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 - 2019

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

I to VIII Semester

Bachelor of Technology in Biotechnology

Department of Biotechnology

Vision and Mission of the Department

Vision

◎	To achieve the highest caliber in Biotechnology Teaching, Research and Training and to develop intellectual leaders for the betterment of the society and modern technological needs for the Biotechnology industries.

Mission

◎	To provide high quality education to students through advanced skill based learning and molding them technologically sound and globally competent biotechnologists.
◎	To establish the state of art laboratories in industrial microbiology, genetic engineering, bioprocessing, and bioenergy with the development of affordable technologies with industrial collaboration.
◎	To impart problem solving abilities in research and entrepreneurship through various training programmes and demonstrations on various latest techniques in Biotechnology.

Program Educational Objectives (PEO's)

PEO 1	Graduates will be a successful biotechnologist in an industry, a skilled researcher and a globally competitive entrepreneur.
PEO 2	Graduates will be critically intense to solve life science related problems
PEO 3	Graduates will have commitment and lifelong learning in their professional carrier.

Programme Outcomes (PO's)

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.
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 modeling 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.
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 diverseteams, 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. programme in Biotechnology, Graduates will be able to	
PSO 1	Students will use their knowledge in biological sciences and use analytical techniques to solve emerging problems in the field of industrial Biotechnology.
PSO 2	Students will be able to design and develop socio-economic projects for the development of all life forms.

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 change/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 programs at this Institute from Academic year 2019-2020 and onwards.

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 programmes 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. programmes offered at the institute, at present;

b. They shall also be applicable to all the new B.E / B. TECH. programmes which may be started at the Institute 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 these Regulations, unless the context otherwise requires :

Sl. No.	Name	Definition
1.	**Programme**	Refers to Degree Programme that is B.E. / B. TECH. Degree Programme.
2.	**Discipline**	Refers to branch or specialization of B.E./B. TECH. Degree Programme, 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.	**Head of the Institution**	Refers to the Principal of the College.
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.	**College (KIT)**	Refers to KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore.
9.	**Curriculum**	Refers to the various components/courses studied in each programme that provide appropriate outcomes (knowledge, skill and behavior/attitude) in the chosen branch of study.
10.	**T- P - TU - C**	Refers to Theory, Practical, Tutorial, and Credits respectively.
11.	**Humanities and Social Sciences (HS)**	Courses include English, Professional Ethics and Human Values, Communication skills etc.
12.	**Basic Sciences (BS)**	Courses include Mathematics, Physics, Chemistry, etc.,
13.	**Engineering Sciences (ES)**	Courses include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Civil / Computer Engineering etc.,
14.	**Professional Core (PC)**	Courses include the core courses relevant to the chosen specialization / branch.
15.	**Professional Elective (PE)**	Courses include the elective courses relevant to the chosen specialization / programme.
16.	**Open Elective**	Open Elective (OE) courses include the courses which a student can choose from the curriculum of other B.E. / B. Tech. programmes and courses offered by the Departments under the Faculty of Science and Humanities & Department of Management. These courses may be offered by internal/external experts.
17.	**Project Work (PW)**	Refers to the project done by a student or a group of students during final year.
18.	**Career Enhancement Courses (CEC)**	Includes Mini Project Work and/or Internship, Seminar, Professional Practices, Case Study, soft skills and Industrial/Practical Trainings etc.,
19.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned(For details refer **Annexure V**)
20.	**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 **Annexure V**)

4. ADMISSION

4.1 B.E. / B. TECH. Degree Programme (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

i. The candidates who possess 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. in the branch corresponding to the branch of study.

(OR)

ii. 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 Tamilnadu and Anna University. Department Evaluation Committee (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 Academic Evaluation Committee (AEC) for approval and the committee's decision shall be final.

5. PROGRAMMES OFFERED

B.E. / B. TECH. Programmes under the Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Information and Communication Engineering and Faculty of Technology. KIT offers 4 year (8 Semesters) B.E./B. TECH. Degree programme affiliated to Anna University, under Choice Based Credit System (CBCS) for students admitted from 2019 onwards in the following branches of Engineering and Technology as in Table 1.

Table 1. List of B.E. / B. TECH. programmes offered

B.E.	B.Tech.
Aeronautical Engineering	Bio Technology
Agriculture Engineering	
Bio Medical Engineering	
Computer Science and Engineering	
Electronics and Communication Engineering	
Electrical and Electronics Engineering	
Mechanical Engineering	

6. ACADEMIC STRUCTURE OF PROGRAMMES

6.1 Medium of Instruction

The medium of instruction for the entire undergraduate programme will be English.

6.2 Categorization of Courses

Every B.E. / B. Tech. Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

The typical curriculum structure for UG degree programmes are based on AICTE and Anna University and is given in Table 2.

Table 2 : Curriculum Structure

Humanities and Social Sciences including Management Courses (HS)	Basic Sciences (BS)	Basic Engineering Sciences (ES)
Professional Core (PC)	**Professional Elective (PE)**	**Open Elective (OE)**
Project Work(PW)		
Career Enhancement Courses(CEC)		
Mandatory Course (MC)		

The course outcomes (CO's) are designed to align with the Programme Outcomes (PO's) and Programme Educational Objectives (PEO's) of the respective programmes.

In addition to the courses listed in the curriculum, the department can include elective courses offered by reputed Industry / Educational Institutions /Experts from time to time, approved by DEC / AEC and ratified by the Academic Council.

The credits earned through such courses shall be considered equivalent to Professional Elective (PE) credits or Open Elective (OE) credits as decided by the Department evaluation Committee (DEC) on a course to course basis.

Experts from the Industry / Institution may design such specialized elective courses based on the current technical skill requirements. The Department evaluation Committee (DEC) shall review and approve the course offered by the expert from the industry / Institution.

In addition to the courses that carry credits, all students are required to complete mandatory non-credit courses, if offered (eg.,Value education courses, and others).Credits will not be awarded but will be assessed and graded, and must be completed.

The following is the credit distribution of KIT based on the suggested AICTE distribution. (Table 3)

Table 3 : Credit Distribution

Category	Credit range
A - Foundation Courses	
Humanities and Social Sciences including Management Courses (HS)	6-9
Basic Sciences Courses (BS)	17-26
Basic Engineering Sciences (ES)	10-29
B - Professional Core Courses	
Professional Core Courses (PC)	62-87
C - Elective Courses	
Professional Electives (PE)	15-18
Open Electives (OE)	6-12
D - Project Work	
Project Work (PW)	11-13
E - Mandatory Courses Prescribed by AICTE/UGC	
Mandatory Courses (Induction Program, Environmental Sciences, Indian Constitution)	-
F - Career Enhancement Courses(CEC)	8
Total Credits	**165 - 174**

6.3 Number of courses per semester

Each semester curriculum shall normally have a blend of lecture courses not exceeding 8 and Laboratory courses and Career Enhancement Courses (CEC) not exceeding 7. However, the total number of courses per semester shall not exceed 15. The students can register for Professional Elective/Open Elective courses in any semester, starting from the third semester.

6.4 Credit Assigned

Each course offered is given a T-P-TU-C structure, depending on the number of lecture periods (T), number of periods for practical (P) and number of tutorial periods (TU) required per week 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 T-P-TU-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 4 : Credit Assigned

Contact period per week	Credits
1 Lecture Period (**T** = Lectures given during class by the faculty)	1
1 Tutorial Periods (**TU** = Tutorial, also class based with more emphasis on problem solving)	1
2 Practical Period (**P**) (Laboratory Periods / CEC / Projects)	1

6.5 Career Enhancement Courses

6.5.1 Personality and Character Development

All students shall enroll, on admission, in any one of the personality and character development programmes (NCC / NSS / YRC) and undergo training and attends camp as prescribe by the respective officers/ coordinators. The training shall include classes on hygiene and health awareness and also training in first-aid.

National Cadet Corps (NCC) will have number of parades/camps specified by the NCC officer.

National Service Scheme (NSS) will have social service activities in and around the College / Institution.

Youth Red Cross (YRC) will have activities related to social services in and around College/Institutions. While the training activities will normally be during weekends, the camp will normally be during vacation period.

6.5.2 Industrial Training / Internship

Students shall 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). Industrial training may also be referred to as “In-plant training”.

The Industrial Training / Internship shall carry 100 marks and shall be evaluated through CIA only. The credit will be awarded to the student after the submission

of Internship/Training report to the HoD. The report will be evaluated by a team of (DEC) faculty members nominated by the HoD for awarding the Credit. Based on the recommendation by the team, the student will be awarded credits and the results will be sent to the Controller of Examinations. The awarded credit will taken for CGPA calculation. The final year project period at industry/research organization will not be considered as industrial Training/internship.

6.5.3 Industrial Visit

Every student is required to go for at least one Industrial Visit every year starting from the second year of the Programme 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.

6.5.4 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 is 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 cancelled. 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.

6.5.5 Online Courses

Students may be permitted to register for online courses (which are provided with certificate after evaluation of the performance, SWAYAM/NPTEL), during third to sixth semester of his/her study. On successful completion of the course, he/she has to submit the copy of the certificates to the Head of the Department. The assessment will not be calculated for CGPA.

6.5.6 Soft Skills

Every Student is required to go for two soft skill courses during first year of study. The soft skill course includes the communication skill, interpersonal skill and career development courses. One credit will be awarded for each soft skills courses and it will be included for SGPA/CGPA calculations.

6.5.7 Career Ability Course

The career Ability courses will be designed by the respective department with approval from DEC/AEC based on the industry requirements. One credit will be awarded for each soft skills courses and it will be included for SGPA/CGPA calculations.

6.5.8 Evaluation of One Credit Courses

Students can register for one credit courses in any semester when it is offered. Experts from the industry/Institution (KIT) may design such specialized one-credit courses based on the current technical skill requirements. The Department Evaluation Committee (DEC) shall review and approve the syllabus, course plan, and pedagogy and assessment pattern for the course. One credit courses can also be offered by internal experts i.e faculty members from other departments (not belonging to the specific discipline of the programme) also can offer such courses to the students with the approval of DEC.

A one - credit course shall carry 100 marks and shall be evaluated through Continuous Internal Assessment (CIA) only. The QP pattern and scheme will be decided by the course faculty and will be approved by the DEC/AEC.

The Head of the Department may identify a faculty member as the coordinator for the course. A committee consisting of the Head of the Department, faculty handling the course (if available), coordinator and a senior Faculty member nominated by the Head of the Department shall monitor the evaluation process.

The grades shall be assigned to the students by the above committee based on their performance and included in the calculation of CGPA.

6.5.9 Industry Supported Project Work

The students satisfying the following conditions shall be permitted to carry out their final semester Project work for six months in industry/research organization.

The student should not have current arrears and shall have CGPA of 8.0 and above until 5th semester. The student shall undergo the eighth semester courses in the sixth and seventh semesters. The Head of Department, in consultation with the faculty handling the said courses shall forward the proposal recommended by the Principal to CoE after approval from AEC at least four weeks before the commencement of the sixth semester of the programme.

6.6 Course Numbering Scheme

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

6.7 Credit Requirement for Programmes

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. programme, a regular student must earn 165-174 credits (varies with the programme) in minimum of eight semesters, while a lateral-entry student must earn 122-131 credits in a minimum of six semesters.

7 DURATION OF THE PROGRAMMES

7.1 The duration for the B.E./B. TECH. degree programmes shall extend over a period of 4 years (8 semesters) for the students admitted in the first semester but in any case not more than 7

years (14 semesters) and 3 years (6 semesters) for the students admitted in third semester (Lateral Entry Scheme) and not more than 6 years (12 semesters).

7.2 Each semester normally consists of 90 working days, including test and examination days. In any contingent situation, the number of working days per semester shall not be less than 65 days. The Principal is given the discretionary powers to decide the number of working days. In such contingencies, the Principal shall ensure that every faculty member teaches the full content of the specified syllabus for the course being taught.

7.2.1 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.

7.3 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 7.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree.

