commencement of the first (third in the case of Lateral Entry) semester to which the candidate was admitted.

iii. Successfully passed any additional courses prescribed by the Academic council

iv. Successfully completed the NCC / NSS / NSO / YRC requirements if any.

v. Successfully passed any additional courses prescribed by the Department & concerned whenever readmitted under regulations 2023 (R23) (vide Clause 3.3)

vi. No disciplinary action pending against the student.

vii. The award of Degree must have been approved by the Academic Council.

17.1 Classification of the Degree Awarded

17.1.1 First Class with Distinction

Degree (i)	Duration of Program (ii)	Duration permitted (iii)	Additional credits above the requirement of curriculum (iv)	CGPA (v)	Pass in (vi)	Break of study (vii)	Prevention due to lack of attendance	Withdrawal from writing ESE (viii)
B.E. / B.Tech. (Regular)	4 years	5 years	-	8.50	First attempt	One year authorized break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt
B.E. / B.Tech. (Lateral Entry)	3 years	4 years	-	8.50	First attempt	One year authorized break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt
B.E. / B.Tech. (Honours) Specialisation in the same discipline	3 / 4 years (Lateral entry, Regular, respectively)	4 / 5 years (Lateral entry, Regular, respectively)	18 credits from any one vertical of the same Program	8.50	First attempt	One year authorized break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt
B.E. / B.Tech. (Honours)	3/4 years (Lateral entry, Regular, respectively)	4/5 years (Lateral entry, Regular, respectively)	18 credits from more than one verticals of the same Program	8.50	First attempt	One year authorized break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt
B.E. / B.Tech. minor in other specialisation	3/4 years (Lateral entry, Regular, respectively)	4/5 years (Lateral entry, Regular, respectively)	18 credits from any one vertical of the other Program	8.50	First attempt	One year authorized break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt

17.1.2 First Class

Degree (i)	Duration (ii)	Duration permitted (iii)	Additional credits (iv)	CGPA (v)	Pass in (vi)	Break of study (vii)	Prevention due to lack of attendance	Withdrawa l from writing examination (viii)
B.E. / B.Tech. (Regular)	4 years	5 years	-	6.50	-	One year authorised break of study included in the Duration permitted (iii)	Included in the Duration permitted (iii)	–
B.E. / B.Tech. Lateral Entry	4 years	5 years	-	6.50	-	One year authorised break of study included in the Duration permitted (iii)	Included in the Duration permitted (iii)	–
B.E. / B.Tech. (Honours) Specialisation in the same discipline	3 / 4 years (Lateral entry, Regular, respectively)	4 / 5 years (Lateral entry, Regular, respectively)	18 credits from any one vertical of the same Program	7.50	First attempt	One year authorised break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt
B.E. / B.Tech. (Honours)	3/4 years (Lateral entry, Regular, respectively)	4/5 years (Lateral entry, Regular, respectively)	18 credits from more than one verticals of the same Program	7.50	First attempt	One year authorised break of study included in the Duration permitted (iii)	Not permitted	Will not be considered as an attempt
B.E. / B.Tech. minor in other specialisation	3/4 years (Lateral entry, Regular, respectively)	4/5 years (Lateral entry, Regular, respectively)	18 credits from more than one verticals of the other Program	6.50	First attempt	One year authorised break of study Included in the Duration permitted (iii)	Included in the Duration permitted (iii)	–

18. PROVISION FOR WITHDRAWAL FROM EXAMINATION

18.1 A student may, for valid reasons, (medically unfit / unexpected family situations / sports approved by Head of the Institution) be granted permission to withdraw from appearing for the End Semester Examination in any course or courses in ANY ONE of the semester examinations during the entire duration of the degree Program. The application shall be sent to COE through the Head of the Institutions with required documents.

18.2 Withdrawal application is valid if the student is otherwise eligible to write the examination (Clause 10) and if it is made within TEN days after the date of the examination(s) in that course or courses and recommended by the Head of the Institution and approved by the Controller of Examinations. For a student to withdraw from a course / courses, he/she should have registered for the course, fulfilled the attendance requirements (vide clause 10) and earned continuous assessment marks.

18.3 Notwithstanding the requirement of mandatory TEN working days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

18.4 If a student withdraws from writing end semester examinations for a course or courses, he/she shall register for the same in the subsequent semester and write the end semester examination(s).

18.5 If a student applies for withdrawal from Project Work, he/she will be permitted for the withdrawal only after the submission of project report before the deadline. However, the student may appear for the viva voce examination within 30/60 days after the declaration of results for Project Work and the same shall not be considered as reappearance.

18.6 Withdrawal shall not be considered as an appearance for deciding the eligibility of a student for First Class with Distinction.

18.7 Withdrawal is permitted for the ESE in the final semester as per Clause 7.1.

19. BREAK OF STUDY FROM A PROGRAM

19.1 A student is permitted to go on break of study for a single break of one year only.

19.2 The student can apply for break of study in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the HoD with the approval of the Principal.

19.3 The students permitted to rejoin the Program after break of study / readmission due to lack of attendance, shall be governed by the curriculum and Regulations in force at the time of rejoining. The students rejoining in new regulations shall apply in the prescribed format through HoD at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

19.4 The total period for completion of the Program reckoned from, the commencement of the first semester to which the student was admitted shall not exceed the maximum period specified in Clause 6 irrespective of the period of break of study in order that the student may be eligible for the award of the Degree (vide Clause 16).

19.5 In case there is any period of break of study more than the permitted duration of break of study, the student shall be permitted to continue the Program only if the approval is obtained from the Director of Technical Education / University through the concerned HoD / Principal before the end of the Semester in which the student has taken break of study.

19.6 If a student has not reported to the department for a period of two consecutive Semesters without any intimation, the name of the student shall be deleted permanently from the college enrollment.

19.7 During the break of study period, the students shall pay the prescribed tuition fees failing which the name of the student shall be deleted permanently from the enrollment. Such students are not entitled to seek readmission under any circumstances.

20. RANKING OF A STUDENT

A candidate who qualifies for the degree by passing the examination in all courses of the entire Program in first attempt within a period of Four or Five consecutive academic years applicable for the students joined after permitted Break of Study from the date of admission to the Program can be given his/her position in the class as rank. The Rank is determined from IIIrd semester to VIIIth semester end semester examination CGPA. Students transferred from other institutions to KIT in IIIrd Semester and Lateral entry students are eligible for rank. Students transferred from other institutions beyond IIIrd Semester and students with history of arrears during the entire Program are not eligible for rank.

21. PROCEDURE FOR USING SCRIBE

If a candidate is physically handicapped (in case of accidents / ill health) at the time of examination, he/she may be permitted to use a scribe to write the examination. The compensatory (additional) time should be half hour for three hour duration of examination. The Scribe shall be a non-engineering student / graduate.

22. FACULTY MENTOR

To help the students in palnning their courses of study and for general advice on the academic matters, the HoD will attach a certain number of students (maximum 25) to a faculty member of the department. He / She shall function as Faculty Mentor for these students throughout their period of study. The faculty mentor shall,

- Advice the students in registering and reappearance registering of courses
- Monitor their attendance, academic progress and discipline of the students
- Counsel periodically or during the faculty mentor meeting scheduled in the class time table.
- Inform the students about the various facilities and activities available to enhance the student's
- curricular and co-curricular activities
- If necessary, the faculty mentor may also discuss with or inform the parents about the progress of the students through HoD or in Parent-Teacher meeting.

23. CLASS COMMITTEE

The objective of the Class Committee is to improve the teaching-learning process. The functions of the class committee include :

- Resolving difficulties experienced by students in the classroom and in the laboratories.
- Clarifying the regulations of the degree Program and the details of rules therein.
- Discussing the progress of academic schedule and deviations if any.
- Evaluating the performance of the students of the class after each test and finding the ways and means of improvement.
- Every class in first year of study shall have a class committee consisting of faculty members who are teaching in that class, student representatives
- Cross section of students from boys and girls and a chairperson who is a faculty not handling the course for the class.

From III semester onwards, Class committee comprises of all the faculty members who are handling courses in that particular semester and two student representatives from each course. A chairperson who is a faculty not handling course for that particular semester, nominated by the HoD shall coordinate the activities of this committee.

- The class committee shall be constituted by the HoD/Chief mentor on the first week of commencement of the semester.
- The class committee shall meet three times in a semester as specified in the academic calendar.
- The Principal may participate in any class committee meeting of the institution
- During these meetings, the representative of the class shall meaningfully interact and express the opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.
- The Chairperson is required to prepare the minutes of the meeting, signed by the members and submit the same to HoD within five working days of the meeting. HoD will in turn consolidate and forward the same to the Principal, within five working days of the meeting.
- In each meeting, the action taken report of the previous meeting is to be presented by the Chairperson of the class committee.

24. COMMON COURSE COMMITTEE

- A theory course handled by more than one teacher shall have a “Common Course Committee” comprising of all teachers teaching that course and few students who have registered for that course. There shall be two student representatives from each batch of that course. One of the teachers shall be nominated as Course Coordinator by the HOD concerned and duly approved by the Principal
- The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of the continuous

assessments shall be decided in the first meeting, within the framework of the Regulations. Two or three subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.

- In addition, the "Common Course Committee" (without the student representatives) shall meet to ensure uniform evaluation of continuous assessments after arriving at a common scheme of evaluation for the assessments.

Wherever feasible, the common course committee (without the student representatives) shall also prepare a common question paper for the CIA tests. The question paper for the ESE is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the CoE.

25. DETAILS OF FACULTY PEDAGOGICAL AND STUDENT ASSESSMENT RECORD

Every teacher is required to maintain a Faculty Record Book/ course file consisting of the following details as shown below ;

- Time-table, course syllabus, program outcomes, course outcomes.
- Details of attendance of each student marked in each theory/practical/project work class.
- CIA marks,Details of Assignment/ seminar given, course delivery details, corrective and preventive actions on test performance of students and any other additional details.

The record book should be submitted to the HoD periodically (at least three times in a semester) for checking the syllabus covered, the test marks and attendance. The HoD shall put his/her signature and date in the record book after due verification. At the end of the semester, the record book shall be verified by the Principal who will also ensure safe custody of the document for at least four years. The university or any inspection team appointed by the University/UGC/AICTE may verify the records of attendance.

26. DISCIPLINE

Every student is required to maintain discipline and decorum both inside and outside the institution campus. They shall follow all the rules and regulations and should not indulge in any activity which can tarnish the reputation of the Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

27. SPECIAL CASES

In the event of any clarification in the interpretation of the above rules and relations, they shall be referred to the Standing Committee. The standing committee will offer suitable interpretations/ clarifications/amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

ANNEXURE - I

COURSE NUMBERING SCHEME

B	2	3	M	E	T	7	0	9
Program	Regulation		Department Code		Course Type	Semester	Sequence Number	

Program :

Bachelor Degree (B.E. / B.Tech) - B

Masters Degree (M.E. / M.Tech) - M

Regulation :

R - 23

Department Code :

AE - Aeronautical Engineering

AG - Agricultural Engineering

BT - Bio Technology

BM - Bio Medical Engineering

CS - Computer Science and Engineering

EC - Electronics and Communication Engineering

EE - Electrical and Electronics Engineering

ME - Mechanical Engineering

AD - Artificial Engineering & Data Science

CB - Computer Science & Business System

AM - Computer Science & Engineering (AIML)

CA - Masters in Computer Application

MB - Masters in Business Administration

CH - Chemistry

EN - English PH - Physics

MA - Mathematics

MC - Mandatory Course

CE - Career Enhancement course

Course Type

T - Theory

P - Practical / Project / Internship

E - Elective

O - Open Elective

C - Credit

N - Online courses

S - Special Electives

Semester

1 - First Semester

2 - Second Semester

3 - Third Semester

4 - Fourth Semester

5 - Fifth Semester

6 - Sixth Semester

7 - Seventh Semester

8 - Eighth Semester

Sequence Number

00-99

ANNEXURE - II

POLICY ON MALPRACTICES

GENERAL

- It shall be the endeavour of all concerned to prevent, control and take remedial action to bring about the occurrences of malpractices to "Zero" in Examinations (both Internal and External), Assignments and in all Academic class works.
- Therefore, a comprehensive approach to the malady of malpractices has to be adopted to create a mindset of integrity and honesty, and at the same time take sufficiently stern action to make it clear that such attempts are fraught with comparably very high risk.
- In keeping with this stance, the following measures are to be taken by all concerned from class room level to the Examination Halls :

A. PREVENTION

a. Class room level:

All faculty members are to involve themselves in a psychological growth of students by personal example and self-respect and strive towards.

- Developing a sense of honour in the minds of students so that they look down upon earning undeserved marks.
- Imbibing a sense of self-respect and internal dignity that prevents him/her from succumbing to the temptation of easy marks by cheating.
- Generating an awareness of the risks to their character and career if convicted, while also explaining the process and strict rules and regulations adopted by the educational system to prevent malpractices.
- Taking stern view of copied assignments and attempts at malpractices in internal examinations also merits equal seriousness as semester examinations.
- Setting sufficiently strong deterrent rules in place and regulations like intimation to parents and warning to students in the presence of parents etc. even in case of efforts at malpractices in internal tests and/or repeated acts despite warnings in case of assignments also.

Examination Halls :

Detailed instructions on Invigilation, question paper setting and evaluation and such other instructions will be issued for Invigilation, vigilance, which are to be brought to the notice of all students prior to the examinations.

B. PENAL ACTION FOR MALPRACTICES

All instances of malpractices will be forwarded to the Principal / Chief Superintendents. The offences will be investigated by a Standing Enquiry Committee constituted by Principal, The committee is to summon and give the student an opportunity to present / plead his/her case. The Committee may also summon anybody else, if it so deems necessary for the conduct of enquiry, in the interest of proper investigation and dispensation of the case. The tenure of the committee would be a complete Academic year.

The Committee is to be guided by the following :

- The seriousness of the malpractice, in terms of deviousness, and culpability / criminality of motive.
- The seriousness in terms of effort and degree of deviousness and culpability / criminality of effort.
- Any FIR / Police case that has been registered in the first instance by the Principal/ Chief Superintendent.
- Any other special consideration either mitigating or to the contrary.

C. PENALTY FOR OFFENSES

The penalties awarded will depend on the seriousness of the offence. A list of offences and penalties are placed at Annexure III.

The enquiry report with findings and recommendations of the committee are to be forwarded to the Controller who will undertake necessary follow up action. Based on the recommendations of the CoE, the Principal is empowered to award penalties for offences classified as belonging to categories 1 to 7 of the offence table. The cases falling in categories from S.No. 8 onwards are to be put up to the Principal for consideration and award of suitable penalty.

ANNEXURE - III

Sl.No.	Nature of Malpractice	Maximum Punishment
1.	Appeal by the candidate in the answer script to show mercy by way of awarding more than deserving marks.	Fine of Rs. 1000/- per subject.
2.	The candidate writing his/her name in the answer script.	
3.	The candidate writing his / her registration number / college name in places other than specified in the answer script	
4.	Any special marking in the answer script by the candidate.	
5.	The candidate communicating with neighbouring candidate orally or non-verbally; the candidate causing suspicious movement of his/her body.	
6.	Irrelevant writing by the candidate in the answer script.	
7.	The candidate writing answer on his/her question paper or making use of his/her question paper for rough work.	

8.	The candidate possessing cell phones / programmable calculator(s)/any other electronic storage device(s) gadgets	Invalidating the examination of the particular subject written by the candidate
9.	The candidate possessing any incriminating material(s) (whether used or not). For example : Written or printed materials, bits of papers containing written information, writings on scale, calculator, handkerchief, dress, part of the body, Hall Ticket, etc.	Invalidating the examination of the particular subject written by the candidate.
10.	The candidate possessing cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).	Invalidating the examination of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.
11.	The Candidate possessing the question paper of another candidate with additional writing on it.	
12.	The candidate passing his/her question paper to another candidate with additional writing on it.	
13.	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
14.	The candidate copying from neighbouring candidate.	
15.	The candidate taking out of the examination hall answer booklet(s), used or unused.	
16.	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
17.	Candidate destroying evidence relating to an alleged irregularity.	Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.

		Additional Punishment : i. If the candidate has not completed the Program, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the Program, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
18.	Vulgar / offensive writings by the candidate in the answer script.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears – subjects registered by the candidate.
19.	The candidate possessing the answer script of another candidate.	
20.	The candidate passing his /her answer script to another candidate.	
21.	Involved in any one or more of the malpractices of serial no. 8 to 21 for the second or subsequent times.	Invalidating the examinations of all the theory and practical courses of the current semester and all the arrears- courses registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the Program, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the Program, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
22.	The candidate substituting an answer sheets prepared outside the examination hall for the one already distributed to the candidate.	

23.	The candidate indulge in any disruptive conduct including, but not limited to, shouting, assault of invigilator, officials or students using abusive and / or threatening language, destruction of property.	Invalidating the examinations of all the theory and practical courses of the current semester and all the arrears- courses registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the Program, he/she is debarred from continuing his/her studies for two years i.e., for four subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the Program, he/she is prevented from writing the examinations of the arrears - courses for four subsequent semesters.
24.	The candidate harass or engage others to harass on his/her behalf an invigilator, official, witnesses or any other person in relation to an irregularity by making telephone calls, visits, mails or by any other means.	
25.	Candidate possessing any firearm/weapon inside the examination hall.	
26.	Cases of Impersonation	i. Handing over the impersonator to the police with a complaint to take appropriate action against the person involved in the impersonation by the Chief Supt. If a student is found to impersonate a 'bonafide student', the impersonating student is debarred from continuing his / her studies and writing the examinations permanently. He/she is not eligible for any further admission to any Program. Debarring the 'bonafide student' for whom the impersonation was done from continuing his / her studies and writing the examinations permanently. He/she is not eligible for any further admission to any Program

APPENDIX - IV

Process to Consider the Application for Revocation of Detainment

The process to consider the application for revocation of detainment on account of lack of attendance in 3 or more courses, due to genuine reasons (viz. sports participation, NCC, Medical Grounds etc.) is as follows :

The student submits an application for consideration via a request letter to the CoE,not later than 3 days from the last working day, along with the HoD's recommendation, Class Advisor's report and Mentor's recommendation. A committee consisting of the Principal, CoE, HoD (Respective Department) and HoD's-2 from departments other than the student's own. The committee shall meet within 4 working days,to consider the case. Stakeholders may be called to be present in the meeting as may be required, and Decision arrived at.The decision approved by Principal shall be final.

APPENDIX - V

Academic Evaluation Committee (AEC)

The committee includes the Principal, CoE, HoD concerned. The committee meets to carry out business related to academic matters which require central decision making and approval viz. retest approval of missed CIA, addressing the feedback collected from the various departments' class committee meetings.

Department Evaluation Committee (DEC)

The committee includes HoD (need basis), and a few faculty members of the department from various levels. The committee meets to carry out business related to academic matters that can be addressed within the department viz. course equivalence of common courses for readmitted students; approval of new courses to be offered by the department; consider and approve the credit equivalence of courses offered by industry, review the course offerings; consider the merit of applications involving lack of attendance in PE/OE courses to take up another PE or OE; approve CIAM only courses every semester; approve scheme of assessment for each course; Approval for and Mapping credits of certification courses; approval of list of nationally or internationally recognized professional certification courses with prometric testing.

Curriculum

Scheme of Instructions and Examinations

(For Students admitted from the Academic Year 2019-20 and onwards)

Semester - I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23IPP101	**Induction Program**	**HS**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**-**
Theory / Theory with Practical										
B23MAT101	Matrices and Differential Calculus	**BS**	4	3	1	0	**4**	40	60	100
B23MET101	Engineering Graphics	**ES**	4	2	2	0	**4**	40	60	100
B23HST101	தமிழர் மரபு / Heritage of Tamils	**HS**	1	1	0	0	**1**	40	60	100
B23ENI101	Professional Communication	**HS**	5	3	0	2	**4**	50	50	100
B23CHI101	Engineering Chemistry	**BS**	5	3	0	2	**4**	50	50	100
B23CSI102	Problem Solving and Python Programming	**ES**	5	3	0	2	**4**	50	50	100
Practical										
B23MEP101	**Engineering Practices Laboratory**	**ES**	**4**	**0**	**0**	**4**	**2**	**60**	**40**	**100**
Total credits to be earned							**23**			

Semester - II										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23ENT201	Professional English	**HS**	2	2	0	0	**2**	40	60	100
B23MAT201	Integral Calculus and Complex Analysis	**BS**	4	3	1	0	**4**	40	60	100
B23HST201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	**HS**	1	1	0	0	**1**	40	60	100
B23BTT201	Biochemistry	**PC**	3	3	0	0	**3**	40	60	100
B23BTT202	Bioorganic Chemistry	**BS**	3	3	0	0	**3**	40	60	100
B23PHI101	Engineering Physics	**BS**	5	3	0	2	**4**	50	50	100
Practical										
B23BTP201	Biochemistry and Bioorganic Chemistry Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23CEP201	Soft Skills	**CEC**	2	2	0	0	**NC**	40	60	100
Total credits to be earned							**19**			

BoS Chairman

Semester - III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT304	Partial Differential Equations and Probability	**HS**	4	3	1	0	**4**	40	60	100
B23BTT301	Stoichiometry and Fluid Mechanics	**PC**	3	3	0	0	**3**	40	60	100
B23BTT302	Biochemical Thermodynamics	**ES**	3	3	0	0	**3**	40	60	100
B23BTT303	Bioprocess Principles	**PC**	3	3	0	0	**3**	40	60	100
B23BTT304	Cell Biology and Genetics	**BS**	3	3	0	0	**3**	40	60	100
B23BTI301	Microbiology	**BS**	5	3	0	2	**4**	50	50	100
Practical										
B23BTP301	Chemical Engineering Laboratory	**ES**	4	0	0	4	**2**	60	40	100
B23CEP301	Professional Certificate Course	**CEC**	2	0	0	2	**1**	100	-	100
Total credits to be earned							**23**			
In Plant Training – Minimum ONE WEEK has to be completed. Review will be conducted during the first week of 4th semester and included in 4th semester mark statement.										

Semester IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT406	Biostatistics	**BS**	4	3	1	0	**4**	40	60	100
B23BTT401	Chemical Reaction Engineering	**ES**	4	3	1	0	**4**	40	60	100
B23BTT402	Enzymology and Enzyme Technology	**PC**	3	3	0	0	**3**	40	60	100
B23BTT403	Molecular Biology	**PC**	3	3	0	0	**3**	40	60	100
B23BTT404	Industrial Biotechnology	**PC**	3	3	0	0	**3**	40	60	100
B23BTI401	Analytical Methods in Biotechnology	**PC**	5	3	0	2	**4**	50	50	100
Practical										
B23BTP401	Cell and Molecular Biology Laboratory	**PC**	4	0	0	4	**2**	60	40	100
B23CEP401	In Plant Training	**CEC**	-	-	-	-	**NC**	-	-	-
Total credits to be earned							**23**			
Summer Internship – Duration 15 days (Review will be conducted in first week of Semester V and its credit will be included in Semester V).										

BoS Chairman

Semester - V										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BTT501	Mass Transfer Operations	ES	4	3	1	0	4	40	60	100
B23BTT502	Bioprocess Engineering	PC	3	3	0	0	3	40	60	100
B23BTI501	Genetic Engineering	PC	5	3	0	2	4	50	50	100
B23BTE10_	Professional Elective – I	PE	3	3	0	0	3	40	60	100
B23BTE20_	Professional Elective – II	PE	3	3	0	0	3	40	60	100
B23_____	Open Elective – I	OE	3	3	0	0	3	40	60	100
B23MCT501	Environmental Sciences	MC	3	3	0	0	NC	-	-	-
Practical										
B23BTP501	Bioprocess Laboratory	PC	4	0	0	4	2	60	40	100
B23CEP501	Summer Internship	CEC	-	-	-	-	1	-	-	-
Total credits to be earned							23			

Semester - VI										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BTT601	Immunology	PC	3	3	0	0	3	40	60	100
B23BTI601	Bioinformatics	PC	5	3	0	2	4	50	50	100
B23MGT701	Total Quality Management	HS	3	3	0	0	3	40	60	100
B23BTE30_	Professional Elective – III	PE	3	3	0	0	3	40	60	100
B23BTE40_	Professional Elective – IV	PE	3	3	0	0	3	40	60	100
B23_____	Open Elective – I	OE	3	3	0	0	3	40	60	100
B23MCT601	Indian Constitution	MC	1	1	0	0	NC	-	-	-
Practical										
B23BTP601	Immunology Laboratory	PC	4	0	0	4	2	60	40	100
B23BTP603	Mini Project	PW	4	0	0	4	2	100	-	100
Total credits to be earned							23			

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Semester - VII										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BTT701	Downstream Processing	PC	3	3	0	0	3	40	60	100
B23BTT702	Biopharmaceutical Technology	PC	3	3	0	0	3	40	60	100
B23BTT703	Bioethics, Biosafety and IPR	PC	3	3	0	0	3	40	60	100
B23BTE50_	Professional Elective – V	PE	3	3	0	0	3	40	60	100
B23BTE60_	Professional Elective – VI	PE	3	3	0	0	3	40	60	100
B23_____	Open Elective – III	OE	3	3	0	0	3	40	60	100
B23_____	Open Elective – IV	OE	3	3	0	0	3	40	60	100
B23HST701	Universal Human Values	HS	2	2	0	0	2	40	60	100
Practical										
B23BTP701	Downstream Processing Laboratory	PC	4	0	0	4	2	60	40	100
B23BTP702	Project Work Phase – I	PW	4	0	0	4	2	60	40	100
Total credits to be earned							27			

Semester - VIII										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23BTP801	Project Work Phase – II	PW	16	0	0	16	8	40	60	100
Total credits to be earned							8			

HUMANITIES AND SOCIAL SCIENCES (HS)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23IPP101	Induction Program	HS	-	-	-	-	0	-	-	-
B23ENI101	Professional Communication	HS	5	3	0	2	4	50	50	100
B23HST101	தமிழர் மரபு / Heritage of Tamils	HS	1	1	0	0	1	40	60	100
B23ENT201	Professional English	HS	2	2	0	0	2	40	60	100
B23HST201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	1	0	0	1	40	60	100
B23MAT304	Partial Differential Equations and Probability	HS	4	3	1	0	4	40	60	100
B23MGT701	Total Quality Management	HS	3	3	0	0	3	40	60	100
B23HST701	Universal Human Values	HS	2	2	0	0	2	40	60	100

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BASIC SCIENCES (BS)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory / Theory with Practical										
B23MAT101	Matrices and Differential Calculus	BS	4	3	1	0	4	40	60	100
B23CHI101	Engineering Chemistry	BS	5	3	0	2	4	50	50	100
B23MAT201	Integral Calculus and Complex Analysis	BS	4	3	1	0	4	40	60	100
B23PHI101	Engineering Physics	BS	5	3	0	2	4	50	50	100
B23BTT202	Bioorganic Chemistry	BS	3	3	0	0	3	40	60	100
B23BTT304	Cell Biology and Genetics	BS	3	3	0	0	3	40	60	100
B23BTI301	Microbiology	BS	5	3	0	2	4	50	50	100
B23MAT406	Biostatistics	BS	4	3	1	0	4	40	60	100

ENGINEERING SCIENCES (ES)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MET101	Engineering Graphics	ES	4	2	2	0	4	40	60	100
B23CSI102	Problem Solving and Python	ES	5	3	0	2	4	50	50	100
B23MEP101	Engineering Practices Laboratory	ES	4	0	0	4	2	60	40	100
B23BTT302	Biochemical Thermodynamics	ES	3	3	0	0	3	40	60	100
B23BTP302	Chemical Engineering Laboratory	ES	4	0	0	4	2	60	40	100
B23BTT401	Chemical Reaction Engineering	ES	4	3	1	0	4	40	60	100
B23BTT501	Mass Transfer Operations	ES	4	3	1	0	4	40	60	100