7.4 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 mentor who shall advice and counsel the student about the details of the academic programme and choice of courses, considering the student's academic background and career objectives. Some courses require students to register through a course registration process via online.

8.1 Course Registration

Each student on admission shall register for all the courses prescribed in the curriculum in the students first semester of the study.

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 number of 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.

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.

8.2 Credits details for Course Registration

A student has to earn the total credits specified in the curriculum of the respective programme 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 programme within the specified duration of the programme. 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.

8.3 Flexibility to Add / Drop courses

A student can add or drop the courses registered within the first 5 instructional days, from the commencement of a regular semester, subject to the availability of resources and the minimum/maximum number of credits required to be registered in a semester vide clause 8.2.

From semester 3 to 8, the student has the options for Adding/dropping an existing course. The total number of credits that a student can add/drop is limited to 6. Practical courses cannot be added / dropped.

8.4 Reappearance Registration

8.4.1 If a student fails in a theory or practical course, the student shall do reappearance registration for that course in the subsequent semester by retaining the Continuous Assessment Marks already earned.

8.4.2 If the theory course, in which the student has failed, is a Professional Elective or an Open Elective, 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 DEC.

8.4.3 The student who fails in Project work / Seminar other than Practical courses shall register for the same in the subsequent semester and reappear for the End Semester Examination.

8.4.4 If a student is not eligible to appear for End Semester Examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements. If the course, in which the student has lack of attendance, is an elective, the student may register for the same or any other elective in the subsequent semesters.

8.4.5 If a student has completed the 8 semesters and has obtained RA grade in one or more courses, he can register and appear for arrear examination directly whenever conducted next.

8.4.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear the same course for improvement of Grade/ Marks.

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 5: Mandatory Attendance Requirement for CIA-1, CIA-2, CIA-3 and ESE.

Test / Examination Type	Period of Calculation	Minimum % of attendance required
Continuous Internal Assessment Test I (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%
Continuous Internal Assessment Test II (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)
Continuous Internal Assessment Test III (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)
End Semester Examination (ESE)	From the date of joining (1st semester) / date of commencement of class (2nd to 8th Semester) to the last day of instruction.	75%

9.1.1 Students having a CGPA of 8.50 and above and with no standing arrears will be exempted from the minimum attendance requirements (from 7th Sem. onwards).

9.1.2 A student shall normally be permitted to appear for End Semester Examination of the course if he / she has satisfied the attendance requirements (vide Clause -9.1). He /she is eligible to register for ESE in that semester by paying the prescribed fee.

9.1.3 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%.

9.1.4 However, a candidate who secures overall attendance between 65% and 74% 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 examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate attested by the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.

9.1.5 Candidates who secure less than 65% overall attendance and candidates who do not satisfy the clause 9.1.3 and 9.1.4 shall not be permitted to write the semester examination at the end of the semester 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.

9.1.6 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 Programme 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.

9.1.7 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 End Semester Examinations. 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.

9.1.8 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. PROVISION FOR WITHDRAWAL FROM EXAMINATION

A student may, for valid reasons (medically unfit / unexpected family situations/Sports person representing Tamilnadu / India with prior permission for participation from Principal / CoE / DEC), be granted permission to withdraw (after registering for the examinations) from appearing for any course or courses in the End Semester Examination of a particular semester. The student may withdraw by following the due process of the CoE's office before the commencement of examination. This facility can be availed only once during the entire duration of the degree programme.

Withdrawal from ESE will be valid only if the student is, otherwise, eligible to write the examination and the application for withdrawal is made to the CoE, prior to the examination in the course or courses concerned. The application for withdrawal should be recommended by the Head of the Department concerned and approved by the Head of the Institution.

11. TEMPORARY BREAK OF STUDY FROM A PROGRAMME

11.1 Break of study is normally not permitted. However, if a student intends to temporarily discontinue the programme 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 programme in the next academic year, he / she shall apply in advance to the Principal through the Head of the Department, stating the reasons. The application shall be submitted not later than the last date for registering for the semester examinations. Break of study is permitted only once during the entire period of the degree programme.

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

11.3 The duration specified for passing all the courses for the purpose of classification of degree(vide clause 19) shall be increased by the period of such break of study permitted (vide clause 11)

11.4 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 11.3 is not applicable for such cases.

12. ASSESSMENT PROCEDURES FOR AWARDING MARKS

The total marks for each course generally (Theory, Practical, Project Work) will be 100, comprising of two components namely Continuous Internal Assessment (CIA) and End Semester Examination (ESE). However, there could be some open elective courses, human excellence courses, one credit industry courses, add-on courses and Mandatory courses that have only continuous assessment for 100 marks without an End Semester Examination. The Department Consultative Committee (DCC) has to approve such courses every semester. The scheme of assessment may also be decided by the faculty handling the course concerned with the approval from DCC and shall be made available to the students during the online course registration. Each course shall be evaluated for a maximum of 100 marks as illustrated in **Table - 6.**

Table - 6 : Course Evaluation

S. No.	Category of course	Continuous Internal Assessment	Semester End Examinations
1.	Theory Courses	40 Marks	60 Marks
2.	Laboratory Courses		
3.	Project Work		
4.	Career Enhancement Course (CEC) and Mandatory Course (MC)	100 Marks	-

The End Semester Examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.

The End Semester Examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

For the End Semester Examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations.

13. MARKS DISTRIBUTION

13.1 Attendance Mark

Marks are awarded for the attendance earned by the students for individual courses as per the following table.

Attendance Range in %	Marks to be earned by the students
96 - 100	5
91 - 95	4
86 - 90	3
81 - 85	2
75 - 80	1

13.2 Question paper pattern

a. Table 7.1 Continuous Internal Assessment (CIA - I CIA - II and CIA - III)

2 Marks	12 Marks	Total marks
7	3 (Either or Type)	50

b. Table 7.2 End Semester Examinations

2 Marks	13 Marks	15 marks	Total Marks
10	5 (Either or Type)	1 (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			100

13.3 Theory Courses

Continuous Internal Assessment tests are conducted by the Office of the Controller of Examination. Continuous Internal Assessment comprises three Continuous assessment tests, Assignment / Class test / Presentation / Online Test / Mini projects / Tutorials and Attendance. By adopting this method, the students will go through a continuous and systematic study pattern. The Corresponding weightages are given below.

Table 8 : Continuous Internal Assessment Test for UG Theory Courses

Particulars	Syllabus	Duration	Exam Mark	Internal Mark
Continuous Internal Assessment I	1.5 Units	1.5 hours	50 marks	10
Continuous Internal Assessment II	1.5 Units	1.5 hours	50 marks	10
Continuous Internal Assessment III	1.5 Units	1.5 hours	50 marks	10
Assignment / Class Test / Online Test / Mini Project / Tutorial / Presentation/ Online course/Certificate Course				5
Attendance				5
Total				40

13.4 Criteria for Assessment for Lab Courses

Every exercise / experiment in all practical courses shall be evaluated on a continuous basis. The criteria for Continuous Assessment (for each cycle of exercise/experiment) are given in Table 9.

Table 9 : Assessment for Lab Courses

Sl. No.	Description		Weightage
1.	Continuous Internal Assessment Marks (CIAM)		
	a.	Average of Experimental Report / Workbook	25
	b.	Model examination	10
	c.	Attendance	5
	Total CIAM		**40**
2.	Semester End Exam Marks (ESEM)		
	a.	Lab Examination with Viva Voce	60
	Total ESM		**60**
		Total Marks	**100**

13.5 Project Work

For final year Project Work out of 100 marks, the maximum marks for Continuous Assessment is 40 marks and that for the End Semester Examination (project report evaluation and viva-voce examination) is 60 marks. Project work may be assigned to a single student or to a group of students not exceeding 4 per group, under the supervision of faculty guide(s).

The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three faculty members in the review committee. There shall be three reviews (as per **Table 10**) in total, during the semester by a review committee. The student shall make presentation on the progress made before the committee.

Interim project report shall be submitted before the project reviews with the approval of the guide. The Project Report, prepared according to the approved guidelines and duly signed by the guide and the Head of the Department, shall be submitted to the department as per the timeline announced by the department. The End Semester Examination for project work shall consist of evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted separately for each student, by a committee consisting of the external examiner, and an internal examiner. The Controller of Examinations (CoE) shall appoint Internal and External Examiners for the End Semester Examination of the Project Work.

The Continuous Internal Assessment Marks (CIAM) and End Semester Examinations Marks (ESEM) for Project Work and the Viva-Voce Examination will be distributed as indicated in **Table 10**.

Table - 10 : CIAM and ESEM break-up for project work

Sl.No.	Review No.		Description	Marks	Total Marks
1.	**Continuous Internal Assessment Marks**				
	a.	Review 1	Review Committee	5	10
			Guide	5	
	b.	Review 2	Review Committee	7	15
			Guide	8	
	c.	Review 3	Review Committee	7	15
			Guide	8	
Total CIAM					**40**
2.	**End Semester Examinations Marks**				
	a.	Evaluation of final report and viva-voce	Internal Examiner	10	**50**
			External Examiner	40	
	b.	Outcome*	Publication of papers / prototype / patents etc.,	10	10
Total ESEM					**60**
Total Marks					**100**

Review committee consists of internal faculty members nominated by the Head of the Department. The guide of student being examined shall not be part of the committee.

* Outcome - in terms of paper publication, patents, product development and industry projects shall be awarded by both internal and external examiners, based on the document proofs submitted by the student concerned.

If a student fails to submit project report / does not appear for the ESE /fails in the End Semester Examination (ESE), he/she is deemed to have failed in the project work and shall have to re-register for the same when offered next.

14. PASSING REQUIREMENTS

14.1 A student is declared to have successfully passed a theory based course if he / she has secured :

- A minimum of 45% marks in the End Semester Examinations.
- A minimum of 50% marks on combining both Continuous Internal Assessment Marks (CIAM) and End Semester Examination Marks (ESEM).

14.2 A student is declared to have successfully passed a practical / project based course if he/she has secured :

- A minimum of 45% marks in the End Semester Examinations.
- A minimum of 50% marks on combining both Continuous Internal Assessment Marks (CIAM) and End Semester Examination Marks (ESEM).

14.3 For a student who does not meet the minimum passing requirements, the term “RA” against the course will be indicated in his/her grade sheet. He/she shall reappear in the subsequent examinations for the course as arrear or re-register for the course when offered.

14.4 For a student who is absent for end-semester theory / practical / project viva-voce, the term “RA” will be indicated against the corresponding course. He/she shall reappear for the End Semester Examination of that course as arrear in the subsequent semester or when offered next.

14.5 The letter grade “W” will be indicated for the courses for which the student has been granted authorized withdrawal (refer Clause 10).

14.6 For mandatory courses (non-credit), the student must satisfy the minimum attendance requirement & passing criteria as specified for the course as detailed in Section 16.2.

15. METHODS FOR REDRESSAL OF GRIEVANCES IN EVALUATION

Students who are not satisfied with the grades awarded in the End Semester Examination of Theory for regular and arrear exams can seek redressal as illustrated in Table 11.

Table - 11 : Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	⊙ Apply for photo copy of answer book ⊙ Then apply for revaluation after course expert recommendation	
2.	Challenge of Evaluation	⊙ Apply for photo copy of answer book ⊙ 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 - 12 : 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 photocopy 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 favor of the student, the fee collected will be refunded to the student.
Step 6	The final mark will be announced by CoE.

16. LETTER GRADE

Absolute grading system is adopted in converting marks to grads.

16.1 Absolute Grading Policy

All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below :

Table - 13 : Absolute Grading - Letter Grade and its Range

Sl.No.	Range of percentage of total marks	Letter Grade	Grade Points
1.	91 - 100	O (Outstanding)	10
2.	81 - 90	A+ (Excellent)	9

3.	71 - 80	A (Very Good)	8
4.	61 - 70	B+ (Good)	7
5.	50 - 60	B(Average)	6
6.	<50	RA (Re-appearance)	0
7.	Shortage of Attendance	RA (Re-appearance due to shortage of attendance)	0
8.	Absent	RA (Re-appearance due to absence	0
9.	Withdrawal from examination	W	0
10.	Pass in Mandatory non-credit courses	P	0
11.	Fail in Mandatory non-credit courses	F	0

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”. ‘RA’ indicates that Reappearance is mandatory for that course concerned. ‘SA’ denotes shortage of attendance (as per Clause 9) and hence prevented from writing the End Semester Examination. P and F are grades for mandatory, but non-credit courses.