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PROFESSIONAL CORE (PC)											
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23BTT201	Biochemistry	PC	3	3	0	0	3	40	60	100
B23BTP201	Biochemistry and Bioorganic Chemistry Laboratory	PC	4	0	0	4	2	60	40	100
B23BTT301	Stoichiometry and Fluid Mechanics	PC	3	3	0	0	3	40	60	100
B23BTT303	Bioprocess Principles	PC	3	2	1	0	3	40	60	100
B23BTT402	Enzymology and Enzyme Technology	PC	3	3	0	0	3	40	60	100
B23BTT403	Molecular Biology	PC	3	3	0	0	3	40	60	100
B23BTT404	Industrial Biotechnology	PC	3	3	0	0	3	40	60	100
B23BTI401	Analytical Methods in Biotechnology	PC	5	3	0	2	4	50	50	100
B23BTP401	Cell and Molecular Biology Laboratory	PC	4	0	0	4	2	60	40	100
B23BTT502	Bioprocess Engineering	PC	3	3	0	0	3	40	60	100
B23BTI501	Genetic Engineering	PC	5	3	0	2	4	40	60	100
B23BTP501	Bioprocess Laboratory	PC	4	0	0	4	2	60	40	100
B23BTT601	Immunology	PC	3	3	0	0	3	40	60	100
B23BTI601	Bioinformatics	PC	5	3	0	2	4	50	50	100
B23BTP601	Immunology Laboratory	PC	2	0	0	2	2	60	40	100
B23BTT701	Bioethics, Biosafety and IPR	PC	3	3	0	0	3	40	60	100
B23BTT702	Biopharmaceutical Technology	PC	3	3	0	0	3	40	60	100
B23BTT701	Downstream Processing	PC	3	3	0	0	3	40	60	100
B23BTP701	Downstream Processing Laboratory	PC	4	0	0	4	2	60	40	100

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Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII
Biosciences	**Bioprocess and Biochemical Engineering**	**Medical Biotechnology**	**Agro Biotechnology**	**Animal Biotechnology**	**Computational Biotechnology**	**Quality and Regulatory Affairs**
Biosensors	Bioprocess Control and Instrumentation	Human Genetics	Plant Biotechnology	Fundamentals of Animal Biotechnology	Programming for Bioinformatics Applications	Clinical Trials andHealth care policies in Biotechnology
Bionanotechn ology	Fermentation Technology	Cancer Biology	Therapeutic application of phytochemicals	Animal Health and Nutrition	Fundamentals of Algorithms for Bioinformatics	Biotechnological products and itsvalidation
Stem Cell Technology	Food Processing and Technology	Biopharmaceuticals and Biosimilars	Bio-fertilizer production & mushroom cultivation	Animal Physiology and Metabolism	Molecular Modelling	Quality assurance and quality controlin Biotechnology
Biomaterials	Bioreactor Designand Scale up process	Tissue Engineering	Biotechnological approach incrop improvement	Animal Cell CultureTechnology	Computer Aided Drug Design	Entrepreneurship and patent design
Protein Engineering	Environmental Biotechnology	Molecular Therapeutics and Diagnostics	Advance techniques inagro forestry	Advances in Animal Biotechnology	Metabolomics andMetabolic Engineering	Intellectual property rights in Biotechnology
Modern Bioanalytical Techniques	Bioenergy and Biofuels	Vaccine Technology	Plant tissue culture & transformation techniques	Biotechniques in Animal Breeding	Data Mining And Machine Learning Techniques For Bioinformatics	Biotechnology Business Management

PROJECT WORK (PW)

Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23BTP603	Mini Project	PW	4	0	0	4	2	100	-	100
B23BTP702	Project Work Phase – I	PW	4	0	0	4	2	60	40	100
B23BTP801	Project Work Phase – II	PW	16	0	0	16	8	40	60	100

CAREER ENHANCEMENT COURSE (CEC)

Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23CEP201	Soft Skills	CEC	2	0	0	2	NC	40	60	100
B23CEP301	Professional Certificate Course	CEC	2	0	0	2	1	100	-	100
B23CEP401	In Plant Training	CEC	-	-	-	-	NC	-	-	-
B23CEP501	Summer Internship	CEC	-	-	-	-	1	-	-	-

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MANDATORY COURSE (MC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B23MCT501	Environmental Sciences	MC	1	1	0	0	NC	-	-	-
B23MCT601	Indian Constitution	MC	1	1	0	0	NC	-	-	-

OPEN ELECTIVE COURSES-OFFERED BY DEPARTMENT OF BIOTECHNOLOGY										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
B19BTO501	Food Processing and Preservation	OE	3	3	0	0	3	40	60	100
B19BTO601	Basic Bioinformatics	OE	3	3	0	0	3	40	60	100
B19BTO701	Fundamentals of Nanobiotechnology	OE	3	3	0	0	3	40	60	100
B19BTO801	Biological Waste Management	OE	3	3	0	0	3	40	60	100

SUMMARY

S.No.	Subject Area	Credits As per Semester								Credit Points
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4	4			3	2		**17**
2	BS	8	11	7	4					**30**
3	ES	10		5	4	4				**23**
4	PC		5	6	15	9	9	11		**55**
5	PE					6	6	6		**18**
6	OE					3	3	6		**12**
7	PW						2	2	8	**12**
8	CEC			1		1				**2**
9	MC (Non Credit)					✓	✓			
	Total	**22**	**20**	**23**	**23**	**23**	**23**	**27**	**8**	**169**

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Semester - I

B.E. / B.Tech.	B23MAT101 - MATRICES AND DIFFERENTIAL CALCULUS (Common to all Branches)	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To develop the use of matrices that is needed by engineers for practical applications.
2.	To understand the concept of functions of several variables.
3.	To recognize and classify ordinary differential equations.
4.	To apply the concept of ordinary differential equations in engineering disciplines.
5.	To learn the applications of Laplace transforms in engineering.

UNIT - I	MATRICES	12

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley Hamilton theorem – Quadratic form: Nature, Reduction to canonical form by orthogonal transformation.

UNIT - II	FUNCTIONS OF SEVERAL VARIABLES	12

Partial differentiation –Total derivative – Jacobians – Taylor‘s series expansion for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.

UNIT - III	ORDINARY DIFFERENTIAL EQUATIONS	12

Higher order linear ordinary differential equations with constant coefficients - Method of variation of parameters - Simultaneous differential equations.

UNIT - IV	APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS	12

Solution of specified differential equations connected with electric circuits - Law of Natural growth and decay - Simple harmonic motion (Differential equations and associated conditions need to be given)

UNIT - V	LAPLACE TRANSFORMS	12

Existence conditions - Properties (excluding proofs) - Transform of standard functions -Transforms of derivatives and integrals - Inverse Laplace transform - Applications to solution of linear second order ordinary differential equations with constant coefficients.

Total Instructional hours : 60

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Course Outcomes	
CO1	Make use of Eigen values and Eigen vectors to reduce the quadratic form into canonical form and to find the powers of a square matrix.
CO2	Identify the maxima and minima problems.
CO3	Solve differential equations which existing in different engineering disciplines.
CO4	Develop the applications of differential equations in various engineering field.
CO5	Apply Laplace transform and inverse transform to solve differential equations with constant coefficients.

Text Books	
1.	Grewal B.S.,"Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2015.
2.	Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media - An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2015.
3.	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2015.
4.	George B. Thomas, Joel Hass, Christopher Heil, Maurice D. Weir, "Thomas' Calculus", Pearson, 14th Edition, 2018.

Reference Books	
1.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2019.
2.	Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
3.	Ramana B V., "Higher Engineering Mathematics", Tata Mc Graw Hill Publishing Company, New Delhi, 2017.
4.	Veerarajan T., "Engineering Mathematics for Semester I and II", Tata Mc Graw Hill Publishing Company, New Delhi, 2019.
5.	Gean Duffy., "Advanced Engineering Mathematics with MATLAB", A CRC Press Company, Boca Raton London, New York Washington, D.C, 2nd edition 2009. (Free e-book downloaded from www.EasyEngineering.net.pdf).

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B.E / B.Tech	B23MET101 – ENGINEERING GRAPHICS (COMMON TO ALL)	L	T	P	C
		2	2	0	4

Course Objectives	
1.	Understand the conventions and method of Engineering drawing.
2.	Construct and interpret the basic Engineering drawings.
3.	Improve their visualization skills so that they can apply these skills in new product development.
4.	Enhance their technical communication skill in the form of communicative drawings.
5.	Comprehend the theory of projection.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)	2
Importance of graphics in Engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.	

UNIT - I	PLANE CURVES AND FREE HANDSKETCHING	14
Basic Geometrical constructions, Curves used in Engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views - Free hand sketching of multiple views from pictorial views of objects.		

UNIT - II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	14
Orthographic projection - principles - Principal planes - First angle projection - Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		

UNIT - III	PROJECTION OF SOLIDS	14
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.		

UNIT - IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	14
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		

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UNIT - V	ISOMETRIC AND PERSPECTIVE PROJECTIONS	14
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-prisms, pyramids and cylinders by visual ray method.		

COMPUTER AIDED DRAFTING	3
Introduction to drafting packages and demonstration of their use Basic Geometrical constructions using AUTOCAD	
Total Instructional hours : 75	

Course Outcomes : Students will be able to	
CO1	Construct the basic engineering curves and freehand sketching of basic geometrical constructions and multiple views of objects.
CO2	Solve problems related to projections of points, straight lines and planes
CO3	Build the projection of simple solids.
CO4	Apply the knowledge acquired on practical applications of sectioning and development of solids.
CO5	Construct simple solids and its sections in isometric view and projections, and also to draw its perspective views.

Text Books	
1.	K.V.Natarajan, “A text book of Engineering Graphics”, 28th Edition, Dhana Lakshmi Publishers, Chennai, 2015.
2.	N.D. Bhatt and V.M. Panchal, “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2014.

Reference Books	
1.	K. Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Publishers, 2017.
2.	K.R.Gopalakrishna., “Engineering Drawing” (Vol. I & II combined) Subhas Publications, Bangalore, 2018.
3.	N.S Parthasarathy and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.

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B.E. / B.Tech.	B23HST101 - தமிழர் மரபு	L	T	P	C
		1	0	0	1

அலகு - I	மொழி மற்றும் இலக்கியம்	3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு - II	மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக்கலை	3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு - III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு - IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு - V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டில் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

மொத்தம் - 15 காலங்கள்

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Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroy of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

BoS Chairman

B.E / B.Tech	B23HST101 - HERITAGE OF TAMILS (COMMON TO ALL BRANCHES)	L	T	P	C
		1	0	0	1

UNIT - I	LANGUAGE AND LITERATURE	3

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

UNIT - II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART - SCULPTURE	3

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

UNIT - III	FOLK AND MARTIAL ARTS	3

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

UNIT - IV	THINAI CONCEPT OF TAMILS	3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT - V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total Instructional hours : 15

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Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

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B.E. / B.Tech. (Except CSBS)	B23ENI101 – PROFESSIONAL COMMUNICATION	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To enhance listening and reading ability of learners to comprehend various forms of speech or conversations.
2.	To develop learners' verbal ability through complex texts and speak effectively in real life and workplace context.
3.	To make use of grammatical knowledge to enhance fluency.
4.	To foster learners' ability to write convincing job applications and effective reports.
5.	To develop learners language proficiency through LSRW skills.

UNIT - I	9
Listening	Listening for general information - specific details - conversation - Audio / video (formal & informal); Telephone conversation
Speaking	Self-Introduction; Introducing a friend; - politeness strategies - making polite requests & polite offers
Reading	Introduction to technical texts, scientific texts
Writing	Extended definitions, Writing checklists, Recommendation
Language development	Gerunds, Infinitives
Vocabulary development	Technical vocabulary, abbreviations, British & American spelling

UNIT - II	9
Listening	Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities
Speaking	Narrating personal experiences / Talking about events and situations
Reading	Reading longer technical texts, Summarizing
Writing	Interpreting graphical representations, Writing dialogues about formal and informal contexts
Language development	Use of conjunctions and prepositions
Vocabulary development	Numerical adjectives, Transitional device

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UNIT - III	9
Listening	Listen to a classroom lecture; listening to advertisements about products
Speaking	Picture description - describing locations in workplace, Presenting product, describing shape, size and weight - talking about quantities - talking about precautions, discussing advantages and disadvantages - making comparisons
Reading	Cause & effect texts, practice in speed reading
Writing	Process writing, Use of sequence words, Analytical and issue based essays
Language development	Subject verb agreement, Pronoun concord / pronoun antecedent
Vocabulary development	Sequence words, Misspelled words, Content v/s Function words

UNIT - IV	9
Listening	Listening to TED Talks, Educational videos and completing exercises based on them
Speaking	Short speech (Just A Minute) - Extempore and persuasive speech, discussing and making plans-talking about tasks-talking about progress
Reading	Reading for details in personal and professional emails
Writing	Drafting personal and professional emails, job application - cover letter, résumé preparation, Internship letter
Language development	Clauses, if conditionals
Vocabulary development	Finding suitable synonyms, Paraphrasing

UNIT - V	9
Listening	Listening to debates/ discussions and panel discussions, listening to interviews
Speaking	Making predictions - talking about a given topic, giving opinions & facts, describing a process, discussing safety issues (making recommendations)
Reading	Reading and understanding technical articles
Writing	Writing reports, Minutes of meeting, Writing feasibility, survey and industrial reports
Language development	Reported speech, Active and Passive voice, Impersonal passive, Idioms
Vocabulary development	Verbal analogies, Purpose statements
	Total Theory Instructional hours : 45 **Total Lab Instructional hours : 30**

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Course Outcomes : Students will be able to	
CO1	Develop listening skills to respond appropriately in general and academic purposes.
CO2	Develop strategies and skills to enhance their ability to read and comprehend.
CO3	Apply vocabulary skills to improve their language skills.
CO4	Build writing skills with specific reference to technical writing.
CO5	Demonstrate language proficiency through LSRW skills.

Text Books	
1.	Board of Editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad : 2016
2.	Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

Reference Books	
1.	Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice” Oxford University Press: New Delhi, 2014.
2.	Kumar, Suresh. E. “Engineering English” Orient Blackswan: Hyderabad, 2015.
3.	Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4.	Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
5.	Communicative English for Engineers and Professionals- Nitin Bhatnagar & Mamta Bhatnagar.
6.	Skills for Success. Listening and Speaking. Level 4- Margret Brooks.
7.	Grammar F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press : Oxford, 2011.

Exercises for Batch of 30 Students

1. Listening Comprehension
2. Self- introduction
3. Short presentation
4. Group Discussion

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B.E / B.Tech	B23CHI101 - ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To make the students conversant with boiler feed water requirements, related problems, water treatment and inculcate practical skills in the water quality analysis.
2.	To make the students conversant with basics of polymer chemistry.
3.	To make the students conversant with basic of electrochemical reactions, corrosion and induce experimental skills in the electro-analytical techniques.
4.	To make the student acquire sound knowledge of energy devices.
5.	To develop an understanding of the basic concepts of nano materials.

UNIT - I	WATER TECHNOLOGY	17

Hardness of water : Types, expression of hardness and their units, hardness problems, boiler troubles - scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming

Treatment of Boiler feed water : Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning)

External treatment : Ion exchange process, Zeolite process

Desalination of brackish water : Reverse osmosis - municipal water treatment, break point chlorination

Determination of alkalinity in water sample, Determination of total, temporary & permanent hardness of water by EDTA method. Estimation of iron content of the water sample using spectrophotometer.

UNIT - II	POLYMERS	9

Polymers : Definition, polymerization, types - addition and condensation polymerization, free radical mechanism - tacticity – biodegradable polymer (PHBV) and conducting polymer (poly-aniline)

Plastics : Classification, preparation, properties and uses of PVC, teflon, nylon-6, 6 and epoxy resin

Rubber : Vulcanization of rubber, synthetic rubbers -n-butyl rubber and SBR

Moulding : Ingredients - compression and Injection

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UNIT - III	ELECTROCHEMISTRY AND CORROSION	16

Electrochemistry : Redox reaction, electrode potential - oxidation potential, reduction potential, Nernst equation (derivation) - measurement and applications - electrochemical series and its significance
Corrosion : causes - types-chemical and electrochemical corrosion (galvanic and differential aeration), corrosion control - electrochemical protection (sacrificial anodic method and impressed current cathodic method)
Estimation of iron content of the given solution using potentiometer, Conductometric titration of strong acid vs strong base, Estimation of copper in brass

UNIT - IV	ENERGY DEVICES	9

Batteries : Types of batteries – primary (alkaline battery) and secondary battery (lead acid battery, lithium-ion-battery), Fuel Cells (H2 - O2 fuel cell)
Super Capacitors : Principle, construction, working and applications
Photo voltaic cell : Solar cells - principle, construction, working and applications

UNIT - V	NANOCHEMISTRY	9

Basics : Distinction between molecules, nanoparticles and bulk materials- surface area to volume ratio
Synthesis : Top-down process (ball milling) - Bottom-up process (chemical vapour deposition and sol-gel method)
Properties of nano materials - Optical, electrical, thermal and mechanical
Applications of nano materials - Medicine, Industries, electronics and biomaterials

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Explain the characterization of water and quantitative analysis of alkalinity, hardness and Iron
CO2	Develop the basics of polymer chemistry.
CO3	Illustrate the principles of electrochemical reactions, corrosion and estimation of copper in alloy.
CO4	Apply the concepts of energy devices and its engineering applications.
CO5	Organize the basics of nano chemistry and its applications.

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Text Books	
1.	Dara, S S and Umare, S S, “A Textbook of Engineering Chemistry”, Chand S & Company Ltd., New Delhi, 2015.
2.	Jain, P C and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2015
3.	Vogel’s Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

Reference Books	
1.	Friedrich Emich, “Engineering Chemistry”, Scientific International Pvt. Ltd., New Delhi, 2014.
2.	Prasanta Rath, “Engineering Chemistry”, Cengage Learning India Pvt. Ltd., Delhi, 2015.
3.	Shikha Agarwal, “Engineering Chemistry - Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.
4.	Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", John Wiley Sons, New Jersey, 2003.

Equipment Needed for 30 Students

1. Conductivity Meter - 10
2. Potentiometer - 10
3. Spectrophotometer - 02
4. Electronic Balance - 01

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B.E.	B23CSI102 - PROBLEM SOLVING AND PYTHON PROGRAMMING (COMMON TO AERO, AGRI, BT AND MECH)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To develop python programs with conditional statements and loops.
2.	To learn how to use strings, functions and pass arguments in Python.
3.	To use python data structures such as lists, tuples, and dictionaries.
4.	To use file concepts and to build a package using Python modules for reusability.
5.	To learn the fundamentals of data manipulations with Python.

UNIT - I	INTRODUCTION TO PYTHON PROGRAMMING	9

Introduction : Python basics and its scripting modes – Variables, Operators - Control Structures : if, if - else, nested if, if – elif ladder statements - Iterative statements : while, for, Nested loops, else in loops, break, continue and pass statements.

UNIT - II	STRINGS AND FUNCTIONS	9

Strings : Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions. Regular expression: Matching the patterns, Search and replace. Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments.

UNIT - III	COLLECTIONS	9

List : Create, Access, Slicing, Negative Indices, List Methods, and comprehensions, Tuples : Create, Indexing and Slicing, Operations on tuples. Dictionary: Create, add, and replace values, operations on dictionaries

UNIT - IV	SETS AND FILE HANDLING	9

Sets : Create and operations on set, Files : Manipulating files and directories, text files : reading / writing text and numbers from / to a file; creating and reading a formatted file (csv or tab separated)

UNIT - V	MODULES AND PACKAGES	9

Modules: Importing module, standard modules, executing modules. Packages: Importing Packages, simple programs using built-in functions of packages like pandas, jumpy, matplotlib

Total Instructional hours : 45

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List of Experiments		
Expt. No.		**Description of the Experiments**
1.	Programs Using Simple Statements	
	a.	Exchange the values of two variables,
	b.	Circulate the values of n variables,
	c.	Distance between two points.
2.	Programs Using Conditionals and Iterative Statements	
	a.	Number Series
	b.	Number Patterns
	c.	Pyramid Pattern
3.	Programs Using built-in and user defined Functions	
	a.	Factorial of a Number
	b.	Largest Number in a list
	c.	Area of Shape
4.	Programs using Strings	
	a.	Reversing a String
	b.	Checking Palindrome in a String
	c.	Counting Characters in a String
	d.	Replacing Characters in a String
5.	Operations of Lists	
	a.	Basic Operations (Insertion, Updating, deletion, accessing, List Comprehensions)
	b.	Implement linear search and binary search using list.
	c.	Matrix operations using Nested List.
	d.	Implement Merge, Bubble and Insertion sort
6.	Create a tuple and perform its operations for the following :	
	a.	Basic Operations (Insertion, Updating, deletion, accessing)
	b.	Items present in a library
	c.	Components of a car
	d.	Materials required for construction of a laboratory

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7.	Operations of Dictionaries	
	a.	Python program to create a dictionary with integer keys, and print the keys, values & key-value pairs
	b.	Python program to randomize (shuffle) values of dictionary
8.	Operations of Sets	
	a.	Basic operations of set (Membership, Operations and Modifications)
9.	Programs using File Handling	
	a.	Copy from one file to another.
	b.	Word count
	c.	Longest word
10.	Python programs using Time and Calendar related functions	
	a.	Print the current time using time module.
	b.	Display the calendar of given month of the year using calendar module.
11.	Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)	
Total Instructional hours: (45+15) = 60		

Course Outcomes : Students will be able to	
CO1	Outline the different problem-solving techniques.
CO2	Make use of various data types and control structures to solve a given problem.
CO3	Develop C programs with different types of arrays and string operations
CO4	Experiment with the usage of pointers and functions in C.
CO5	Build C Programs data using structures and unions

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of the Equipment	Quantity required (Nos.)
1.	HP Make, Core i5, 11th Generation, 16GB RAM PCs, Operating systems: Windows* 10 or later, macOS, and Linux. Python* version: 3.10.X	30

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Text Books	
1.	Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Updated for Python 3, Shroff / O ‘Reilly Publishers, 2016
2.	Reema Thereja, “Python Programming using Problem Solving Approach”, 4th Impression, Oxford University Press, 2019.
3.	Python Course Data Analysis with Python by Bernd Klein, 2021.

Reference Books	
1.	John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and expanded Edition, MIT Press, 2013.
2.	Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python : An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd, 2016.
3.	Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd, 2015.
4.	Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.

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B.E. / B.TECH	B23MEP101 – ENGINEERING PRACTICES LABORATORY (GROUP - A & B) (Common to all Branches)	L	T	P	C
		0	0	4	2

Course Objectives	
1.	Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work, sawing, planning, making joints in wood materials used in common household wood work.
2.	Welding various joints in steel plates using arc welding work; machining various simple processes like turning, drilling, tapping in parts; assembling simple mechanical assembly of common household equipments, making a tray out of metal sheet using sheet metal work.
3.	To provide exposure to the students with hands on experience on various basic Engineering practices in Electrical Engineering.
4.	To provide exposure to the students with hands on experience on various basic Engineering practices in Electronics Engineering.

GROUP – A (CIVIL & MECHANICAL)		
I	**Civil Engineering Practices**	**12**
	Plumbing Works Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings	
Carpentry Preparation of wooden joints by sawing, planning and cutting		
1.	Planning & Polishing operation	
2.	Half lap joint	
3.	Cross lap joint	
II	**Mechanical Engineering Practices**	**18**
	Welding Workshop Study of welding tools and equipment's - Study of various welding methods - Instruction of BI standards and reading of welding drawings.	

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Exercise in arc welding for making	
1.	Lap joint
2.	Butt joint
3.	Demonstration of gas welding and cutting.
Machine Shop	
1.	Drilling and Tapping
2.	Lathe Exercise – Facing operation
3.	Lathe Exercise – Straight turning and Chamfering
Sheet metal	
Making of small parts using sheet metal	
1.	Making of Square Tray

GROUP – B (ELECTRICAL & ELECTRONICS)	**30**
Expt. No.	**Description of the Experiments**
1.	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2.	Fluorescent lamp and Stair case wiring.
3.	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
4.	Measurement of energy using single phase energy meter.
5.	Measurement of resistance to earth of an electrical equipment.
6.	Study of Electronic components and equipment's – Resistor color coding
7.	Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
8.	Study of logic gates AND, OR, EX-OR and NOT.
9.	Soldering & desoldering practices.
10.	Study of Fan, Iron Box, Emergency Lamp, Telephone and FM Radio.
	Total Instructional Hours: 60

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Course Outcomes : Students will be able to	
CO1	Explain the pipe connections and identify the various components used in plumbing.
CO2	Develop simple wooden joints using wood working tools and simple components using lathe and drilling machine.
CO3	Construct simple lap, butt and tee joints using arc welding equipment and simple parts using sheet metal.
CO4	Construct Residential house wiring, Fluorescent lamp wiring and Stair case wiring.
CO5	Measure electrical quantities such as voltage, current, power & power factor in RLC Circuit, resistance to earth, AC signal parameter (peak-peak, RMS period, frequency) and ripple factor.
CO6	Examine logic gates (AND, OR, EOR and NOT), Electronic components and equipment's.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS			
GROUP – A (CIVIL & MECHANICAL)			
Sl. No.	**Description of Equipment**		**Quantity required**
1.	Assorted components for plumbing, Consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.		15
2.	Carpentry vice (fitted to work bench)		15
3.	Standard woodworking tools		15
4.	Models of industrial trusses, door joints, furniture joints		5
5.	Power Tools :		
	(a)	Rotary Hammer	2
	(b)	Demolition Hammer	2
	(c)	Circular Saw	2
	(d)	Planer	2
	(e)	Hand Drilling Machine	2
	(f)	Jigsaw	2
6.	Arc welding transformer with cables and holders		5
7.	Welding booth with exhaust facility		5

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8.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	
9.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2
10.	Centre lathe	2
11.	Hearth furnace, anvil and smithy tools	2
12.	Moulding table, foundry tools	2
13.	Power Tool: Angle Grinder	2
14.	Study-purpose items: Centrifugal pump, Airconditioner	1

GROUP – B (ELECTRICAL & ELECTRONICS)		
Sl. No.	**Description of Equipment**	**Quantity required**
1.	Assorted Electrical Components for House Wiring	15 sets
2.	Electrical Measuring Instruments	10 sets
3.	Iron Box	1
4.	Fan and Regulator	1
5.	Emergency Lamp	1
6.	Megger	1
7.	Digital Live Wire Detector	2
8.	Soldering Guns	10
9.	Assorted Electronic Components for Making Circuits	50
10.	Multipurpose PCBs	10
11.	Multi Meters	10
12.	Telephone	2
13.	FM radio	2
14.	Regulated Power Supply	2
15.	CRO (30MHz)	2
16.	Bread board	10
17.	Digital IC types (IC 7432, IC 7408, IC 7400, IC 7404, IC 7402, IC 7486)	Each 10

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Semester - II

B.E. / B.Tech. (Except CSBS)	B23ENT201 – PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives	
1.	To develop the listening and reading skills of first year engineering and technology students.
2.	To help learners' develop vocabulary through reading skills.
3.	To enhance learners' grammatical knowledge.
4.	To enhance the learners' ability of writing different complex texts.
5.	To develop the competency of learners through LSRW skills.

UNIT - I		6
Listening	Listening to voicemail & messages; Listening and contextualizing.	
Speaking	Replying to polite requests and offers, understanding basic instructions.	
Reading	Short comprehension passages, practice in skimming & scanning.	
Writing	Writing Instructions.	
Language development	Parts of Speech, Wh - Questions, yes or no questions, Question tags.	
Vocabulary development	Prefixes - suffixes.	

UNIT - II		6
Listening	Listening commentaries and announcements.	
Speaking	Role Play exercises based on workplace contexts.	
Reading	Comprehension questions including dialogues and conversations.	
Writing	Writing different types of Paragraph.	
Language development	Regular & Irregular Verbs, Tenses.	
Vocabulary development	Understanding contextual meaning, Synonyms.	

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UNIT - III	6
Listening	Listening to a product launch-sensitizing leaners to the nuances of persuasive communication.
Speaking	Debate - discussion on current issues.
Reading	Short texts and longer passages - note making.
Writing	Understanding text structure, use of reference words and discourse markers, jumbled sentences.
Language development	Idioms and Phrases, Degrees of comparison.
Vocabulary development	One word substitutes.