16.2 Grading for Mandatory Courses

Mandatory Courses are courses that are required to be completed to fulfill the degree requirements (e.g. Human excellence, Environmental science, etc.). They are normally non - credit based. These courses will not be taken in to consideration for the SGPA / 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.

16.2.1 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.

16.2.2 For the Mandatory non-credit courses student completing the course will be awarded Pass grade (P) 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 Formula for SGPA and CGPA calculations

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 Semester Grade Point Average (SGPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards

On completion of a semester, each student is assigned a Semester Grade Point Average which is computed as below for all courses registered for, by the student during that semester.

$$\textbf{S}\text{emester }\textbf{G}\text{rade }\textbf{P}\text{oint }\textbf{A}\text{verage} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

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 programme is evaluated by the **C**umulative **G**rade **P**oint **A**verage **(CGPA)** up to that point of time

$$\textbf{C}\text{umulative }\textbf{G}\text{rade }\textbf{P}\text{oint }\textbf{A}\text{verage} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

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. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii. Successfully completed the course requirements, appeared for the End-Semester examinations 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.

v. Successfully passed any additional courses prescribed by the Department & concerned whenever readmitted under regulations 2019 (R19) (vide Clause 4.3)

vi. No disciplinary action pending against the student.

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

18. CLASSIFICATION OF B.E. / B.Tech. DEGREE

The degree awarded to eligible students will be classified as given in **Table 14.**

Table - 14: Classification of the B.E. / B. TECH. Degree

Sl.No.	Class Awarded	Criteria
1.	**First class with distinction**	A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction :** › Should have passed the examination in all the courses of all the 8 semesters and 6 semesters in the case of Lateral Entry) in the student's First Appearance within five years and Four years in the case of Lateral Entry). › Withdrawal from examination will not be considered as an appearance. › Should have secured a CGPA of not less than **8.50**. › One year authorized break of study (if availed of) is included in the five years and (four years in the case of lateral entry) for award of First class with Distinction. › Should NOT have been prevented from writing End Semester Examination due to lack of attendance in any semester.
2.	**First Class**	A student who satisfies the following conditions shall be declared to have passed the examination in **First class** : › Should have passed the examination in all the courses of all eight semesters and 6 semesters in the case of Lateral Entry) **within Six years** and Five years in the case of Lateral Entry) › One year authorized break of study (if availed of) or prevention from writing the End Semester Examination due to lack of attendance (if applicable) is included in the duration of six years and five years in the case of lateral entry) for award of First class › Should have secured a CGPA of not less than **7.00**.
3.	**Second Class**	All other students (not covered in clauses Sl.No.1 and 2 under clause 18) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in Second Class.

Note : A student who is absent for the End Semester Examination in a course / project work Viva Voce after having registered for the same will be considered to have appeared for that examination (except approved withdrawal from End Semester Examinations as per Clause 9) for the purpose of classification.

19. AWARD OF DEGREE

The Academic Council of the institution will approve the award of Degree to all eligible students. The degree will be issued by Anna University, Chennai and the consolidated Grade Sheet will be issued by the institution. The consolidated grade sheet will specify any specializations and distinctions that the student has earned during the course of the study.

20. FACULTY MENTOR

To help the students in planning their courses of study and for general advice on the academic progarmme, the Head of the Department 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 Head of the Department or in Parent-Teacher meeting.

21. 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 programme 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 Head of the Department shall coordinate the activities of this committee.

- The class committee shall be constituted by the Head of the Department/Chief Tutor 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 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 Head of the Department within five working days of the meeting. Head of the Department will in turn consolidate and forward the same to the Principal, within 10 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.

22. 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 continuous assessment tests. The question paper for the End Semester Examination is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the Controller of Examinations.

23. 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 and assessment of both current and previous semesters.

24. 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 University or Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

25. REVISION OF REGULATIONS AND CURRICULUM

The institution may from time to time revise, amend or change the Regulations,scheme of Examinations and syllabi, if found necessary. Academic Council assisted by Board of Studies and Standing Committee will make such revisions / changes.

Note : Any ambiguity in interpretation of this regulation is to be put up to the Standing Committee, whose decision will be final

26. 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	1	9	M	E	T	7	0	9
Programme	Regulation		Department Code		Course Type	Semester	Sequence Number	

Programme :

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

Master's Degree (M.E./M.Tech/MBA/MCA) - M

Regulation :

R - 19

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

CA - Computer Application

MB - Management Studies

CH - Chemistry

EN - English

PH - Physics

MA - Mathematics

MC - Mandatory Course

CE - Career Enhancement

Course Type

T - Theory

P - Practical / Project/ Internship

E - Elective

O - Open Elective

C - One Credit Courses

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 endeavor 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 (This is the best method of tackling this malady)

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 honor 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 external 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 Controller of Examinations, 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 neighboring 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 cell phones/ programmable calculator(s)/any other electronic storage device(s) gadgets	Invalidating the examination of the particular subject written by the candidate
10.	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 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 cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).	
12.	The Candidate possessing the question paper of another candidate with additional writing on it.	
13.	The candidate passing his/her question paper to another candidate with additional writing on it	
14.	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
15.	The candidate copying from neighboring candidate.	
16.	The candidate taking out of the examination hall answer booklet(s), used or unused	
17.	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
18.	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 programme, 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 programme, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
19.	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.
20.	The candidate possessing the answer script of another candidate	
21.	The candidate passing his /her answer script to another candidate	
22.	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 subjects of the current semester and all the arrears -subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, 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 programme, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
23.	The candidate substituting an answer book let prepared outside the examination hall for the one already distributed to the candidate	

24.	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 subjects of the current semester and all the arrears - subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, 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 programme, he/she is prevented from writing the examinations of the arrears - subjects for four subsequent semesters.
25.	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.	
26.	Candidate possessing any fire arm / weapon inside the examination hall.	
27.	Cases of Impersonation	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 of this University 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 programme of the University. 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 programme of the University.

ANNEXURE - 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.

ANNEXURE - 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

Conceptual Frame work

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

Semester	Level of Course	Hrs. / Week	No of Courses	Range of Credits / Courses	Total Credits
PART – I					
A – Foundation Courses					
I to II	Humanities and Social Sciences **(HS)**	1- 3	5	1 - 3	11
I to IV	Basic Sciences **(BS)**	3 - 4	6	2 - 4	25
I to III	Engineering Sciences **(ES)**	3 - 6	8	2 - 4	19
B – Professional Core Courses					
II to VII	Professional Core **(PC)**	3 - 4	30	2 - 4	71
C – Elective Courses					
V to VIII	Professional Elective **(PE)**	3	6	3	18
V to VIII	Open Elective **(OE)**	3	4	3	12
D – Project Work					
V, VII & VIII	Project Work **(PW)**	4 - 16	3	2 - 8	12
E – Mandatory Courses Prescribed by AICTE / UGC (Not to be Included for CGPA)					
I, III & IV	Mandatory Course **(MC)**	3	4	NC	NC
Total Credit					**168**
PART II – Career Enhancement Courses (CEC)					
II	Soft Skills - I	2	1	1	1
III	Soft Skills - II	2	2	1	1
	Professional Certificate Course - I	2		1	1
IV	Career Ability Course - I	2	1	-	-
	NPTEL Online Certificate Courses	-	-	-	-
V	Career Ability Course - II	2	3	-	-
	Professional Certificate Course - II	2		1	1
	Summer Internship	-		1	1
VI	Career Ability Course - III	2	1	-	-
	NPTEL Online Certificate Courses	-	-	-	-
Total Credit					**05**
Total Credit to be Earned					**173**
PART III (Additional Credit Course - Not to be Included for CGPA)					
III	Problem Solving and Python Programming	20 - 30	1	-	**1**
IV	Non Destructive Testing (NDT)	20 - 30	1	-	**1**
V	Basics of Automation	40 - 60	1	-	**1**
VI	CNC Certification Programme	40 - 60	1	-	**1**
VII	Robotics and Embedded Systems	30 - 40	1	-	**1**

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Scheme of Instructions and Examinations

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

Semester - I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
Induction Programme											
B19ENT101	Functional English	HS	3	3	0	0	3	40	60	100	3
B19MAT101	Matrices and Differential Calculus	BS	4	3	0	1	3	40	60	100	4
B19CHT101	Engineering Chemistry	BS	3	3	0	0	3	40	60	100	3
B19CST102	Problem Solving and Programming using C	ES	3	3	0	0	3	40	60	100	3
B19MET101	Engineering Graphics	ES	6	2	4	0	3	40	60	100	4
B19CHP101	Chemistry Laboratory	BS	4	0	4	0	3	40	60	100	2
B19CSP102	Problem Solving and Programming using CLaboratory	ES	4	0	4	0	3	40	60	100	2
B19MCP101	Life skills	MC	2	0	2	0	-	100	-	100	NC
Total Contact Hours/Week			**29**	**14**	**14**	**1**	**TotalCredits**				**21**

Semester - II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19ENT201	Professional English	HS	3	3	0	0	3	40	60	100	3
B19MAT201	Integral Calculus and Complex Analysis	BS	4	3	0	1	3	40	60	100	4
B19PHT101	Engineering Physics	BS	3	3	0	0	3	40	60	100	3
B19BTT201	Biochemistry	PC	3	3	0	0	3	40	60	100	3
B19BTT202	Microbiology	BS	3	3	0	0	3	40	60	100	3
B19HST201	தமிழ்மரபு / Heritage of Tamils	HS	1	1	0	0	3	40	60	100	1
B19PHP201	Physics Laboratory	BS	4	0	4	0	3	40	60	100	2
B19BTP201	Biochemistry Laboratory	PC	4	0	4	0	3	40	60	100	2
B19MEP201	Basic Workshop Practices Laboratory	ES	4	0	4	0	3	40	60	100	2
B19CEP201	Soft Skills – I	CEC	2	0	2	0	-	100	-	100	1
Total Contact Hours / Week			**30**	**15**	**14**	**1**	**Total Credits**				**24**

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Semester - III

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT304	Partial Differential Equations and Probability	BS	4	4	0	0	3	40	60	100	4
B19BTT301	Stoichiometry and Fluid Mechanics	ES	3	2	0	1	3	40	60	100	3
B19BTT302	Biochemical Thermodynamics	PC	3	3	0	0	3	40	60	100	3
B19BTT303	Bioorganic Chemistry	PC	3	3	0	0	3	40	60	100	3
B19BTT304	Cell Biology and Genetics	PC	3	3	0	0	3	40	60	100	3
B19MCT302	Indian Constitution	MC	1	0	0	0	-	100	-	100	NC
B19HST301	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HS	1	1	0	0	3	40	60	100	1
B19BTP301	Cell Biology and Microbiology Laboratory	PC	4	0	2	0	3	40	60	100	2
B19BTP302	Chemical Engineering Laboratory for Biotechnologists	ES	4	0	2	0	3	40	60	100	2
B19CEP301	Soft Skills – II	CEC	1	0	2	0	-	100	-	100	1
B19CEP302	Professional Certificate Course - I	CEC	1	0	2	0	3	100	-	100	1
Total Contact Hours/Week			31	18	8	1	Total Credits				24

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	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT406	Biostatistics	BS	3	3	0	1	3	40	60	100	4
B19BTT401	Industrial Biotechnology	PC	3	3	0	0	3	40	60	100	3
B19BTT402	Molecular Biology	PC	3	3	0	0	3	40	60	100	3
B19BTT403	Enzymology and Enzyme Technology	PC	3	3	0	0	3	40	60	100	3
B19BTT404	Analytical Methods in Biotechnology	ES	3	3	0	0	3	40	60	100	3
B19MCT301	Environmental Sciences	MC	3	3	0	0	-	100	-	100	NC
B19BTP401	Molecular Biology Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BTP402	Analytical Methods Laboratory	ES	4	0	4	0	3	40	60	100	2
B19CEP401	Career Ability Course – I	CEC	1	0	2	0	-	100	-	100	NC
B19CEP402	In Plant Training	CEC	-	-	-	-	-	-	-	-	NC
B19CEP403	Online Certificate Course	CEC	-	-	-	-	-	-	-	-	NC
Total Contact Hours/Week			27	17	10	1	Total Credits				20

Summer Internship - Duration 15 days (Review will be conducted in first week of Semester V and its credit will be included in Semester V).
Online Certificate Courses (like SWAYAM etc.)has to be completed within second year (NC).