UNIT - IV	6
Listening	Listening to short academic videos.
Speaking	Making short presentation through short films.
Reading	Intensive and Extensive reading-reading different types of magazines.
Writing	Letter writing- formal and informal.
Language development	Direct / indirect questions.
Vocabulary development	Phrasal verbs

UNIT - V	6
Listening	Listening to talks/lectures by specialists on specific topics.
Speaking	Discussion on general and current topics.
Reading	Longer texts - cloze reading.
Writing	Writing short essays, developing outline, identifying main and subordinate ideas, Dialogue writing.
Language development	Spelling and Punctuations, Modal verbs.
Vocabulary development	Collocations
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Develop listening and reading skills for effective communication
CO2	Develop vocabulary skills
CO3	Build grammatical understanding
CO4	Explain opinions efficiently in writing formal and informal contexts
CO5	Develop knowledge through LSRW skills.

Text Books	
1.	Board of Editors Using English, “A Course book for Undergraduate Engineers and Technologists”, Orient Black Swan Limited, Hyderabad : 2015.
2.	Richards, C. Jack,“ Interchange Students Book - 2”, New Delhi, CUP, 2015.

Reference Books	
1.	Bailey, Stephen, “A practical guide for students”, New York Rutledge, 2011.
2.	Raman, Meenakshi and Sharma, Sangeetha “Technical Communication Principles and Practice” Oxford University Press: New Delhi, 2014.
3.	Dutt P. Kiranmai and Rajeevan Geeta, “Basic Communication Skills”, Foundation Books, 2013.

BoS Chairman

B.E. / B.TECH.	B23MAT201 - INTEGRAL CALCULUS AND COMPLEX ANALYSIS (Common to all Branches)	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To recognize various techniques of integration.
2.	To apply integration techniques in evaluating area and volume of solids.
3.	To develop the use of Vector calculus in two and three dimensional spaces.
4.	To demonstrate understanding of the basic concepts of complex differentiation.
5.	To understand Cauchy theorem and Cauchy integral formulae and apply these to evaluate complex contour integrals.

UNIT - I	INTEGRAL CALCULUS	12

Riemann sum – Definite and Indefinite integrals - Substitution rule (Exponential, logarithmic, Trigonometric functions) – Integration by parts – Integration of Rational functions by Partial fraction.

UNIT - II	MULTIPLE INTEGRALS	12

Double integrals : Double integrals in Cartesian coordinates - Double integrals in Polar coordinates – Area enclosed by plane curves – Triple integrals: Evaluation of triple integrals - Volume as triple integral (Simple problems)

UNIT - III	VECTOR CALCULUS	12

Gradient and directional derivative - Divergence and curl - Solenoidal and Irrotational vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and applications (for cubes and rectangular parallellopipeds)

UNIT - IV	COMPLEX DIFFERENTIATION	12

Analytic functions - Cauchy - Riemann equations (excluding proof) – Properties of analytic function – Harmonic conjugate - Construction of analytic function by Milne Thomson method – Bilinear transformation.

UNIT - V	COMPLEX INTEGRATION	12

Cauchy's integral theorem – Cauchy's integral formula – residues - Cauchy's Residue theorem – Evaluation of real integrals – Stereographic projection – Use of circular contour and semicircular contour (excluding poles on real axis)

Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Develop Fundamental Theorem of Calculus, techniques of Integration such as substitution, partial fractions and integration by parts.
CO2	Make use of integration to compute multiple integrals, area, volume, integrals in polar coordinates
CO3	Apply the line, surface and volume integrals for verification of Green's, Gauss and Stokes theorems.
CO4	Construct Analytic function and develop Conformal Mapping
CO5	Identify infinite series of a complex function within the contour and types of the singularities, finding of complex integrals

Text Books	
1.	Grewal B.S.,"Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3.	George B. Thomas , Joel Hass , Christopher Heil , Maurice D. Weir, "Thomas' Calculus", Pearson, 14th Edition, 2018.

Reference Books	
1.	Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media - An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2015.
2.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition 2019.
3.	O'Neil, P.V.,"Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd, New Delhi, 7th Edition 2017.
4.	Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5.	Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics", (Tata McGraw Hill Education Pvt. Ltd), 6th Edition, New Delhi, 2012.
6.	Gean Duffy., "Advanced Engineering Mathematics with MATLAB", A CRC Press Company, Boca Raton London, New York Washington, D.C, 2nd edition 2009. (Free e-book downloaded from www.EasyEngineering.net.pdf)

BoS Chairman

B.E. / B.Tech.	B23HST201 - தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

அலகு – I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு – II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை

அலகு – III	உற்பத்தித் தொழில் நுட்பம்	3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருவாக்குதல், எ.ஃ.கு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

அலகு – IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன் வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்

அலகு – V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்

மொத்தம் – 15 காலங்கள்

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Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroy of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

BoS Chairman

B.E. / B.Tech.	B23HST201 - TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT - I	WEAVING AND CERAMIC TECHNOLOGY	3

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

UNIT - II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

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

UNIT - III	MANUFACTURING TECHNOLOGY	3

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

UNIT - IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

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

UNIT - V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Total Instructional hours : 15

BoS Chairman

Text - Cum - Reference Books	
1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு - தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL - (in print)
6.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by : International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by : International Institute of Tamil Studies).
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the Histroyb of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by : The Author)
11.	Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) - Reference Book.

BoS Chairman

B. TECH.	B23BTT201 – BIOCHEMISTRY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To introduce the biomolecules.
2.	To understand the fundamentals of biomolecules.
3.	To understand the structure and regulations of biomolecules.
4.	To understand the metabolism of biomolecules. .
5.	To understand the metabolism and regulation of hormones.

UNIT - I	INTRODUCTION TO BIOCHEMISTRY	9

Foundations of Biochemistry - Cellular, Physical and Chemical.

Water : chemical nature, ionization, Hydrogen bonding and hydrophobic interactions, Water as a reactant.

Buffers : pH, pKa, Henderson and Hasselbalch equation and biological buffers.

UNIT - II	CARBOHYDRATES AND THEIR METABOLISM	9

Carbohydrates : Monosaccharides, disaccharides, polysaccharides – Starch, glycogen, cellulose, chitin, proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulphate.

Carbohydrate metabolism : Glycolysis, TCA cycle, oxidative phosphorylation, Gluconeogenesis, Pentose phosphate pathway, Photosynthesis, metabolism of carbohydrates in anaerobic conditions.

UNIT - III	LIPIDS AND THEIR METABOLISM	9

Lipids : Types; fatty acids, triacyl glycerides, phospholipids, sphingolipids, glycolipids, sterols, biological membranes.

Fatty acid metabolism : Fatty acid synthesis, elongation, unsaturation. Beta oxidation, ketone bodies; lipid biosynthesis - TAG synthesis and cholesterol biosynthesis - Regulation.

UNIT - IV	AMINO ACIDS AND THEIR METABOLISM	9

Amino acids - classification- structure - properties - chemical reactions. Peptide bond.

Proteins – primary, secondary, tertiary and quaternary structures, structural and functional proteins. Introduction to enzymes.

Amino acid metabolism : Amino acid oxidation, urea cycle, amino acid biosynthesis (Glutamate, Serine).

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UNIT - V	NUCLEIC ACIDS AND THEIR METABOLISM	9
Nucleic acids : Chemical composition of nucleic acids- bases, nucleosides, nucleotides, nucleic acid polymers, structure, functions of nucleic acids. Watson and Crick model of DNA. **Nucleotide metabolism :** Salvage and de nova synthesis, degradation – Regulation.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the basic structure of life and the physiochemical properties of water.
CO2	Explain the structure and metabolism of carbohydrates
CO3	Illustrate the various structures of lipids and their metabolic pathway.
CO4	Identify the organization of proteins and their metabolism
CO5	Make use of the chemistry and metabolism of nucleic acids.

Text Books	
1.	Lehninger, “Principles of Biochemistry” 8th Ed DL Nelson, MM. Cox (Eds.) 2013.
2.	Satyanarayana, U and Chakerapani U, “Biochemistry” 6th Ed, Books & Allied (P) Ltd, 2021.

Reference Books	
1.	Voet D and Voet JG, “Biochemistry”, 4th Ed. John Wiley & Sons Inc. 2010.
2.	Rastogi, SC. “Biochemistry” 3rd Ed. Tata McGraw-Hill, 2010.

BoS Chairman

B. TECH.	B23BTT202 – BIOORGANIC CHEMISTRY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To explain the fundamental concepts pertaining to atoms and bonding.
2.	To understand stereochemical aspects of atoms and molecules.
3.	To understand substitution and addition reactions along with their applications in biological world.
4.	To understand kinetics and catalysis in organic chemical reactions.
5.	To understand the structure and properties of phytochemicals.

UNIT - I	ATOMS AND BONDING	9

Overview of bioorganic chemistry – atoms, electrons and orbitals - covalent Bonds - Octet rule - Polar covalent Bonds – Electronegativity - Electrophiles and Nucleophiles – Concept of Resonance - Inductive and mesomeric effects - formal charge - Resonance Acids and Bases - Acid Base equilibria - SP^3 hybridization.

UNIT - II	STEREOCHEMISTRY	9

Special properties of carbon as the centre of organic world - Fisher projections and absolute configurations - Stereochemical activity around the tetrahedral carbon - Cis- trans isomerism, Conformation analysis of ethane, butane and cyclohexane - optical activity and chiral centres - Optical activity of glucose.

UNIT - III	MECHANISM OF SUBSTITUTION AND ADDITION REACTION	11

S_N1 and S_N2 reaction on tetrahedral carbon - Nucleophilic addition of aldehydes and ketones: Hydration, acetal formation, acetal protection – Reactions of carbonyl group with amines – esterification and ester hydrolysis – saponification of an ester – hydrolysis of amides - Ester enolates – Claisen condensation – Michael condensation – Substitution and addition reactions in the biological world, examples.

UNIT - IV	KINETICS AND CATALYSIS	8

Reaction kinetics– Rate law and mechanism – Transition states- Intermediates – Trapping of intermediates – Reactivity –Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis.

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UNIT - V	CHEMISTRY OF PHYTOCHEMICALS	8
Sources, general structure, functions, examples and uses of flavonoids, flavones, anthocyanins, tannins, alkaloids, isoprenes, glycosides and volatile oils.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the basic concepts of organic chemistry related to atoms and bonding.
CO2	Explain the three-dimensional alignment of atoms in space.
CO3	Compare the different types of Chemical reactions involved in biomolecules
CO4	Illustrate the concepts of kinetics and catalysis in organic chemistry.
CO5	Identify the structure and functions of various phytochemicals.

Text Books	
1.	Carey Francis A, “Organic Chemistry”, 8th Ed. Tata McGraw Hill, 2009.
2.	Kalsi PS and Jagtap S, “Pharmaceutical, Medicinal and Natural Product Chemistry”, Narosa Publishing House, New Delhi, 2013.

Reference Books	
1.	Page MI and Williams A, “Organic and Bioorganic Mechanisms”, Pearson, 2010.
2.	Penney C and Dugas H, “Bioorganic Chemistry: A Chemical Approach to Enzyme Action” 3rd Ed. Springer, 2003.
3.	Chatwal GR, “Organic Chemistry of Natural products” Vol. I & II, Himalaya Publishing House, New Delhi, 2011.

BoS Chairman

B.E. / B.Tech.	B23PHI101 - ENGINEERING PHYSICS (Common to all Branches)	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To gain knowledge on the basics of properties of matter, its applications and inculcate practical skills in the determination of elastic property of the materials.
2.	To acquire knowledge & experimental skills on the concepts of Photonics and their applications in fiber optics.
3.	To have adequate knowledge on the concepts of electrical, magnetic properties of materials and enhance the practical skills in determination of electrical properties of the materials.
4.	To get knowledge on advanced physics concepts of quantum theory and its applications in SEM, TEM and induce practical skills in microscope.
5.	To enhance the fundamental knowledge of students in Crystal Physics and its Applications relevant to various streams of Engineering and Technology.

UNIT - I	PROPERTIES OF MATTER	14

Elasticity - Modulus, types of modulii of elasticity, Stress - strain diagram and its uses - factors affecting elastic modulus and Twisting couple, torsion pendulum; theory and experiment

Bending of beams - Bending moment - uniform and non- uniform bending; theory and experiment - I - shaped girders and its applications

Determination of rigidity modulus - Torsion pendulum - Determination of Young's modulus by non-uniform bending method - Determination of Young's modulus by uniform bending method

UNIT - II	PHOTONICS AND FIBER OPTICS	12

Lasers ; properties of laser-spontaneous and stimulated emission-amplification of light by population inversion - Einstein's A and B coefficients - derivation – Types of laser; Nd. - YAG Laser, Semiconductor lasers; homojunction and heterojunction, Industrial and Medical Applications

Fiber Optics ; Principle, Numerical Aperture and Acceptance Angle - Types of optical fibres - Fiber optic communication System - Block diagram - Medical Applications - Endoscopy

Determination of wavelength of the Laser using grating- Determination of particle size using Laser - Determination of Numerical aperture and acceptance angle of an optical fiber

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UNIT - III	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	12

Classical free electron theory – Relaxation time and collision time - Expression for electrical conductivity – Thermal conductivity – Wiedemann - Franz law – Lorentz number - Drawbacks of classical theory - Quantum theory - Fermi - Dirac statistics – variation of Fermi level with temperature

Introduction to magnetic materials – Comparision of Dia, Para and Ferro magnetic materials – Domain theory of ferromagnetism - Hysteresis - Soft and Hard magnetic materials - Ferrites and its applications.

Determination of specific resistance of the wire using Carey Foster's Bridge

UNIT - IV	QUANTUM PHYSICS	12

Black body radiation; Planck's theory (derivation) - wave particle duality- debroglie's wavelength - concept of wave function and its physical significance

Wave equation ; Schroedinger's time independent and time dependent equations, particle in a one-dimensional rigid box. Applications; Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM)

Determination of thickness of a thin wire by using travelling microscope

UNIT - V	CRYSTAL PHYSICS	10

Crystal Structures; Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattices - Miller indices- inter - planar distances – coordination number and packing factor for SC, BCC, FCC and HCP structures

Crystal imperfections; Point and Line defects - Burger vector

Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Categorize the basics of properties of matter and its applications, classify the elastic properties of materials by using uniform, non-uniform bending method and torsional pendulum apparatus
CO2	Explain the basics of Laser, Fiber Optics and their applications, determination of Particle size, Wavelength of laser and acceptance angle, numerical aperture of optical fiber.
CO3	Justify the concepts of electrical, magnetic properties of materials, determination of Specific resistance of the material
CO4	Determine the thickness of thin sheet using travelling microscope and explain the basics of quantum theory
CO5	Classify and compare the different types of Crystals, their structures and its defects

BoS Chairman

Text Books	
1.	Bhattacharya, D.K. & Poonam, T, “Engineering Physics”, Oxford University Press, 2015.
2.	Gaur, R.K. & Gupta, S.L. “Engineering Physics”, Dhanpat Rai Publishers, 2012.
3.	Pandey, B.K. & Chaturvedi, S. “Engineering Physics”, Cengage Learning India, 2012.
4.	Rajendran V, “Engineering Physics”, Tata McGraw Hill, Publishing Company, New Delhi, 2011.
5.	Wahab, M.A. - Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, 2009.