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Semester - V											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTT501	Heat and Mass Transfer Operations	**ES**	3	2	0	1	**3**	40	60	100	**3**
B19BTT502	Bioprocess Technology	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BTT503	Genetic Engineering	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BTT504	Bioinformatics	**PC**	3	2	1	0	**3**	40	60	100	**3**
B19BTE50_	Professional Elective – I	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19 _____	Open Elective – I	OE	3	3	0	**0**	**3**	40	60	**100**	**3**
B19BTP501	Bioprocess Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19BTP502	Genetic Engineering Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
B19CEP501	Career Ability Course – II	**CEC**	1	0	2	0	**-**	100	-	100	**NC**
B19CEP502	Professional Certificate Course–II	**CEC**	2	0	2	0	**3**	100	-	100	**1**
B19CEP503	Summer Internship	**CEC**	-	-	-	-	**-**	-	-	-	**1**
Total Contact Hours / Week			**30**	**17**	**13**	**1**	**Total Credits**				**24**

Summer Internship - Duration 15 days (Review will be conducted in first week of Semester V and its credit will be included in Semester V).

Online Certificate Courses (like SWAYAM etc.) has to be completed within third year (NC).

Semester - VI											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTT601	Chemical Reaction Engineering	**ES**	3	2	0	1	**3**	40	60	100	**3**
B19BTT602	Immunology	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BTT603	Downstream Processing	**PC**	3	3	0	0	**3**	40	60	100	**3**
B19BTE60_	Professional Elective – II	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE60_	Professional Elective – III	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19_____	Open Elective – II	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BTP601	Immunology Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19BTP602	Downstream Processing Laboratory	**PC**	2	0	2	0	**3**	40	60	100	**1**
B19BTP603	Mini Project	**PW**	4	0	4	0	**0**	100	-	100	**2**
B19CEP601	Career Ability Course – III	**CEC**	1	0	2	0	**-**	100	-	100	**NC**
B19CEP602	Online Certificate Course	**CEC**	-	-	-	-	**-**	-	-	-	**NC**
Total Contact Hours/Week			**29**	**17**	**12**	**1**	**Total Credits**				**22**

Online Certificate Courses (like SWAYAM etc.)has to be completed within third year (NC)

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Semester - VII											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MBT701	Total Quality Management	HS	3	3	0	0	3	40	60	100	3
B19BTT701	Bioethics, Biosafety and IPR	PC	3	3	0	0	3	40	60	100	3
B19BTT702	Biopharmaceutical Technology	PC	3	3	0	0	3	40	60	100	3
B19BTE70_	Professional Elective – IV	PE	3	3	0	0	3	40	60	100	3
B19BTE70_	Professional Elective – V	PE	3	3	0	0	3	40	60	100	3
B19_____	Open Elective – III	OE	3	3	0	0	3	40	60	100	3
B19BTP701	Tissue Culture Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BTP702	Project Work Phase – I	PW	4	0	4	0	-	100	0	100	2
Total Contact Hours/Week			26	18	8	0	Total Credits				22

Semester - VIII											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTE80_	Professional Elective – VI	PE	3	3	0	0	3	40	60	100	3
B19_____	Open Elective – IV	OE	3	3	0	0	3	40	60	100	3
B19BTP801	Project Work Phase – II	PW	16	0	16	0	3	40	60	100	8
Total Contact Hours / Week			22	6	16	0	Total Credits				14

HUMANITIES AND SOCIALSCIENCES (HS)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19ENT101	Functional English	HS	3	3	0	0	3	40	60	100	3
B19ENT201	Professional English	HS	3	3	0	0	3	40	60	100	3
B19MBT701	Total Quality Management	HS	3	3	0	0	3	40	60	100	3
B19HST201	தமிழர்மரபு / Heritage of Tamils	HS	1	1	0	0	3	40	60	100	1
B19HST301	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HS	1	1	0	0	3	40	60	100	1

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BASIC SCIENCES (BS)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MAT101	Matrix and Differential Calculus	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19CHT101	Engineering Chemistry	**BS**	3	3	0	0	**3**	40	60	100	**3**
B19CHP101	Chemistry Laboratory	**BS**	4	0	4	0	**3**	40	60	100	**2**
B19MAT201	Integral Calculus and Complex Analysis	**BS**	4	3	0	1	**3**	40	60	100	**4**
B19PHT201	Engineering Physics	**BS**	3	3	0	0	**3**	40	60	100	**3**
B19PHP201	Physics Laboratory	**BS**	4	0	4	0	**3**	40	60	100	**2**
B19MAT304	Partial Differential Equations and Probability	**BS**	4	4	0	0	**3**	40	60	100	**4**
B19MAT406	Biostatistics	**BS**	4	4	0	0	**3**	40	60	100	**4**

ENGINEERING SCIENCES (ES)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19CST102	Problem Solving and Programming using C	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19MET101	Engineering Graphics	**ES**	6	2	4	0	**3**	40	60	100	**4**
B19CSP102	Problem Solving and Programming using C Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19MEP201	Basic Workshop Practices Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19BTT301	Stoichiometry and Fluid Mechanics	**ES**	3	2	0	1	**3**	40	60	100	**3**
B19BTP302	Chemical Engineering Laboratory	**ES**	2	0	2	0	**3**	40	60	100	**1**
B19BTT404	Analytical Methods in Biotechnology	**ES**	3	3	0	0	**3**	40	60	100	**3**
B19BTP402	Analytical Methods Laboratory	**ES**	4	0	4	0	**3**	40	60	100	**2**
B19BTT501	Heat and Mass Transfer Operations	**ES**	3	2	0	1	**3**	40	60	100	**3**
B19BTT601	Chemical Reaction Engineering	**ES**	3	2	0	1	**3**	40	60	100	**3**

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PROFESSIONAL CORE (PC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTT201	Biochemistry	PC	3	3	0	0	3	40	60	100	3
B19BTP201	Biochemistry Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BTT202	Microbiology	BS	3	3	0	0	3	40	60	100	3
B19BTT302	Biochemical Thermodynamics	PC	3	3	0	0	3	40	60	100	3
B19BTT303	Bioorganic Chemistry	PC	3	3	0	0	3	40	60	100	3
B19BTT304	Cell Biology and Genetics	PC	3	3	0	0	3	40	60	100	3
B19BTP301	Cell Biology and Microbiology Laboratory	PC	2	0	2	0	3	40	60	100	1
B19BTT401	Industrial Biotechnology	PC	3	3	0	0	3	40	60	100	3
B19BTT402	Molecular Biology	PC	3	3	0	0	3	40	60	100	3
B19BTT403	Enzymology and Enzyme Technology	PC	3	3	0	0	3	40	60	100	3
B19BTP401	Molecular Biology Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BTT502	Bioprocess Technology	PC	3	3	0	0	3	40	60	100	3
B19BTT503	Genetic Engineering	PC	3	3	0	0	3	40	60	100	3
B19BTT504	Bioinformatics	PC	3	2	1	0	3	40	60	100	3
B19BTP501	Bioprocess Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BTP502	Genetic Engineering Laboratory	PC	4	0	4	0	3	40	60	100	2
B19BTT602	Immunology	PC	3	3	0	0	3	40	60	100	3
B19BTT603	Downstream Processing	PC	3	3	0	0	3	40	60	100	3
B19BTP601	Immunology Laboratory	PC	2	0	2	0	3	40	60	100	1
B19BTP602	Downstream Processing Laboratory	PC	2	0	2	0	3	40	60	100	1
B19BTT701	Bioethics, Biosafety and IPR	PC	3	0	0	3	3	40	60	100	3
B19BTT702	Biopharmaceutical Technology	PC	3	3	0	0	3	40	60	100	3
B19BTP701	Tissue Culture Laboratory	PC	4	0	4	0	3	40	60	100	2

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PROFESSIONAL ELECTIVES (PE)											
Semester – V											
Elective – I											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
B19BTE501	Principles of Food Preservation	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE502	Biophysics	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE503	Biosensors	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE504	Nanobiotechnology	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE505	Disaster Management	**PE**	3	3	0	0	**3**	40	60	100	**3**

Semester - VI											
Elective – II											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
B19BTE601	Biopolymers	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE602	Phytochemicals and Herbal Medicine	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE603	Metabolic Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE604	Bioprocess Plant Design and Economics	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE605	Vaccine Technology	**PE**	3	3	0	0	**3**	40	60	100	**3**

Semester - VI											
Elective – III											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
B19BTE606	Developmental Biology	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE607	Molecular Modelling	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE608	Protein Engineering	**PE**	3	0	3	0	**3**	40	60	100	**3**
B19BTE609	Lifestyle Diseases	**PE**	3	3	0	0	**3**	40	60	100	**3**
B19BTE610	Neurobiology and Cognitive Science	**PE**	3	3	0	0	**3**	40	60	100	**3**

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Semester - VII											
Elective – IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTE701	Tissue Engineering and Biomaterials	PE	3	3	0	0	3	40	60	100	3
B19BTE702	Molecular Pathogenesis and Disease Diagnosis	PE	3	3	0	0	3	40	60	100	3
B19BTE703	System Biology	PE	3	0	3	0	3	40	60	100	3
B19BTE704	Environmental Biotechnology	PE	3	3	0	0	3	40	60	100	3
B19BTE705	Biofuels	PE	3	3	0	0	3	40	60	100	3

Semester - VII											
Elective – V											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTE706	Research Methodology	PE	3	3	0	0	3	40	60	100	3
B19BTE707	Cancer Biology	PE	3	3	0	0	3	40	60	100	3
B19BTE708	Stem Cell Technology	PE	3	0	3	0	3	40	60	100	3
B19BTE709	Forensic Biotechnology	PE	3	3	0	0	3	40	60	100	3
B19BTE710	Telemedicine	PE	3	3	0	0	3	40	60	100	3

Semester - VIII											
Elective – VI											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTE801	Bioentrepreneurship	PE	3	3	0	0	3	40	60	100	3
B19BTE802	Clinical Research and Data Management	PE	3	3	0	0	3	40	60	100	3
B19BTE803	Marine Biotechnology	PE	3	0	3	0	3	40	60	100	3
B19BTE804	Human Rights	PE	3	3	0	0	3	40	60	100	3
B19BTE805	Hazard Management	PE	3	3	0	0	3	40	60	100	3

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OPEN ELECTIVES (OE)											
Semester – V											
Elective – I											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
B19AEO501	Basics of Flight Mechanics	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19AGO501	Environment and Agriculture	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BMO501	Introduction to Medical Physics	**OE**	3	0	3	0	**3**	40	60	100	**3**
B19CSO501	Fundamentals of Database Management System	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19ECO501	Logic and Distributed Control Systems	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19EEO501	Rotating Machines and Transformers	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19MEO501	Robotics	**OE**	3	3	0	0	**3**	40	60	100	**3**

Semester – VI											
Elective – II											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
B19AEO601	Aircraft Electrical and Electronic Systems	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19AGO601	Integrated Water Resources Management	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19BMO601	Introduction to Biomedical Engineering	**OE**	3	0	3	0	**3**	40	60	100	**3**
B19CSO601	E-Commerce Technology and Management	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19ECO601	Geographic Information System	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19EEO601	Fundamentals of Power Electronics	**OE**	3	3	0	0	**3**	40	60	100	**3**
B19MEO601	Entrepreneurship Development	**OE**	3	3	0	0	**3**	40	60	100	**3**