Reference Books	
1.	Halliday, D., Resnick, R. & Walker, J. “Principles of Physics””, Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”, Cengage Learning, 2010.
3.	Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics”, W.H. Freeman, 2007.
4.	Avadhanulu M.N, “Engineering Physics - Volume 1”, S.Chand & Company Ltd., New Delhi, 2010.
5.	Garcia, N. & Damask, A. - Physics for Computer Science Students. Springer - Verlag, 2012.
6.	Senthil Kumar, G. Physics Laboratory I & II, VRB publishers Pvt. Ltd., Chennai (2016).

Equipment Needed for 30 Students

1. Diode Laser (2 mS power) , He – Ne Laser source (2mW), Optical Fibre Kit - 06
2. Travelling Microscope ,Knife edge, Slotted weights - 19
3. Carey Foster Bridge - 06
4. Air Wedge Apparatus with Travelling Microscope - 06
5. Torsional Pendulum - 06

BoS Chairman

B. TECH.	B23BTP201 – BIOCHEMISTRY AND BIOORGANIC CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To have hands on experience in the preparation of various solutions and buffers
2.	To build the basic knowledge on the qualitative and quantitative study of biomolecules

Expt. No.	List of Experiments
1.	Basic laboratory calculations and standardization of solutions.
2.	Preparation of buffers.
3.	Determination of pKa by titration method.
4.	Qualitative analysis of sugars.
5.	Qualitative analysis of amino acids.
6.	Estimation of glucose by DNS method.
7.	Estimation of Protein by Lowry/Bradford method.
8.	Determination of acid value and iodine number of oil.
9.	Synthesis of aspirin.
10.	Extraction and estimation of lycopene from tomato.
11.	Extraction of caffeine from various coffee powder samples.
12.	Saponification reactions of vegetable oils.
13.	Extraction of oil from seed (Soxhlet apparatus).
	Total Instructional hours : 30

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Develop reagents and buffers for analytical purpose.
CO2	Dissect the biomolecules qualitatively
CO3	Examine the biomolecules quantitatively
CO4	Construct organic compounds at laboratory level
CO5	Test for the extraction of bioactive molecules from natural sources.

References	
1.	Sadasivam S and Manickam A, “Biochemical Methods”, 3rd Ed. New Age International (P) Limited, New Delhi, 2005.
2.	Plummer DT, “An Introduction to Practical Biochemistry”, 3rd Ed. London; New York : McGraw-Hill.
3.	Siegel IH, “Biochemical Calculations”, 2nd Ed. John Wiley & Sons, London, 2014
4.	Vogel AI and Tatchell AR, “Vogel’s Text book of Practical Organic Chemistry”, 5th Ed. Longman Scientific and Technical & John Wiley & Sons, 2004
5.	Shanmugam S, Sathishkumar T and Paneerselvam K, “Laboratory Handbook on Biochemistry”, Prentice - Hall, India Pvt. Ltd., 2010

BoS Chairman

B.E. / B.Tech.	B23CEP201 – SOFT SKILLS (Common to all Branches)	L	T	P	C
		2	0	0	0

Course Objectives	
1.	To identify personality using evaluation method.
2.	To encourage creative thinking by practice.
3.	To enrich interpersonal skills through integrated activities.
4.	To develop social and professional etiquette.
5.	To identify and apply employability skills for professional success.

UNIT - I	SELF EVALUATION	6
Introduction to soft skills, Familiarize oneself, Self-understanding, SWOT analysis, Goal Setting.		

UNIT - II	INNOVATIVE THINKING	6
Divergent thinking, Encourage curiosity, Writing a story, Poster making.		

UNIT - III	INTERPERSONAL SKILLS	6
Interpersonal skills - Need & Components – Understanding Intercultural Competence - Team Work-Problem Solving Skills - Conflict Management & Resolutions in Workplace, Leadership skills, Managerial skills.		

UNIT - IV	BUSINESS ETIQUETTE	6
Define Etiquette -Types and Importance of Workplace Etiquette - Basic Corporate Etiquette - Telephone Etiquette - Meeting & E-mail Etiquette - Customer Service Etiquette.		

UNIT - V	CORPORATE SKILLS	6
Work Ethics - Adaptability - Analytical Reasoning - Lateral Thinking - Stress & Time Management.		
Total Instructional hours : 30		

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Course Outcomes : Students will be able to	
CO1	Develop the Interpersonal Skills.
CO2	Show the creative skill in different aspects.
CO3	Explain their ideas through conversations.
CO4	Develop adequate Soft Skills required for the workplace.
CO5	Develop leadership qualities.

References	
1.	Butterfield, Jeff “Soft Skills for Everyone” Cengage Learning, New Delhi, 2015.
2.	S.Hariharanetal ”Soft Skills” MJP Publishers : Chennai, 2010.
3.	Peter, Francis “Soft Skills and Professional Communication” New Delhi : Tata McGraw Hill, 2012. Print.
4.	Meenakshi Raman, Shalini Upadhyay, ’Soft Skills’, Cengage Learning India Pvt. Ltd, Delhi, 2018.
5.	M.S. Rao, ‘Soft Skills Enhancing Employability’, I. K. International Publishing House Pvt. Ltd, New Delhi, 2010
6.	Sabina Pillai, Agna Fernandez, ‘Soft Skills and Employability Skills’, Cambridge University Press, 2018.
7.	John Peter.A, ‘Self – Development and Professional Excellence’, Cengage Learning India Pvt. Ltd, Delhi, 2019.

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Semester - III

B.TECH.	B23BTT301 – STOICHIOMETRY AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of unit conversion, the use of ideal gas and real gas law in composition calculation.
2.	To develop the material balance for different unit operations and unit processes.
3.	To develop the energy balance equation for various chemical processes and to apply this in phase change operations.
4.	To understand the properties of fluids and to develop the Bernoulli's equation using the principle of continuity equation.
5.	To study the principle and operation of fluid flow measuring device and various types of pumps.

UNIT - I	BASIC CHEMICAL CALCULATIONS	9

Dimension, systems of units – basic and derived units, conversion, composition of mixture and solutions, calculations of pressure, volume and temperature using ideal gas law, use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT - II	MATERIAL BALANCE	9

Concept of material balance, overall and component balance, Applications of material balance to unit operations – evaporator, distillation (Binary system), liquid-liquid extraction, solid-liquid extraction, drying, absorption, crystallization and mixing/blending, recycle and bypass illustration, Material balance with chemical reaction – limiting and excess reactants, combustion reaction.

UNIT - III	ENERGY BALANCE	9

General energy balance equation for open systems and closed system, heat capacity, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, standard heat of reaction, formation, combustion, solution and mixing, phase change operations, calculation of standard heat of reaction from heat of formation and combustion, effect of temperature on heat of reaction.

UNIT - IV	FLUID PROPERTIES AND DYNAMICS	9

Physical and rheological properties of fluids, types of flow, pressure measuring device – manometer, continuity equation and energy equation, Bernoulli’s equation, Dimensional analysis.

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UNIT - V	TRANSPORTATION AND METERING OF FLUIDS	12
Measurement of fluid flow – Orifice meter, Venturimeter, Rotameter and Pitot tube, Transportation of fluid – Positive displacement pumps, Rotary and Reciprocating pumps, Centrifugal pumps, Loss due to friction in pipes and fittings.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Solve problems in pure components and mixtures using system of units and ideal gas law.
CO2	Apply the concepts of material balance in various unit operations and unit processes.
CO3	Utilize the basics of energy balance in various chemical processes.
CO4	Make use of the basic fluid properties and continuity equation in a fluid system.
CO5	Identify the performance of various flow meters and pumps using the fluid flow properties.

Text Books	
1.	Bhatt B I and Thakore S B “Stoichiometry”, 5th Ed. Tata McGraw Hill, 2012.
2.	Gavhane K A, “Introduction to Process calculations (Stoichiometry)”, Nirali Publication, 2016.

Reference Books	
1.	Sikdar D C. “Chemical Process Calculations”, PHI learning Private Ltd, 2013.
2.	Rajput R K, “Fluid Mechanics & Hydraulic Machines”, S. Chand Limited, 2008.
3.	Himmelblau D M “Basic Principles & Calculations in Chemical Engineering” 6th Ed., PHI, 2006.
4.	Mc Cabe W L, Sonith J C and Harriot P “Unit Operations of Chemical Engineering” 6th Ed., McGraw Hill, 2001.
5.	Bansal R K, “A Textbook of Fluid Mechanics”, Laxmi Publications, 2008.

BoS Chairman

B. TECH.	B23BTT302 – BIOCHEMICAL THERMODYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To estimate properties of fluids using thermodynamic laws.
2.	To acquire knowledge on partial molar properties in solutions.
3.	To calculate extent of phase change at equilibrium.
4.	To analyse chemical reactions at equilibrium conditions.
5.	To apply thermodynamic principles to describe microbial growth and product formation.

UNIT - I	FUNDAMENTALS OF THERMODYNAMICS	9

Fundamentals and basic concepts, first law of thermodynamics – Flow and non-flow processes, PVT- behaviour for pure fluids, estimation of thermodynamic properties using equations of state; Second Law of thermodynamics; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT - II	SOLUTION THERMODYNAMICS	9

Partial molar properties; concepts of chemical potential and fugacity; composition models for ideal and non-ideal solutions; activity and activity coefficient; Gibbs Duhem equation, Property changes of mixing.

UNIT - III	PHASE EQUILIBRIA	9

Criteria for phase equilibria, Phase equilibria in single and multicomponent systems, Duhem's Theorem, Vapour- Liquid Equilibria (VLE), Phase diagrams for binary solution, VLE calculations- binary systems and multi component systems, Phase equilibrium in ideal solution, Azeotropes, Vapour- Liquid Equilibrium at low and high pressures, liquid-liquid equilibrium, Ternary equilibrium diagrams.

UNIT - IV	CHEMICAL REACTION EQUILIBRIA	9

Criteria for chemical reaction equilibrium, Equilibrium criteria for homogeneous chemical reactions, evaluation of equilibrium constant, effect of temperature and pressure on equilibrium constant, Giauque functions, calculation of equilibrium conversion and yields for single and multiple reactions.

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UNIT - V	BIOTHERMODYNAMICS	9
Stoichiometry of autotrophic and heterotrophic microbial growth; thermodynamics of maintenance; Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert – Pirt Relation for Electron Donor; thermodynamics and stoichiometry of product formation.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Identify the properties of fluids using the laws of thermodynamics.
CO2	Make use of the concepts of partial molar properties in solution thermodynamics.
CO3	Utilize phase equilibrium concepts in ideal and non-ideal solutions.
CO4	Test for chemical reactions at equilibrium conditions.
CO5	Examine the microbial growth and product formation using thermodynamic principles.

Text Books	
1.	Narayanan K V, “A Text Book of Chemical Engineering Thermodynamics”, 2nd Ed., PHI, 2013.
2.	Smolke C D, “The Metabolic Pathway Engineering Handbook Fundamentals”, CRC Press Taylor & Francis Group, 2010.

Reference Books	
1.	Smith J M, Van Ness H C and Abbot M M, “Introduction to Chemical Engineering Thermodynamics”, 8th Ed., Tata McGraw-Hill, 2019.
2.	Sandler SI, “Chemical, Biochemical and Engineering Thermodynamics”, Wiley, 1989.

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B. TECH.	B23BTT303 – BIOPROCESS PRINCIPLES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on microbial fermentation processes with all its prerequisites.
2.	To endow the students with the basics of microbial isolation, preservation and strain improvement
3.	To enhance the skills of students to develop media for the fermentation process
4.	To provide insights on sterilization methods and kinetics.
5.	To implement stoichiometric and energetics to estimate microbial growth and product formation.

UNIT - I	OVERVIEW OF FERMENTATION PROCESSES	9

Overview of fermentation industry; Range of fermentation; general requirements of fermentation processes; Types of fermenters; basic configuration of batch fermentor and ancillaries; Parameters to be monitored and controlled.

UNIT - II	ISOLATION, PRESERVATION AND STRAIN IMPROVEMENT	9

Isolation, screening, and maintenance of microbes for industrial processes. Strain selection and improvement methods. Inocula development for Industrial fermentations.

UNIT - III	MEDIA DESIGN FOR FERMENTATION PROCESS	9

Media formulation - medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements; examples of simple and complex media; design of media for industrial fermentations; Medium optimization.

UNIT - IV	STERILIZATION KINETICS	9

Sterilization types; Thermal death kinetics; Design of Batch and continuous sterilization; Sterilization of the fermenter, feeds and liquid wastes, Filter sterilization- fermentation media and air; Sterilization of fermenter exhaust air.

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UNIT - V	METABOLIC STOICHIOMETRY AND ENERGETICS	9
Elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct the general requirements of fermentation processes.
CO2	Identify the techniques of isolation, preservation, and strain improvement of industrially relevant microbes.
CO3	Develop the strategies to formulate media for growth and product formation.
CO4	Compare the different sterilization techniques involved in various bioprocess operations.
CO5	Examine the metabolic stoichiometry and energetics in microbial processes.

Text Books	
1.	Peter F. Stanbury, Stephen J. Hall & A. Whitaker, “Principles of Fermentation Technology”, 3rd Ed., Elsevier Science, 2016.
2.	Doran, Pauline M. “Bioprocess Engineering Principles”, Elsevier, 2nd Ed., 2012.

Reference Books	
1.	Shuler M L and Kargi F, “ Bioprocess Engineering”, Pearson Education India; 2nd Ed., 2015.
2.	Lydersen B K. “Bioprocess Engineering Systems, Equipment and Facilities” JohnWiley, 1994.
3.	Bailey J E and Ollis D F, “Biochemical Engineering Fundamentals”, 2nd Ed., McGraw Hill, 1986.

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B. TECH.	B23BTT304 – CELL BIOLOGY AND GENETICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basic structure and functions of cell and its organelles.
2.	To provide insights about intercellular interactions.
3.	To understand the specific aspects of the cell cycle and explore different implications of cell cycle regulation.
4.	To know the fundamentals of genetics and sex determination.
5.	To understand the facts of evolutionary genetics.

UNIT - I	CELL STRUCTURE AND FUNCTIONS OF THE ORGANELLES	9

Introduction to cell biology; Comparison of eukaryotic and prokaryotic cells; cellular organelles – structure and functions - disorders related to organelles; biological membrane organization - fluid mosaic model - membrane proteins – functions of membrane proteins; cytoskeletal proteins.

UNIT - II	CELL TRANSPORT AND SIGNAL TRANSDUCTION	9

Cell Transport : Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na^+, K^+, Ca^{2+} pumps, Cotransport: uniport, symport antiporter system. Ligand gated, voltage gated channels, Agonists and Antagonists.

Signal Transduction : Receptors – extracellular signalling, Cell surface and cytosolic receptors with examples; autocrine, paracrine, endocrine models; Secondary messengers – cAMP, cGMP, DAG and IP3; Growth hormones.

UNIT - III	CELL CYCLE AND REGULATION	9

Cell cycle; cell division – types: mitosis and meiosis; cell cycle regulation – cyclins and CDKs – checkpoints – CDK inhibitors; cancer - oncogenes and tumour suppressor genes; apoptosis – MAPK and AKT pathways; Introduction to stem cells.

Cell cycle analysis - Flow cytometry and Microscopic techniques.

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UNIT - IV	MENDELIAN GENETICS AND SEX DETERMINATION	9

Mendel's experiment and principle of segregation, monohybrid crosses dominance and recessiveness; Principle of independent assortment - dihybrid crosses; multiple alleles - ABO blood type, Rh factor alleles, Mendelian problems. Non- Mendelian ratios – Interaction of genes – codominance – incomplete dominance - linkage and crossing over.

Mechanism of sex determination, sex differentiation, sex linked inheritance. – pedigree analysis.

UNIT - V	MUTATION AND EVOLUTIONARY GENETICS	9

Mutations - spontaneous, physical and induced; applications of mutation; organization of DNA in mitochondria and plastids; cytoplasmic male sterility in plants; Genetic variation; random mating and Hardy – Weinberg method; inbreeding, outbreeding and assortative mating; genetic equilibrium, evolutionary genetics.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the different types of cells and the structure and function of intracellular organelles
CO2	Demonstrate the concept of cellular transport and signal transduction to unlock revolutionary advancements in healthcare and biotechnology
CO3	Explain the different channels and signaling pathways involved in cell cycle for unveiling different therapeutic strategies
CO4	Utilize the laws of Mendelian genetics in predicting hereditary disorders.
CO5	Select from the various breeding techniques to improve agricultural practices.

Text Books	
1.	Simmons M J and Snustad DP, "Principles of Genetics", John Wiley, 2012.
2.	Lodish H, Berk A, Zipurursky S L, Matsudaria P, Baltimore D and Darnell J, "Molecular Cell Biology", WH Free Man and Company, 2000.

Reference Books	
1.	Gardner E J and Simmons M J and Snustad D P, "Principles of Genetics", John Wiley, 2006.
2.	Rastogi S C, "Cell Biology, India": New Age International Pub. Ltd., 2001.
3.	Robert H T, Principles of Genetics, Tata McGraw Hill, 2002.
4.	Hardin J, and Bertoni G, "Becker's World of the Cell", 9th Ed. Pearson Education, 2018.

BoS Chairman

B. TECH.	B23BTI301 – MICROBIOLOGY	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To perform different bacterial staining techniques
2.	To classify microbes based on their structure, function and biochemical profile.
3.	To calculate microbial growth and growth requirements
4.	To outline the control measures of microorganisms
5.	To prepare microbial metabolites with industrial applications

UNIT - I	INTRODUCTION TO MICROBIOLOGY	9 + 6

History : History and discoveries, classification, and nomenclature of microorganisms.

Microscopy : Light, fluorescent, dark field, phase contrast and electron microscopy; Microscopic examination of microorganisms morphology and fine structure of bacteria.

Staining : Principles of stains and different staining techniques: Simple, Gram's, Acid fast, negative, capsular, endospore and flagellar staining.

Isolation of microorganisms; Staining of microorganisms : Simple, Gram's, Endospore, Capsule staining, Staining of fungi.

UNIT - II	MICROBIAL DIVERSITY	9 + 3

Taxonomy and classification system – structure and functions of cellular components of bacteria, fungi, algae and viruses

Identification of microbes – morphological and biochemical analysis

Culture methods: Broth, slant, agar deep, pour plate, spread plate and streak plate. Preservation of microorganisms: glycerol stock, lyophilisation and cryopreservation.

UNIT - III	GROWTH AND REPRODUCTION OF MICROORGANISMS	9 + 3

Growth : Factors affecting growth; types of culture media; nutritional types, growth curve - methods of enumeration of microorganisms, preservation techniques.

Reproduction : Reproduction in Bacteria, virus, fungus, actinomycetes and molds. Replication of viruses: Lytic and Lysogenic life cycle –importance of bacteriophages.

Quantification of microbes: Enumeration of total heterotrophic bacteria in soil Microbial growth curve : Bacteria and Yeast

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UNIT - IV	CONTROL OF MICROORGANISMS	9 + 3
Physical and chemical control of microorganisms; principles of sterilization; heat sterilization (moist heat and dry heat), radiation and filtration; disinfection: phenol, alcohol and detergents; chemotherapy and antibiotics, mode of action and resistance to antibiotics. **Effect of disinfectants - Phenol coefficient test; Antibiotic sensitivity assay; Membrane filtration technique.**		

UNIT - V	APPLIED MICROBIOLOGY	9
Bacterial metabolism – Aerobic and anaerobic respiration; fermentation; role of microorganisms in nitrogen, phosphorus and sulfur cycle. Industrial use of microorganisms: pharmaceutical industries (production of penicillin, vitamin B-12); food industries (dairy and brewery), agriculture - biofertilizers, biopesticides; bioremediation, bioleaching.		
Total Theory Instructional hours : 45		
Total Lab Instructional hours : 15		

Course Outcomes : Students will be able to	
CO1	Demonstrate different microbial staining techniques used for visualisation under microscope.
CO2	Identify bacteria based on morphological and biochemical tests.
CO3	Test for the microbial growth and their mode of reproduction and its dependency on nutritional requirements.
CO4	Examine the efficiency of different sterilization methods
CO5	Explain the significance of industrially relevant microbial metabolites.

Text Books	
1.	Willey J M, Sandman K M and Wood D H, Prescott's Microbiology, 12th Ed., Mc Graw Hill Pvt. Ltd., 2022.
2.	Pelczar M J, Chan E C S and Krein N R, Microbiology, 5th Ed., Affiliated East West Press Private Limited New Delhi, 2023.

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Reference Books	
1.	Ray B and Bhuniya A, “Fundamental Food Microbiology”, 5th Ed. CRC Press, USA, 2013.
2.	Lim D, “Microbiology”, 2nd Ed. WCB - McGraw Hill, 2001.
3.	Talaron K, Talaron A, Casita, Pelczar and Reid, “Foundations in Microbiology”, W.C. Brown Publishers, 2005.

BoS Chairman

B. TECH.	B23BTP301 – CHEMICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To understand the principle and calibrate the types of flow meters.
2.	To develop a sound knowledge on different types of pumps.
3.	To understand the working principles of various heat transfer equipment.
4.	To understand the basic principle of distillation equipment.
5.	To study the filtration characteristics of plate and frame filter press and leaf filter.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Measuring the fluid flow through a pipe using constant area flow meter – Venturimeter.
2.	Measuring the fluid flow through a pipe using constant area flow meter – Orificemeter.
3.	Measuring the fluid flow through a pipe using variable area flow meter – Rotameter.
4.	Determination of velocity and friction factor in flow through straight pipe.
5.	Characteristic curves of centrifugal pump.
6.	Characteristic curves of reciprocating pump.
7.	Determination of heat transfer coefficient in a parallel flow double pipe heat exchanger.
8.	Determination of heat transfer coefficient in a counter flow double pipe heat exchanger.
9.	Determination of heat transfer coefficient in a shell and tube heat exchanger.
10.	Verification of Rayleigh's equation by simple distillation.
11.	Batch filtration studies using a Leaf filter.
12.	Batch filtration studies using a Plate and Frame Filter press.
	Total Instructional hours : 30

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Course Outcomes : Students will be able	
CO1	Estimate the coefficient of discharge in flow meters and energy losses in straight pipe.
CO2	Test for the efficiency of various pumps.
CO3	Examine the heat transfer co-efficient in heat exchangers.
CO4	Determine the composition of binary mixture using simple distillation.
CO5	Classify the filtration characteristic in various filtration equipment.

Reference Books	
1.	McCabe W L, Smith J C and Harriott P. "Unit Operations in Chemical Engineering", 7th Ed., McGraw Hill, 2014.
2.	Bird R B, Stewart W E and Lightfoot E N, "Transport Phenomena", 2nd Ed., Wiley, 2006
3.	Coulson J M , Richardson J F, and Sinnott R K "Chemical engineering design", 6th Ed., Elsevier, 2019.
4.	Green D and Perry R, "Perry's Chemical Engineers' Handbook", 8th Ed., 2007.

Semester - IV

B. TECH.	B23BTT401 – CHEMICAL REACTION ENGINEERING	L	T	P	C
		3	1	0	4

Course Objectives : The aim of this course is to	
1.	To utilize the concepts of reaction kinetics in chemical reactions.
2.	To construct the performance equation for ideal reactors.
3.	To demonstrate the flow behaviour and conversion of non-ideal reactors.
4.	To examine the reaction mechanism and kinetics of heterogeneous reactions.
5.	To analyse the various industrial reactors for gas-liquid reactions.

UNIT - I	REACTION KINETICS	9 + 3

Classifications of chemical reactions, Factors affecting rate of reactions. Order and molecularity, Rate equation, Effect of concentration and temperature on rate constant, theories of reaction rate - Arrhenius theory and Collision theory.

UNIT - II	IDEAL REACTORS	9 + 3

Classification of reactors, Performance equations: batch, plug flow and mixed flow reactors; Space time and Space velocity; Size comparison of single reactors, Multiple reactor systems- Equal sized CSTRs in series and parallel, Equal sized PFRs in series and parallel, Recycle reactor.

UNIT - III	NON- IDEAL REACTORS	9 + 3

Non-ideality in reactors, reasons for non-ideal flow, RTD: RTD function and measurement, RTD in plug flow and mixed flow reactor, Conversion in non-ideal flow, relation among E,F and C curve, non ideal flow models: tank-in-series and dispersion models.

UNIT - IV	HETEROGENEOUS REACTING SYSTEM	9 + 3

Rate equation for heterogeneous reactions, Ideal contacting patterns, Solid catalysed reactions-mechanism. Catalyst deactivation-types and mechanism, surface kinetics and pore resistance.

UNIT - V	INDUSTRIAL REACTORS FOR G/L REACTIONS	9 + 3

Reactors to carry out G/L reactions on solid catalysts-slurry, trickle bed, fluidized bed, contacting patterns in the fixed bed and fluidized bed catalytic reactors.

Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Summarize the concepts of reaction mechanism and kinetics in chemical reactions
CO2	Interpret the performance equations to predict the conversion in ideal reactors.
CO3	Utilize the residence time distribution studies to study the non-ideal reactors.
CO4	Develop the kinetics of heterogeneous reacting system involving solid catalyst.
CO5	Select the industrial reactors to carry out gas-liquid reaction on solid catalyst.

Text Books	
1.	Levenspiel O, “Chemical Reaction Engineering”, 3rd Ed., Wiley, 2006.
2.	Fogler H S, “Elements of Chemical Reaction Engineering”, 5th Ed., Pearson, 2016.

Reference Books	
1.	Nauman E B, “Chemical Reactor Design, Optimization, and Scaleup”, 2nd Ed., John Wiley & Sons, 2008.
2.	Missen R W, Mims C A and Saville B A, “Introduction to Chemical Reaction Engineering and Kinetics”, John Wiley 1999.
3.	Dawande S D, “Principles of Reaction Engineering”, 1st Ed., Central Techno Publications, 2001.
4.	Smith J M, “Chemical Engineering Kinetics”, 3rd Ed., McGraw Hill, 1981.

BoS Chairman

B. TECH.	B23BTT402 – ENZYMOLOGY AND ENZYME TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To develop an understanding of the nature and mechanism of enzymes
2.	To investigate the kinetics of enzyme catalyzed reactions
3.	Make students to know extraction and purification of enzymes
4.	Give some examples of applications of enzymes in a range of fields.

UNIT - I	PRINCIPLES OF ENZYMOLOGY	9

Chemistry of enzymes, Classification of enzymes, Monomeric and Oligomeric enzymes, Mechanisms of enzyme action, Concept of active site, Energetics of enzyme substrate complex formation, specificity of enzyme action, principles of catalysis – collision theory, transition state theory, role of entropy in catalysis.

UNIT - II	BIOTRANSFORMATION APPLICATIONS OF ENZYMES	9

Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions – aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis – esters, amide, peptide, Modified and Artificial Enzymes , Catalytic antibodies.

UNIT - III	KINETICS OF ENZYME ACTION	9

Kinetics of single substrate reactions - estimation of Michaelis – Menten parameters, turnover number; kinetics of multi substrate enzyme catalysed reactions; Investigation of the kinetics of enzyme catalysed reactions, Cooperativity; Koshland, Némethy, Filmer and Monod Changeux Wyman models, Allosteric regulation of enzymes.

UNIT - IV	ENZYME INHIBITION AND IMMOBILIZATION	9

Types of inhibitions and models- competitive, non-competitive, uncompetitive, mixed, partial, substrate; pH and temperature effect on enzymes; Immobilization- types, merits and demerits, applications; enzyme reactors.