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Semester – VII											
Elective – III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19AEO701	Unmanned Aircraft Systems Operation & MRO	OE	3	3	0	0	3	40	60	100	3
B19AGO701	Production Technology in Agricultural Machinery	OE	3	3	0	0	3	40	60	100	3
B19BMO701	Telemedicine	OE	3	0	3	0	3	40	60	100	3
B19CSO701	Fundamentals of Cloud Computing	OE	3	3	0	0	3	40	60	100	3
B19ECO701	Introduction to Communication Systems	OE	3	3	0	0	3	40	60	100	3
B19EEO701	Hybrid Electric Vehicles	OE	3	3	0	0	3	40	60	100	3
B19MEO701	3D Printing and Tooling	OE	3	3	0	0	3	40	60	100	3

Semester – VIII											
Elective – IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19AEO801	Vehicle Aerodynamics	OE	3	3	0	0	3	40	60	100	3
B19AG0801	Agriculture, Finance, Banking and Cooperatives	OE	3	3	0	0	3	40	60	100	3
B19BMO801	Hospital Management	OE	3	0	3	0	3	40	60	100	3
B19CSO801	Fundamentals of IoT	OE	3	3	0	0	3	40	60	100	3
B19ECO801	Wireless Technologies	OE	3	3	0	0	3	40	60	100	3
B19EEO801	Energy Conservation and Management	OE	3	3	0	0	3	40	60	100	3
B19MEO801	Lean Six Sigma	OE	3	3	0	0	3	40	60	100	3

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PROJECT WORK (PW)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19BTP603	Mini Project	**PW**	4	0	4	0	**0**	100	-	100	**1**
B19BTP702	Project work Phase – I	**PW**	4	0	4	0	**0**	100	-	100	**2**
B19BTP801	Project Work Phase – II	**PW**	16	0	16	0	**3**	40	60	100	**8**

CAREER ENHANCEMENT COURSE (CEC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19CEP201	Soft Skills – I	**CEC**	2	0	2	0	**-**	100	-	100	**1**
B19CEP301	Soft Skills – II	**CEC**	2	0	2	0	**-**	100	-	100	**1**
B19CEP302	Professional Certificate Course – I	**CEC**	2	0	2	0	**3**	100	-	100	**1**
	In plant Training	**CEC**	0	-	-	-	**-**	-	-	-	**NC**
B19CEP401	Career Ability Course – I	**CEC**	1	0	2	0	**-**	100	-	100	**NC**
B19CEP501	Career Ability Course – II	**CEC**	1	0	2	0	**-**	100	-	100	**NC**
B19CEP502	Professional Certificate Course – II	**CEC**	2	0	2	0	**3**	100	-	100	**1**
B19CEP503	Summer Internship	**CEC**	-	-	-	-	**-**	-	-	-	**1**
B19CEP601	Career Ability Course – III	**CEC**	1	0	2	0	**-**	100	-	100	**NC**

MANDATORY COURSE (MC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
B19MCP101	Life Skills	**MC**	2	0	2	0	**-**	100	-	100	**NC**
B19MCT301	Indian Constitution	**MC**	3	3	0	0	**-**	40	60	100	**NC**
B19MCT401	Environmental Sciences	**MC**	3	3	0	0	**-**	100	-	100	**NC**

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Semester - I

B. TECH.	B19ENT101 - FUNCTIONAL ENGLISH	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	To develop the basic reading and writing skills of first year engineering and technology students.
2.	To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
3.	To help learners develop their speaking skills and speak fluently in real contexts.
4.	To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT - I		12
Reading	Short comprehension passages, practice in skimming-scanning	
Writing	Instructions, developing hints.	
Listening	Listening to peer group	
Speaking	Self Introduction, introducing others	
Language development	Parts of Speech, Wh-Questions, asking and answering-yes or no questions	
Vocabularydevelopment	Prefixes-suffixes, articles.	

UNIT - II		12
Reading	Skimming and Scanning - Pre & post reading, comprehension questions, including dialogues and conversations	
Writing	Paragraph writing, free writing, day to day events	
Listening	Telephonic conversations, conceptual conversations	
Speaking	Sharing information of a personal kind, greeting, taking leave	
Language development	Regular & Irregular Verbs, tenses	
Vocabularydevelopment	Guessing meanings of words in context.	

UNIT - III		12
Reading	Short texts and longer passages, note making	
Writing	Understanding text structure, use of reference words and discourse markers, jumbled sentences	

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Listening	Listening to longer texts and filling up the table, product description, narratives from different sources.
Speaking	Short presentation, asking about routine actions and expressing facts and opinions
Language development	Idioms and Phrases, Degrees of comparison, sentence pattern and types of sentences
Vocabularydevelopment	Single word substitutes

UNIT - IV	**12**
Reading	Intensive and Extensive reading, reading longer texts, reading different types of texts-magazines,
Writing	Letter writing, informal or personal letters, e-mails
Listening	Listening to dialogues or conversations and completing exercises based on them
Speaking	Speaking about one self, speaking about one's friend, conceptual conversations
Language development	Direct / indirect questions
Vocabularydevelopment	Synonyms - antonyms, phrasal verbs

UNIT - V	**12**
Reading	Longer texts-close reading
Writing	Writing short essays, developing an outline, identifying main and subordinate ideas, dialogue Writing
Listening	Listening to talks, conversations
Speaking	Participating in conversations, short group conversations
Language development	Spelling and Punctuations, modal verbs
Vocabulary development	Collocations
	Total Instructional hours : 60

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Course Outcomes	
CO1	Develop basic reading and effective reading skills
CO2	Build their grammatical understanding.
CO3	Explain their opinions efficiently in writing in formal and informal contexts through letters
CO4	Develop their vocabulary skills
CO5	Develop their knowledge 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.	Diana L. Fried-Booth, Project Work, Oxford University Press, Oxford: 2014.

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B. TECH.	B19MAT101 - MATRICES AND DIFFERENTIAL CALCULUS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	Matrix algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
2.	The goal of this course is to achieve conceptual understanding and to retain the best traditions of differential calculus.
3.	This is a foundation course which mainly deals with topics such as single variable and multivariable differential calculus and plays an important role in the understanding of science, engineering, medical and business among other disciplines.
4.	The syllabus is designed to provide the basic tools of differential calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.

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 – Change of variables – 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 Higher order linear ordinary differential equations with variable coefficients Cauchy Euler‘s and Cauchy Legendre‘s type - Method of variation of parameters (ordinary differential equations with constant coefficients) Simultaneous differential equations.

UNIT - IV	APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS	12

Solution of specified differential equations connected with electric circuits, Bending of beams and simple harmonic motion (Differential equations and associated conditions need to be given).

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UNIT - V	LAPLACE TRANSFORMS	12
Existence conditions - Properties (excluding proofs) - Transform of standard functions Transforms of derivatives and integrals - Periodic function – Inverse Laplace transform Applications to solution of linear second order ordinary differential equations with constant coefficients.		
		Total Instructional hours : 60

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	Determine solution for maxima and minima problems
CO3	To 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, 2014.
2.	Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media - An imprint of Lakshmi Publications Pvt., Ltd., New Delhi, 7th Edition, 2017.
3.	Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

Reference Books	
1.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2018.
2.	Srimantha Pal and Bhunia, S.C, "Engineering Mathematics", Oxford University Press, 2015.
3.	Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.
4.	Veerarajan T., “Engineering Mathematics for Semester I and II”, Tata McGraw Hill Publishing Company, New Delhi, 2015.
5.	Gean Duffy., “Advanced Engineering Mathematics with MATLAB”, A CRC Press Company, Boca Raton London , New York Washington, D.C, 2nd edition 2009.

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B. TECH.	B19CHT101 - ENGINEERING CHEMISTRY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
2.	To make the students conversant with basics of polymer chemistry.
3.	To make the students conversant with basic of electrochemical reactions and corrosion.
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	9

Hardness of water : Types, Expression of Hardness and their units, boiler troubles Scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming.

Water quality standards : WHO, BIS and CPCB

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.

UNIT - II	POLYMERS AND COMPOSITES	9

Polymers : Definition, polymerization, types - addition and condensation polymerization - Tacticity - biodegradable and conducting polymers

Plastics : Classification, preparation, properties and uses of PVC, Teflon, Nylon-6,6 and Epoxy resin.

Rubber : Vulcanization of rubber, Synthetic rubbers - Butyl rubber, SBR.

Moulding : Ingredients - compression and Injection.

Composites : Definition, types, polymer matrix composites - FRP.

UNIT - III	ELECTROCHEMISTRY AND CORROSION	9

Electrochemistry : Redox reaction, Electrode potential - oxidation potential, reduction potential, Nernst equation (derivation) - Measurement and applications - Electrochemical Series and its significance.

Corrosion : causes- factors- types-chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method.

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UNIT - IV	ENERGY DEVICES	9

Batteries : Types of batteries – Primary battery (dry cell), Secondary battery (lead acid battery, lithium-ion-battery), Fuel Cells- H_2 & O_2 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 - Quantum confinement (0D,1D,2D,3D) - 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 (nano products of today)

Total Instructional hours : 45

Course Outcomes : The students will be able to	
CO1	Outline the principle and characterization of water for the treatment of potable and industrial purposes.
CO2	Illustrate and interpret about the basics of Polymer Chemistry.
CO3	Relate the principles of electrochemical reactions and corrosion.
CO4	Understand the concepts of energy devices and its engineering applications.
CO5	Understand the basics of Nano-chemistry and its applications.

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”, DhanpatRai Publishing Company Pvt. Ltd., New Delhi, 2015
3. Vairam, S Kalyani, P and Suba Ramesh, “Engineering Chemistry”, Wiley India Pvt. Ltd., New Delhi, 2013.

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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.

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B. TECH.	B19CST102 – PROBLEM SOLVING AND PROGRAMMING USING C	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the organization of a digital computer, number systems, algorithm and Pseudo code.
2.	To learn the basic of C Programming and control statements.
3.	To understand the concept of Arrays and String operations.
4.	To develop the simple applications using Functions and Pointers.
5.	To understand and develop the applications using structures and unions in C.

UNIT - I	INTRODUCTION	8

Computer : Generation and Classification of Computers, Basic Organization of a Computer.
Number System : Binary, Decimal, Conversion, Problems.
Need for logical analysis and thinking : Algorithm, Pseudo code, Flow Chart.

UNIT - II	C PROGRAMMING BASICS	10

Introduction to "C" programming : Fundamentals, structure of a "C" program, compilation and linking processes.
Basic elements of "C" programming : Constants, Variables, Data Types, Expressions, operators, Managing Input and Output operations.
Control Statements : Decision Making and Branching, Looping statements.
Problem Solving : Solving simple scientific and statistical problems.

UNIT - III	ARRAYS AND STRINGS	9

Arrays : Initialization, Declaration, One dimensional and two-dimensional arrays.
String : String operations, String Arrays.
Simple programs : sorting, searching, matrix operations.

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UNIT - IV	FUNCTIONS AND POINTERS	9
Function : Definition of function, Declaration of function, pass by value, Pass by reference, Recursion. **Pointers :** Definition, Initialization, Pointers arithmetic, Pointers and arrays, Example Problems.		

UNIT - V	STRUCTURES AND UNIONS	9
Introduction : need for structure data type, structure definition, Structure declaration, Structure within a structure. Union, Storage classes, Pre-processor directives, Files handling.		
		Total Instructional hours : 45

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.

Text Books	
1.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2016.
2.	Yashavant P. Kanetkar. "Let Us C", 16th Edition, BPB Publications, 2016.

Reference Books	
1.	Byron S Gottfried, "Programming with C", Schaum"s Outlines, Fourth Edition, Tata Mc Graw - Hill, 2018
2.	Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.
3.	Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
4.	Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
5.	Kernighan, B. and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2006.