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UNIT - V	ENZYME EXTRACTION, PURIFICATION AND APPLICATIONS	9
Identification, extraction and purification of enzymes from plant, animal and microbial sources; applications of enzymes in industrial, healthcare and environmental sectors.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic chemistry of enzymes and the various theories pertaining to catalysis.
CO2	Demonstrate the role of enzymes in biological reactions.
CO3	Develop kinetic models to determine the rate equations for different enzymes.
CO4	Identify the type of enzyme inhibition.
CO5	Select suitable enzyme purification methods for various sources.

Text Books	
1.	Palmer T, “Enzymes: Biochemistry, Biotechnology and Clinical Chemistry”, Affiliated East-West Press Pvt. Ltd, New Delhi, 2008.
2.	Dugas, Hermann “Bioorganic Chemistry: A Chemical Approach to Enzyme Action”, 3rd Ed., Springer, 2003.

References Books	
1.	Faber K., “Biotransformations in Organic Chemistry”, 4th Ed., Springer, 2000.
2.	Lee J M, “Biochemical Engineering”, PHI, USA, 1992.
3.	Bailey J E and Ollis D F, “Biochemical Engineering Fundamentals”, McGraw Hill, 1986.
4.	Blanch H W and Clark S D, “Biochemical Engineering”, Marcel Dekker Inc., 1997.

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B. TECH.	B23BTT403 – MOLECULAR BIOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To provide comprehensive background of salient features of nucleic acids and DNA models.
2.	To impart detailed understanding of key events of DNA replication and repair.
3.	To provide adequate knowledge about Transcription process in prokaryotes and eukaryotes and post transcriptional modifications.
4.	To develop comprehensive understanding regarding the genetic codes and translational process in prokaryotes and eukaryotes and post translational modifications.
5.	To give detailed explanation of transcriptional regulation in prokaryotic as well as eukaryotic organisms.

UNIT - I	NUCLEIC ACIDS AND THEIR ORGANIZATION	9

Historical developments of molecular biology; Evidence of nucleic acids as genetic material – Griffith, Hershey and Chase, Avery McLeod & McCarty experiments; Chemistry and Nomenclature of nucleic acids; Structure of DNA: primary structure; secondary structure, Forms of DNA: A, B, Z and their function; Genome organization in prokaryotes and eukaryotes; Structure and Types of RNA.

UNIT - II	DNA REPLICATION AND REPAIR	9

Central dogma of Molecular Biology; DNA replication- Models of DNA replication; Prokaryotic and Eukaryotic DNA replication- Origin and steps - initiation, elongation and termination; Enzymes, accessory proteins and their mechanisms; DNA replication errors and their repair.

UNIT - III	TRASCRIPTION	9

Structure of mRNA, promoter, RNA polymerases, transcription factors and terminators; Process of transcription in prokaryotes and eukaryotes: Initiation, Elongation & Termination of transcription (Rho dependent and independent); Post transcriptional processing of RNA- capping, splicing, polyadenylation and RNA editing; mRNA stability; Inhibitors of transcription.

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UNIT - IV	TRANSLATION	9
Components of translational machinery in prokaryotes and eukaryotes: structure and function of ORF, tRNA, rRNA, aminoacyl synthetases, Ribosomes, Ribosome binding sites; Process of Translation in prokaryote and eukaryote: Initiation, Elongation & Termination. Concept of genetic code and Wobble hypothesis. Post translational modifications of protein, Protein folding, Protein targeting and degradation; Inhibitors of translation.		

UNIT - V	REGULATION OF GENE EXPRESSION	9
Principle of gene regulation: negative and positive regulation; inducer, repressor, co- repressor, activators, co-activators, silencers, insulators, enhancers; Gene regulation in prokaryote: concept of operon model, (lac, trp and ara operon); Regulation of gene expression with reference to lambda phage life cycle; Gene regulation in eukaryotes: DNA looping model, hormonal control of gene expression (steroid and non-steroid), regulations at level of translation.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the physical and chemical nature of DNA and RNA.
CO2	Summarize DNA replication in prokaryotes and eukaryotes.
CO3	Demonstrate the transcription mechanism.
CO4	Identify the genetic codes and utilize the translation machinery.
CO5	Classify regulation of gene expression with suitable examples.

Text Books	
1.	Friefelder D, “Molecular Biology”, 2nd Ed., Narosa Publishing House, New Delhi, 2009.
2.	Watson J, Baker T, Bell S, Gann A, Levine M and Losick R, “Molecular Biology of the Gene”, Pearson Education, Inc., 2008.

Reference Books	
1.	Friefelder D and Malacinski M G. “Essentials of Molecular Biology” 2nd Ed., Panima Publishing, 1993.
2.	Tropp B E, “Molecular Biology: Genes to Proteins”. 3rd Ed., Jones and Bartlett, 2008.

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B. TECH.	B19BTT404 – INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the basics and fundamentals of Industrial bioprocess.
2.	To acquire knowledge on various bioproducts produced by the microorganisms.
3.	To know different microbial fermented foods.
4.	To know the importance of rDNA technology through fermentation.
5.	To formulate the bulk production of agriculture based bioproducts.

UNIT - I	BASICS OF INDUSTRIAL BIOTECHNOLOGY	9

Introduction – Scope and importance of Industrial Biotechnology; Basics of upstream and downstream processing in bioprocess; Strategies of industrial fermentation technology; Industrial media and nutrition. Process flow sheeting – block diagrams, pictorial representation.

UNIT - II	MICROBIAL METABOLITES	9

Microbial metabolites: Introduction, types: Primary and Secondary metabolites; Major products of industrial Biotechnology: Organic acids (citric acid, acetic acid), Amino acids (glutamic acid, lysine), Alcohol (ethanol, acetone), Antibiotics (penicillin, streptomycin), Vitamins (Vitamin B2).

UNIT - III	INDUSTRIAL BIOPRODUCTS	9

Production of industrial enzymes (amylases, proteases and lipases); Biopreservatives (bacteriocins, Nisin); Fermented Foods- classic (wine, bread, vinegar), new fermented food (non-dairy yogurt, fermented vegetables); Production of dairy products: (yogurt, kumis and cheese); Technique of mass culture of algae (SCP); Bioplastics- bio-PET.

UNIT - IV	RECOMBINANT PRODUCTS	9

Recombinant products using microbial, animal and plant cell culture platforms - Production of recombinant proteins (insulin, human growth hormone), Vaccines and recombinant vaccines, Monoclonal antibodies-production and advantages, transgenic animals, plant molecular farming.

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UNIT - V	AGRO-INDUSTRIAL BIOTECHNOLOGY	9
Biofertilizers in agro ecosystem; Biopesticides – advantages and its applications. Composting – Vermicomposting and its methods; Bioremediation and bioleaching - introduction, scope and applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the scope of Biotechnology and tell the basics of Industrial bioprocess and to develop a bio product with flowsheet.
CO2	Explain about the steps and operation involved in various metabolites production.
CO3	Outline the industrially important microbial strains for the production of biopolymers, enzymes and food products.
CO4	Make use of rDNA technology in the production of recombinant bioproducts.
CO5	Develop biotechnology techniques for the production of ecofriendly agricultural bioproducts.

Text Books	
1.	Lee S Y, Nielsen J. and Stephanopoulos G., “Industrial Biotechnology: Products and Processes”, John Wiley & Sons, 2016.
2.	Waites M J., Morgan N L., Rockey J S, Higton G, “Industrial Microbiology: An Introduction” Blackwell, 2001.
3.	Cruger W, Cruger A, “A Textbook of Industrial Microbiology”, Panima Publishing Corporation, 2nd Edition, 2005.
4.	Okafor N, “Modern Industrial Microbiology and Biotechnology”, CRC Press, 2007.

Reference Books	
1.	Casida L E. “Industrial Microbiology”, New Age International Pvt. Ltd, 1968.
2.	Pandey A, Negi S, Soccol C R, “Current Developments in Biotechnology and Bioengineering: Production, isolation and purification of industrial products”, Elsevier, 2016.
3.	Presscott and Dunn’s, “Industrial Microbiology”, CBS Publisher, 1987.
4.	Saikai R, “Microbial Biotechnology”, New India Publishing, 2008.
5.	Frazier W C, Westhoff D C and Vanitha N M, “Food Microbiology”, 5th Ed, McGraw Hill, 2017.

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B.TECH.	B23BTI401 – ANALYTICAL METHODS IN BIOTECHNOLOGY	L	T	P	C
		3	0	2	4

Course Objectives	
1.	To familiarize with the concepts of measurement, precision and errors.
2.	To impart understanding of various spectroscopy techniques in sample analysis.
3.	To understand and characterize biological samples at atomic, molecular and structural levels.
4.	To provide an insight about separation of biomolecules based on its physical and chemical characteristics.
5.	To understand and apply thermal and electro-analytical techniques for sample characterization.

UNIT - I	PRINCIPLES OF ANALYTICAL METHOD VALIDATION	9 + 3

Concepts of precision, accuracy, reproducibility, Repeatability, specificity, detection limit, quantitation limit and linearity range; method development, positive and negative controls; noise – sources, signal to noise ratio, improving signal to noise ratio; measurement errors – types; methods of quantification; instrument sensitivity; calibration approaches.

Estimate precision and validity in an experiment; Estimate limits of detection using aluminium alizarin complex.

UNIT - II	MOLECULAR SPECTROSCOPY	9 + 9

Measurement of transmittance and absorbance; Beer-Lambert's law – derivation and deviations from the law; spectroscopy - spectrophotometers – qualitative and quantitative absorption measurements – types of spectrophotometers – UV-visible, IR, FTIR, Raman spectroscopy – principle, instrumentation and applications.

Validation of Beer-Lambert's law; Estimation of nucleic acids and proteins; Chemical actinometry using potassium ferrioxalate; Finding the molar absorptivity and stoichiometry of the Fe^{3+}-1,10 phenanthroline using absorption spectrometry; Finding the pKa of 4-nitrophenol using absorption spectroscopy.

UNIT - III	STRUCTURAL ELUCIDATION AND RADIOISOTOPE METHODS	9

Mass spectrometry: MALDI-TOF– principle and instrumentation; Electron spray ionization [ESI] and chemical ionization [CI] – principle, instrumentation and applications; X-ray diffraction and nuclear magnetic resonance (NMR): principle, instrumentation and applications.

Radioactivity – principles, radioactive isotopes and labelling, types of radioactive decay; scintillation counters – principle, instrumentation and applications.

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UNIT - IV	CHROMATOGRAPHY AND ELECTROPHORESIS	9 + 3
Chromatography - principles, van Deemter equation, elution methods; column chromatography - Gel filtration, Ion exchange and affinity chromatography; HPLC, GC. Electrophoresis – principles, agarose gel, 2D-gel electrophoresis, Native/SDS-PAGE; enzyme zymography; capillary electrophoresis; isoelectric focusing; isotachophoresis. **Chromatography analysis using TLC; Chromatography analysis using column chromatography.**		

UNIT - V	THERMAL METHODS AND ELECTRO-ANALYTICAL TECHNIQUES	9
Thermal methods - principle, instrumentation and applications - thermo-gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC). Electroanalytical methods - electrochemical cells - electrodes, reference electrodes, ion selective electrodes and pH meter; potentiometry; voltammetry; colorimetry and amperometry – theory, instrumentation and applications; sensors- oxygen sensors, glucose sensors.		
		Total Theory Instructional hours : 45
		Total Lab Instructional hours : 15

Course Outcomes : Students will be able to	
CO1	Summarize the concepts of accuracy and reproducibility while measuring various parameters
CO2	Extend the spectroscopy techniques in estimating, processing, visualizing and interpreting different samples
CO3	Identify the analyte structure using spectrometry techniques and radioisotope methods.
CO4	Utilize chromatography and electrophoresis for separation process.
CO5	Make use of thermal and electro-analytical methods for predicting the characteristics of an analyte

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Text Books	
1.	Skoog D A, Holler F J and Crouch S R, “Instrumental Methods of Analysis”, 6th Ed., Cengage Learning, 2016.
2.	Wilson K and Walker J, “Principle and Techniques of Practical Biochemistry", 5th Ed., Cambridge University Press, Oxford, 2002.
3.	Chatwal G R and Anand S K, “Instrumental Methods of Chemical Analysis”, 5th Ed., Himalaya Publishing House, India, 2012.

Reference Books	
1.	Sharma B K, “Instrumental Methods of Chemical Analysis”, 24th Ed., Goel Publishing House, India, 2014.
2.	Heftman E. “Chromatography”, 6th Ed., Elsevier, Netherlands, 2004.

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B. TECH.	B23BTP401 – CELL AND MOLECULAR BIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To demonstrate various techniques to learn the morphology and identification of cells.
2.	To provide hands-on experience in performing basic molecular biology techniques.
3.	To understand phenotypic characterization of cells.
4.	To demonstrate protein and nucleic acid separation using electrophoresis.
5.	To analyze DNA from various samples.

Expt. No.	List of Experiments
1.	Introduction to microscopes – principle and working of different microscopes
2.	Identification of given plant, animal and bacterial cells & their components by microscopy
3.	Staining for different stages of mitosis in Allium cepa (Onion)
4.	Enumeration of microbes from soil/water
5.	Biochemical characterization of bacteria
6.	Cell viability assay – Trypan blue
7.	Electrophoresis - Agarose and Polyacrylamide Gel
8.	Extraction of genomic DNA from microbial source (bacteria)
9.	Extraction of genomic DNA from plant source
10.	Extraction of genomic DNA from animal sample
11.	Qualitative and quantitative analysis of DNA using UV-spectrophotometer
12.	Extraction of plasmid DNA
13.	Amplification and sequencing of DNA
	Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Illustrate the cells and their components using microscope.
CO2	Interpret the total microbial count in the given sample.
CO3	Classify bacterial strains based on phenotypic characteristics.
CO4	Evaluate nucleic acids and proteins using molecular biology techniques.
CO5	Identify the genotypic characteristics of organisms using extracted DNA.

Reference Books	
1.	Rickwood D and Harris J R, “Cell Biology: Essential Techniques”, John Wiley, 1996.
2.	Cappuccino J G and Sherman N, “Microbiology: A Laboratory Manual”, 4th Ed., Addison- Wesley, 1999.
3.	Sambrook J and Russell D W, “The Condensed Protocols: From Molecular Cloning : A Laboratory Manual”, Cold Spring Harbor, 2006.

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