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B. TECH.	B19MET101 – ENGINEERING GRAPHICS	T	P	TU	C
		2	4	0	4

Course Objectives (After Completion of the course student can able to)	
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 (DEMONSTRATION ONLY)	3
Introduction to drafting packages and demonstration of their use.	
Total Instructional hours : 75	

Course Outcomes : At the end of the course student can able to	
CO1	Construct the basic engineering curves and freehand sketching of basic geometrical constructions and multiple views of objects.
CO2	Draw 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 to draw its perspective views.

Text Books	
1.	N.D. Bhattand V.M. Panchal, “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2014.
2.	K. Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Publishers, 2017.

Reference Books	
1.	Gopalakrishna KR, “Engineering Drawing” (Vol. I & II combined) Subhas Publications, Bangalore, 2018.
2.	Natarajan KV, “A text book of Engineering Graphics”, 28th Ed, Dhanalakshmi Publishers, Chennai, 2015.
3.	Parthasarathy NS and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.

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B. TECH.	B19CHP101 – CHEMISTRY LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To make the students to acquire practical skills in the determination of water quality parameters and estimation of ions through volumetric and instrumental analysis.

List of Experiments	
Expt. No.	**Description of the Experiments (Any 8 experiments)**
1.	Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinityin water sample.
2.	Determination of total, temporary & permanent hardness of water by EDTA method.
3.	Determination of DO content of water sample by Winkler's method.
4.	Determination of chloride content of water sample by Argentometric method.
5.	Estimation of copper in brass.
6.	Determination of strength of given hydrochloric acid using pH meter.
7.	Estimation of iron content of the given solution using potentiometer.
8.	Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline/ thiocyanate method).
9.	Estimation of sodium and potassium present in water using flame photometer.
10.	Conductmetric titration of strong acid vs strong base
11.	Estimation of iodine in common salt.
12.	Estimation of calcium in milk powder.
	Total Instructional hours : 30

Course Outcomes : The students will be able to	
CO1	Relate the acquired knowledge in the quantitative estimation of alkalinity, hardness, DO and chloride ion present in the water samples.
CO2	Understand the nature of water quality parameters to find the pollution level in water.
CO3	Estimate the amount of copper, iodine, calcium in alloys and food products.
CO4	Apply the spectroscopic techniques for the quantitative estimation of sodium, potassium and Ferrous ion.
CO5	Analyze the solutions by electrochemical parameters like conductivity, pH and EMF.

	Text Books
1.	Vogel's Textbook of Quantitative Chemical Analysis, 8th edition, 2014.

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B. TECH.	B19CSP102 - PROBLEM SOLVING AND PROGRAMMING USING C LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To develop programs in C using the role of constants, variables, identifiers, operators and other building blocks of C Language.
2.	To create the C programs by using the conditional expressions and looping statements.
3.	To develop the applications in C by using the concept of Array and pointers dealing with memory management.
4.	To develop the applications in C using Structures and unions.
5.	To develop programs using file operations.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Develop a C program with I/O Statements.
2.	Develop a C program by using arithmetic operators.
3.	Construct a C program by using the Decision making, branching and looping statements.
4.	Develop a simple calculator which performs basic operations.
5.	Develop a C program to perform sorting of numbers using array.
6.	Develop a C program to perform matrix multiplication using two-dimensional array.
7.	Implementa C program to perform the string operations using build in methods.
8.	Develop a C Program to experiment with call by value and call by reference.
9.	Develop a C program to perform linear search using pointers.
10.	Develop a payroll system of an employee using structures.
11.	Develop a C program to create student details using Unions.
12.	Develop a C program to perform file operations.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply arithmetic operations.
CO2	Build applications using control statements.
CO3	Develop applications using arrays.
CO4	Build applications using functions and pointers.
CO5	Apply structures and unions and file handling concepts to develop applications.

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B. TECH.	B19MCP101 - LIFE SKILLS	T	P	TU	C
		0	2	0	0

Course Objectives	
1.	To make the students to enhance their attitude, confidence and communication.

UNIT - I	TRANSITION MANAGEMENT	6
Getting started - Getting involved - being responsible - adapting to the new environment.		

UNIT - II	VISION AND GOAL	6
Defining Vision and designing Goals in accordance - Seeing College life as a path towards Lifetime Goals.		

UNIT - III	VALUES VIRTUES	6
Not as preaching but a way of life to succeed in all aspects of life.		

UNIT - IV	FOCUS	6
Focus on basic quality in all activities .Tips to enhance memory and focus skills.		

UNIT - V	LEARNING SKILLS AND PASSIONATE LEARNER	6
Transforming information into knowledge and learning to read people like a book - hedding out inhibitions - Blossoming with talent and leadership abilities.		
Total Instructional hours : 30		

Course Outcomes : Students will be able to	
CO1	Develop the adapting skills to various environment.
CO2	Identify the vision and Goal towards success.
CO3	Build Values and Virtues to succeed in life.
CO4	Show focus in all activities
CO5	Develop knowledge to understand various kinds of people.

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Semester - II

B. TECH.	B19ENT201 – PROFESSIONAL ENGLISH	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
2.	Foster their ability to write convincing job applications and effective reports.
3.	Develop their speaking skills to make technical presentations, participate in group discussions.
4.	Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT - I		12
Listening	Listening to motivational speech	
Speaking	Asking for and giving directions	
Reading	Reading short technical texts from newspapers and magazines	
Writing	Extended definitions, Gerunds & Infinitives, writing checklists, recommendation	
Vocabularydevelopment	Technical vocabulary, abbreviations	
Language development	Subject verb agreement	

UNIT - II		12
Listening	Listening to TED talks	
Speaking	Describing a process, narrating a story	
Reading	Reading longer technical texts, summarizing	
Writing	Interpreting charts, graphs	
Vocabularydevelopment	Vocabulary used in formal letters/emails and reports	
Language development	British and American spelling, numerical adjectives.	

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UNIT - III	12
Listening	Listening to classroom lectures, commentaries and announcements
Speaking	Oral presentations
Reading	Longer texts both general and technical, practice in speed reading
Writing	process writing, use of sequence words, analytical essays and issue based essays
Vocabularydevelopment	Sequence words, misspelled words.
Language development	Identifying different types of sentences.

UNIT - IV	12
Listening	Listening to documentaries, listening to resume preparation and making notes.
Speaking	Techniques of effective presentations
Reading	Reading for detailed comprehension
Writing	Email etiquette, job application- cover letter, résumé preparation, Vocabulary
Vocabularydevelopment	Finding suitable synonyms, paraphrasing
Language development	Clauses, if conditionals

UNIT - V	12
Listening	Listening to talks based on profession
Speaking	Participating in a group discussion
Reading	Reading and understanding technical articles
Writing	Writing reports, minutes of a meeting, writing feasibility, survey and industrial reports
Vocabularydevelopment	Verbal analogies
Language development	Reported speech, active and passive voice, impersonal passive
	Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Develop their Vocabulary skills
CO2	Develop their grammatical proficiency
CO3	Develop strategies and skills to enhance their ability to read and comprehend
CO4	Interpret graphical representation by comparing and contrasting the information
CO5	Extend their knowledge 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.	Meenakshi R. and Sharma S., “Technical Communication Principles and Practice” Oxford University Press: New Delhi, 2014.
2.	Sureshkumar E., “Enineering English” Orient Blackswan: Hyderabad, 2015
3.	Diana L. Fried-Booth, Project Work, Oxford University Press, Oxford: 2014.

BoS Chairman

B. TECH.	B19MAT201 - INTEGRAL CALCULUS AND COMPLEX ANALYSIS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
2.	To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
3.	The various methods of complex analysis can be used for efficiently solving the problems that occur in various branches of engineering disciplines.
4.	To develop an understanding of the standard techniques of complex integration so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.

UNIT - I	DEFINITE AND INDEFINITE INTEGRALS	12
Definite and Indefinite integrals - Substitution rule - Techniques of integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions.		

UNIT - II	MULTIPLE INTEGRALS	12
Double integrals: Change of order of integration – 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 parallell opipeds).		

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 – Taylor's and Laurent's series - Singularities – Residues – Cauchy's Residue theorem – Evaluation of real integrals – 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, in addition to change of order and change of variables.
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, 2016.

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, 2016.
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", CRC Press, Boca Raton London, New York Washington, DC, 2nd Ed, 2009. (Free e-book downloaded from www.EasyEngineering.net.pdf)

BoS Chairman

B. TECH.	B19PHT101 - ENGINEERING PHYSICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To make the students enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT - I	PROPERTIES OF MATTER	9

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

Bending of beams - Bending moment - cantilever; theory and experiment - uniform and non-uniform bending; theory and experiment - I-shaped girders.

UNIT - II	PHOTONICS AND FIBER OPTICS	9

Lasers; Population of energy levels, Einstein's A and B coefficients derivation- resonant cavity, optical amplification (qualitative) – Types; Nd-YAG Laser, Semiconductor lasers; homojunction and heterojunction, Industrial and Medical Applications. Fibre Optics; Principle, Numerical Aperture and Acceptance Angle - Types of optical fibres (material, refractive index, mode) – Applications; Fibre optic communication system - Block diagram, fibre optic sensors- pressure and displacement sensors – Endoscopy.

UNIT - III	ULTRASONICS	9

Classification of Sound, Production of ultrasonics - Magnetostriction generators, piezoelectric generators - acoustic grating – cavitation - ultrasonic cleaning. Applications; Non Destructive Testing, pulse echo system through transmission and reflection modes, A, B and C, scan displays- Engineering applications; SONAR,- Medical applications; Sonograms.

UNIT - IV	QUANTUM PHYSICS	9

Black body radiation; Planck's theory (derivation) - wave particle duality - debroglie wavelength - electron diffraction - Davisson - Germer experiment - 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).

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UNIT - V	CRYSTAL PHYSICS	9
Crystal Structures; Single crystalline, polycrystalline and amorphous materials - unit cell - 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. Growth of single crystals; Solution and melt growth techniques (Bridgeman & Czhochralski).		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basics of Properties of matter and its applications.
CO2	Illustrate the basics of Laser, Fiber optics and their applications.
CO3	Infer the concepts of ultrasonics and its applications
CO4	Interpret the basic knowledge of Quantum theory that could be helpful in understanding the wave functions of a particle
CO5	Classify and compare the different types of crystals, their structures and its preparation techniques

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.

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.

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B. TECH.	B19BTT201 – BIOCHEMISTRY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the biomolecules.
2.	To understand the basics and 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 BIOMOLECULES	9

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical,nature of water, pH and biological buffers.

Carbohydrates : Monosaccharides, disaccharides, glycosidic linkages, oligosaccharides, polysaccharides, glycoproteins, glycolipids structure and functions.

Amino acids and proteins : Amino acids – classification- structure – properties- chemical reactions. Peptides – proteins – structure and functions.

Enzymes : Introduction, classification and properties.

UNIT - II	STRUCTURE AND PROPERTIES OF BIOMOLECULES	9

Lipids : Types – fatty acids, triacyl glycerides, phospholipids, sphingolipids, glycolipids, sterols, biological membranes – structure, composition and membrane proteins, membrane transport.

Nucleic acids : Chemical composition of nucleic acids- bases, nucleosides, nucleotides, nucleic acid polymers, structure, complementarily and functions of nucleic acids.

UNIT - III	METABOLISM OF CARBOHYDRATES AND LIPIDS	9

Carbohydrate metabolism : Glycolysis, TCA cycle, Gluconeogenesis, Glycogen synthesis and breakdown, Pentose phosphate pathway – Photosynthesis, respiration and oxidative phosphorylation. Regulation of carbohydrate metabolism.

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

UNIT - IV	METABOLISM OF PROTEINS AND NUCLEIC ACIDS	9

Amino acid metabolism : Amino acid oxidation, urea cycle, amino acid biosynthesis, Regulation. Metabolic disorders of amino acid metabolism: Phenyl ketonuria, albinism metabolic disorders of nucleic acid metabolism: Lesch-Nyhan syndrome, Gout.

Nucleotide metabolism : Salvage and de nova synthesis, degradation – Regulation.

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UNIT - V	HORMONAL REGULATION OF METABOLISM	9
Interconnection of pathways of metabolism. Metabolic regulation: reversible and coupling reactions. Hormonal regulation of glycolysis and gluconeogenesis: insulin, glucagon and glucocorticoids; Hormonal control of glycogenolysis: epinephrine and glucagon; Hormonal control of lipid and protein metabolism.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the structure and properties of different biomolecules.
CO2	Outline the different metabolic pathways involved in the living systems.
CO3	Make use of the metabolic pathways to study the metabolic disorders.
CO4	Apply and identify the relationship between the metabolic pathways and hormones
CO5	Select the appropriate hormonal control mechanism for biomolecules.

Text Books	
1.	Lehninger, “Principles of Biochemistry” 6th Ed DL Nelson, MM. Cox (Eds.) 2013.
2.	Satyanarayana, U and Chakerapani U, “Biochemistry” 5th Rev. Ed, Books & Allied (P) Ltd, 2006.
3.	Rastogi, SC. “Biochemistry” 3rd Ed. Tata McGraw-Hill, 2010.
4.	Conn EE, Stumpf PK, Bruening G and Doi RY, “Outlines of Biochemistry” 5th Ed. John Wiley & Sons, 1987.

Reference Books	
1.	Berg J.M., Tymoczko JL, Gatto Jr. GJ and Stryer L. “Biochemistry”, 8th Ed. WH Freeman & Co., 2015.
2.	Rodwell V.W., Bender DA, Botham KM, Kennelly PJ and Weil PA “Harper’s Illustrated Biochemistry”, 30th Ed. McGraw-Hill, 2015.
3.	Voet D. and Voet J.G., “Biochemistry”, 4th Ed. John Wiley & Sons Inc. 2010.

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B. TECH.	B19BTT202 – MICROBIOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the world of microorganisms.
2.	To understand the nutritional requirements, growth and metabolism of microbes.
3.	To understand the physiology and replication mechanisms of microorganisms.
4.	To comprehend the control measures of microorganisms.
5.	To apply the microbial systems in various

UNIT - I	INTRODUCTION TO MICROBIOLOGY	9

Basic of microbial existence : History of Microbiology, classification, and nomenclature of Microorganisms. Contribution of Antoine van Leeuwenhoek, Lazzaro Spallanzani, Louis Pasteur, Robert Hooke, Robert Koch, Edward Jenner, Alexander Fleming to Microbiology.

Microscopy : Light and Electron microscopy. Microscopic examination of microorganisms morphology and fine structure of Bacteria. Principles of different staining techniques: Simple, Gram's, Acid fast, Negative, Capsular, Endospore and Flagellar staining.

UNIT - II	MICROBIAL NUTRITION, GROWTH AND METABOLISM	9

Nutritional requirements of bacteria – microbial culture media: types and applications, different media for culturing of microorganisms, screening and isolation of microorganisms; Pure culture techniques; preservation and maintenance of cultures. Microbial growth: growth curve, direct and indirect methods of microbial growth determination, factors affecting microbial growth.

UNIT - III	MICROBIAL PHYSIOLOGY AND REPLICATION	9

Types, classification, characteristics, morphology structure, cultivation and reproduction of microorganisms: Bacteria, virus, fungus, actinomycetes and molds. Aerobic and anaerobic growth of microorganisms. Replication of viruses: Lytic and Lysogenic life cycle –importance of bacteriophages.

UNIT - IV	CONTROL OF MICROORGANISMS AND ANTIMICROBIALS	9

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: anti-bacterial, anti-fungal agents, anti-viral agents, common mode of actions to control microbes and resistance to antibiotics.

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UNIT - V	APPLIED MICROBIOLOGY	9
Microbial metabolites: Microbial applications in agricultural, biotechnological, pharmaceutical, and environmental applications. Physical, chemical, and biological control of microorganisms. Host microbe interactions such as plant - microbe interaction & animal microbe interaction.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basics and fundamentals of Microbiology.
CO2	Demonstrate the different staining techniques and use of microscope.
CO3	Illustrate the important physiology and controlling microorganisms of microorganisms.
CO4	Explain the basics of nutritional requirements of microorganisms.
CO5	Apply the knowledge of microbes for the development of various metabolites.

Text Books	
1.	Prescott L.M., Harley J.P., Klein DA, Microbiology, 9th Edition, Wm. C. Brown Publishers, 2014.
2.	Pelczar MJ, Chan ECS and Krein NR, Microbiology, 5th Edition, Tata McGraw Hill Edition, New Delhi, India.

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.E. / B.Tech.	B19HST201 - தமிழர் மரபு	T	P	TU	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

Text - Cum - Reference Books

BoS Chairman

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.	B19HST201 - HERITAGE OF TAMILS (Common to all Branches)	T	P	TU	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

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 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. TECH.	B19PHP101 – PHYSICS LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To introduce different experiments to test basic understanding of physics concepts applied in properties of matter, optics, thermal physics, and liquids.

List of Experiments		
Expt. No.	**Description of the Experiments (Any 8 experiments)**	
1.	Determination of rigidity modulus – Torsion pendulum.	
2.	Determination of Young's modulus by non-uniform bending method	
3.	Determination of Young's modulus by uniform bending method	
4.	Determination of wavelength of mercury spectrum – spectrometer grating	
5.	Determination of Refractive index of a prism – spectrometer.	
6.	Determination of thickness of a thin wire – Air wedge method.	
7.	a.	Determination of wavelength, and particle size using Laser.
	b.	Determination of acceptance angle in an optical fiber.
8.	Determination of thermal conductivity of a bad conductor – Lee's Disc method.	
9.	Determination of band gap of a semiconductor.	
10.	Determination of specific resistance of the wire using Carey Foster's Bridge.	
11.	Experiment with Poiseuille's apparatus to determine the viscosity of liquids.	
12.	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.	
Total Instructional hours : 30		

BoS Chairman

Course Outcomes	
CO1	Classify the elastic properties of the materials by using uniform, non- uniform Bending method and torsional pendulum apparatus.
CO2	Illustrate the Optical properties of light with the help Classify the elastic properties of the materials by using uniform, non- uniform Bending method and torsional pendulum apparatus of LASER, applications, Spectrometer and to determine the thickness of the wire using air wedge.
CO3	Interpret the thermal conductivity of bad conductor using Lee's Disc apparatus.
CO4	Utilize the band gap apparatus to find the band gap a semiconductor and determine the specific resistance of the wire using Carey Foster's Bridge.
CO5	Make use of Poiseuilles's apparatus to determine the viscosity of liquid and to determine the velocity of sound and compressibility of liquid by using ultrasonic Interferometer.

Text Books	
1.	Prepared by Physics Department
2.	Senthilkumar G, "Physics Laboratory" Vol. I & II, VRB Publishers Pvt. Ltd., Chennai, 2016.

BoS Chairman

B. TECH.	B19BTP201 – BIOCHEMISTRY LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To have a 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.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Basic laboratory calculations and standardization of solutions.
2.	Preparation of buffers and determination of pKa.
3.	Quantitative analysis of carbohydrates and aminoacids.
4.	Estimation of glucose by DNS method.
5.	Estimation of Protein by Lowry/Bradford method.
6.	Determination of acid value and iodine number of oil.
7.	Synthesis of aspirin.
8.	Extraction and estimation of lycopene from tomato.
9.	Extraction of caffeine from various coffee powder samples.
10.	Biodiesel preparation
11.	Saponification reactions of vegetable oils
12.	Extraction of oil from seed (Soxhlet apparatus)
13.	Extraction of bioactive molecules from medicinal plant
	Total Instructional hours : 30

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Demonstrate the preparation of reagents and buffers.
CO2	Demonstrate the qualitative and quantitative analysis of biomolecules.
CO3	Demonstrate the extraction of bioactive molecules from natural sources.

Reference Books	
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”, 5thEd. 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. TECH.	B19MEP201 – BASIC WORKSHOP PRACTICE LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical Engineering.
2.	To provide exposure to the students with hands on experience on various basic engineering practices in Electrical Engineering.
3.	To provide exposure to the students with hands on experience on various basic engineering practices in Electronics Engineering.

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

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	Sheet metal **Making of small parts using sheet metal** 1. Tray Funnel 2. Funnel
	Machine assembly practice and Demonstration 1. Machine assembly practice on: 2. Study of centrifugal pump 3. Study of air conditioner
	Total Instructional hours : 30

GROUP – B (ELECTRICAL & ELECTRONICS)	
Expt. No.	**List of 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 and Desoldering practices.
	Instruction Hours: 30
	Total Instructional Hours: 60

BoS Chairman

Course Objectives : 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

BoS Chairman

B. TECH.	B19CEP201 – SOFT SKILLS - I	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	Enhance communication and problem solving skills
2.	Develop the inter personal skills
3.	Enhance the Employability and Career Skills of students

UNIT - I	SELF EVALUATION	6
Introducing to soft skills, Familiarize yourself, Self-understanding, SWOT analysis, Goal Setting		

UNIT - II	INNOVATIVE THINKING	6
Divergent thinking, Encourage curiosity, Write your story, Poster making		

UNIT - III	COMMUNICATION SKILLS	6
Just a Minute, workplace communication, Role Play, Extempore, Effectiveness of body language.		

UNIT - IV	EMOTIONAL INTELLIGENCE	6
Personal etiquette and relationship, Stress and Time Management.		

UNIT - V	PERSONALITY DEVELOPMENT	6
Leadership skills, Managerial skills, corporate etiquette, Team Building Language Development.		
	Total Instructional hours : 30	

Course Outcomes	
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

Reference Books	
1.	Butterfield J, “Soft Skills for Everyone” Cengage Learning, New Delhi, 2015.
2.	Hariharan S, Sundararajan N and Shanmugapriya SP, “Soft Skills”, MJP Publishers, Chennai, 2010.
3.	Francis F, “Soft Skills and Professional Communication”, New Delhi, Tata McGraw Hill, 2012.

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Semester - III

B. E. MECH / B. TECH. BT	B19MAT304 – PARTIAL DIFFERENTIAL EQUATIONS AND PROBABILITY	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To introduce the basic concepts of PDE for solving standard partial differential equations.
2.	To understand Fourier series analysis in representation of Periodic signals.
3.	To develop Fourier series techniques in solving wave and heat flow problems.
4.	To introduce the basic concepts of probability and random variables.
5.	To introduce the basic concepts of two dimensional random variables

UNIT - I	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of first order partial differential equations of the forms f(p,q) = 0, z = px + qy + f(p,q) – Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT - II	FOURIER SERIES	12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series - Parseval's identity – Harmonic analysis.

UNIT - III	BOUNDARY VALUE PROBLEMS	12

Classification of second order linear PDE – Method of separation of variables – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction – Fourier series solutions in Cartesian coordinates.

UNIT - IV	PROBABILITY AND RANDOM VARIABLES	12

Probability – Conditional probability – Baye's theorem Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson and Normal distributions.

UNIT - V	TWO - DIMENSIONAL RANDOM VARIABLES	12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.

Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Solve the partial differential equations with constant coefficients
CO2	Solve differential equations using Fourier series analysis
CO3	Apply Fourier series to solve boundary value problems.
CO4	Develop the concepts of probability and standard distributions.
CO5	Apply the basic concepts of two dimensional random variables.

Text Books	
1.	Grewal BS, “Higher Engineering Mathematics”, 44th Ed. Khanna Publishers, New Delhi, 2020.
2.	Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics" Volume III, S. Chand & Company Ltd., 2016.
3.	Johnson RA, Miller I and Freund J, “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 8th Ed. 2015.

Reference Books	
1.	Ramana BV, “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2.	Kreyszig E, “Advanced Engineering Mathematics “, 10th Ed. John Wiley, India, 2016
3.	Ray Wylie C and Barrett LC, “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt. Ltd, 6th Ed. New Delhi, 2012.
4.	Devore JL, “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Ed. 2014.

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B. TECH.	B19BTT301 – STOICHIOMETRY AND FLUID MECHANICS	T	P	TU	C
		3	0	1	3

Course Objectives	
1.	To study the basic chemical calculations and the gas law equations.
2.	To apply the material balance equations for various operations.
3.	To understand and solve the energy balance problems
4.	To introduce the students to the mechanics of fluids.
5.	To expose the applications of the laws of conservation.

UNIT - I	BASIC CHEMICAL CALCULATIONS	9 + 3

Dimension – Systems of units - conversion – composition of mixtures and solutions –chemical reactions and process calculations. Ideal and actual gas equations, Vander Walls, compressibility factor equations, application to pure gas and gas mixtures – partial pressures, partial volumes – Air- water vapour systems –Basics of humidity and its types.

UNIT - II	MATERIAL BALANCE	9 + 3

Material balance concept – overall and component – material balance applications for evaporator, gas absorber without reaction, distillation (Binary system), liquid extraction, solid-liquid extraction, drying, crystallization, humidification, reverse osmosis separation and mixing recycle and bypass illustration. Chemical reaction-limiting, excess component, fractional conversion, percent conversion, fractional yield in multiple reactions. Simple problems, combustion reactions.

UNIT - III	ENERGY BALANCE	9 + 3

General energy balance equation for open systems, closed system, sensible and latent heat calculations, heat required for phase change thermo chemistry, application of steam tables, saturated and superheated steam application in bioprocess.

UNIT - IV	FLUID PROPERTIES	9 + 3

Units and dimensions - properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics, types of flow - continuity equation and energy equation.

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UNIT - V	FLOW MEASUREMENTS	9+3
Bernoulli's equation – applications - Venturimeter – orifice meter – Rotameter – elbow meter, Pitot tube. Flow through pipes – laminar and turbulent flow in pipes, Darcy – Weisbach equation for friction head loss – Chezy's formula – major and minor losses.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to :	
CO1	Understand the units of various physical parameters, conversion factors.
CO2	Understand about the various material balances and difference between steam and heat and their balances.
CO3	Explain about the application of energy balance in bioprocesses.
CO4	Explain about the fluid flow in packed columns and their flow patterns.
CO5	Understand about the process of agitation and various agitator vessels.

Text Books	
1.	Bhatt BI and SB Thakore, "Stoichiometry", 5th Ed. Tata McGraw Hill, 2012.
2.	Gavhane KA, "Introduction to Process calculations", Nirali Publication 2016.
3.	Sikdar DC. "Chemical Process Calculations", PHI learning Private Ltd, 2013.
4.	Rajput RK, "Fluid Mechanics & Hydraulic Machines", S. Chand Limited, 2008.

Reference Books	
1.	Mc Cabe WL, Sonith JC and Harriot P "Unit Operations of Chemical Engineering" 6th Ed. McGraw Hill, 2001.
2.	Fox RW, Alan T, Mc Donald and Pritchard PJ "Introduction to Fluid Mechanics" 6th Ed. John Wiley & Sons, 2003.
3.	Himmelblau DM "Basic Principles & Calculations in Chemical Engineering" 6th Ed. PHI, 2006.
4.	Bansal RK, "A Textbook of Fluid Mechanics", Laxmi Publications, 2008.

BoS Chairman

B. TECH.	B19BTT302 – BIOCHEMICAL THERMODYNAMICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand basic concepts in thermodynamics
2.	To acquire knowledge on solution thermodynamics
3.	To understand the concept of phase equilibrium
4.	To acquire knowledge on chemical reaction equilibrium and to apply for bioprocess reaction.
5.	To describe the thermodynamics involved in cell growth and to apply for biological reaction.

UNIT - I	THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS	9

First law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non-ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT - II	SOLUTION THERMODYNAMICS	9

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT - III	PHASE EQUILIBRIA	9

Criteria for phase equilibria, Phase equilibria in single and multicomponent systems, Duhem's Theorem, VLE calculations for binary and multi component systems, Phase equilibrium in ideal solution, Vapor-Liquid Equilibrium at low, moderate and high pressures, liquid-liquid equilibrium, Ternary liquid-liquid equilibrium, and solid-solid equilibria.

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	THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION	9
Thermodynamics of microbial growth, stoichiometry 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	Explain the theoretical concepts of thermodynamics.
CO2	Explain thermodynamics concepts applies to energy conversion in technological applications and biological systems.
CO3	Demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.
CO4	Design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.
CO5	Describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.

Text Books	
1.	Smith JM. Van Ness HC and Abbot MM, “Introduction to Chemical Engineering Thermodynamics”, 6th Ed. Tata McGraw-Hill, 2003.
2.	Narayanan KV, “A Text Book of Chemical Engineering Thermodynamics”, PHI, 2003.
3.	Smolke CD, “The Metabolic Pathway Engineering Handbook Fundamentals”, CRC Press Taylor & Francis Group, 2010.

Reference Books	
1.	Sandler SI, “Chemical, Biochemical and Engineering Thermodynamics”, Wiley, 1989.

BoS Chairman

B. TECH.	B19BTT303 – BIOORGANIC CHEMISTRY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the basics and fundamentals of organic chemistry.
2.	To understand about various elements of atom, charges and their bonding rule.
3.	To understand the various kinetic properties and types of reaction mechanisms.
4.	To understand the biologically important chemical molecules.
5.	To understand the biosynthesis and process of bioactive molecules.

UNIT - I	INTRODUTION TO ORGANIC CHEMISTRY	9

Overview of bioorganic chemistry – historical connection between organic and biological chemistry; weak interactions in organic and biological world; proximity effect in organic chemistry; molecular recognition; chemistry of the living cells; analogy between biochemical and organic reaction.

UNIT - II	BONDING AND STEREOCHEMISTRY	9

Atoms electron and orbitals – covalent bonds – octet rile – polar covalent bonds – electronegativity – formal charge – resonance acids and bases – Arrhenius and Bronsted Lowry theories – acid base equilibria – sp3 hybridization – conformations analysis ethane, butane and cyclohexane – cis- trans isomerism. Stereochemical activity around the tetrahedral carbon – optical activity – conformation of the peptide bond.

UNIT - III	MECHANISM OF SUBSTITUTION AND ADDITION REACTIONS	9

Sn1 and Sn2 reaction on tetrahedral carbon – nucleophiles – mechanism steric effects – nucleophilic addition on acetals and ketals – aldehyde and ketone groups reactions of carbonyl group with amines – acid catalyzed ester hydrolysis – saponification of an ester – hydrolysis of amides. Ester enolates – Claisen condensation – Michaeal condensation.

UNIT - IV	CHEMISTRY OF NATURAL PRODUCTS	9

Alkaloids: properties and reactions; synthesis and biological properties of coniine, piperine, terpenoids and carotenoids: general methods of synthesis of terpenoids; isoprene rule; structure and synthesis of menthol; general methods of anthocyanines and flavones synthesis; Cyanidine chloride and quercetin; curcumin, structure and synthesis.

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UNIT - V	CHEMICAL SYNTHESIS OF BIOLOGICAL MOLECULES	9
General methods of amino-acid synthesis, properties and general reactions, peptide synthesis, reagents for protection and de-protection, end group analysis, solid phase synthesis and oligonucleotide synthesis.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Develop basic knowledge in atoms, electrons, reactions and orbitals and organic chemistry.
CO2	Learn basic concepts about kinetic method and different mechanism involved.
CO3	Obtains knowledge in catalytic activity and reactivity in bioorganic chemistry.
CO4	Obtains knowledge in bioorganic reactions in timing of bond formation and fission.
CO5	Develop skills on the process of chemical synthesis of bio-active molecules.

Text Books	
1.	Carey Francis A, “Organic Chemistry”, 7th Ed. Tata McGraw Hill, 2009.
2.	Page MI and Williams A, “Organic and Bioorganic Mechanisms”, Pearson, 2010.
3.	Kalsi PS and Jagtap S, “Pharmaceutical, Medicinal and Natural Product Chemistry”, Narosa Publishing House, New Delhi, 2013.

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

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B. TECH.	B19BTT304 – CELL BIOLOGY AND GENETICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic knowledge on the fundamentals of cell biology and structure and functions of cell and cell cycle.
2.	To acquire knowledge on transportation across cell membrane and role of receptors.
3.	To deliver elementary facts on mechanisms of signal transduction.
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, CELL DIVISION AND CELL CYCLE	9

History of cell biology; Comparison of eukaryotic and prokaryotic cells; biological membrane organization-membrane proteins; cytoskeletal proteins; types of cell division - mitosis and meiosis; cell cycle – regulation – checkpoints – cancer, oncogenes, growth hormones and their roles.

UNIT - II	TRANSPORT ACROSS CELL MEMBRANE AND RECEPTORS	9

Passive and active transport, permeases, sodium potassium pump, Ca^{2+} ATPase pumps, lysosomal and vacuolar membrane; ATP dependent proton pumps, co-transport (symport, antiport), Cytosolic; Nuclear and membrane bound receptors; examples of receptors; Autocrine, paracrine and endocrine models of action. Endocytosis and exocytosis; receptor-mediated endocytosis.

UNIT - III	SIGNAL TRANSDUCTION	9

Types of ion-channels; Ligand-gated and voltage-gated ion channels; Neurotransmitters – mechanism of action, nerve conduction. Ion-channel agonists and antagonists. Signal amplifications; different models of signal amplification; Second messengers cAMP, Inositol phosphates, DAG, cGMP, G proteins, Ca; Protein kinases, serine threonine kinases

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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. Mechanism of sex determination, sex differentiation, sex linked inheritance, linkage and crossing over.		

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	Demonstrate the structure and function of intracellular organelles; and illustrate the mechanism of cell division.
CO2	Illustrate the mechanism of transport across cell membrane and explain about receptors.
CO3	Describe the functioning of ion-channels, ligand and voltage – gated ion channels, mechanism of neurotransmitters.
CO4	Explain the principles of Mendelian genetics and sex determination process.
CO5	Make use of the concept of mutation and evolutionary genetics.

Text Books	
1.	Simmons MJ and Snustad DP, "Principles of Genetics", John Wiley, 2012
2.	Gardner EJ and Simmons MJ and Snustad DP, "Principles of Genetics", John Wiley, 2006.
3.	Lodish H, Berk A, Zipurursky SL, Matsudaria P, Baltimore D and Darnell J, "Molecular Cell Biology", WH Free Man and Company, 2000.
4.	Rastogi SC, "Cell Biology, India": New Age International Pub. Ltd., 2001.

Reference Books	
1.	Robert HT, Principles of Genetics, Tata McGraw Hill, 2002
2.	Becker WM. et al., "The World of the Cell", 9th Ed. Pearson Education, 2003.

BoS Chairman

B. TECH.	B19MCT302 - INDIAN CONSTITUTION	T	P	TU	C
		2	0	3	0

Course Objectives	
1.	To understand the constitutional organization of India.
2.	To understand the hierarchy of Union Government of India.
3.	To know the hierarchy and systems of state Governments.
4.	To know the power, role of local administration in Government sectors.
5.	To understand role, function of Election Commission of India.

UNIT - I	THE CONSTITUTION - INTRODUCTION	6

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

UNIT - II	UNION GOVERNMENT	6

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

UNIT - III	STATE GOVERNMENT	6

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

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UNIT - IV	LOCAL ADMINISTRATION	6

- District Administration
- Municipal Corporation
- Zila Panchayat

UNIT - V	ELECTION COMMISSION	6

- Role and Functioning
- Chief Election Commissioner
- State Election Commission

Total Instructional hours : 30

Course Outcomes : Students will be able to	
CO1	Develop the knowledge on organization of Indian constitution.
CO2	Explains the hierarchy organization of Indian Government.
CO3	Explain various systems and applications of State Governments.
CO4	Understand the power and functional systems of local administration.
CO5	Understand the role and administration of Indian Election Commission.

Text Books	
1.	Bhargava R, “Ethics and Politics of the Indian Constitution”, Oxford University Press, New Delhi, 2008.
2.	Fadia, B.L., “The Constitution of India”,Sahitya Bhawan; New edition 2017.
3.	Basu, D.D., “Introduction to the Constitution of India”, Lexis Nexis; Twenty - Third 2018.

Suggested Software / Learning Websites	
1.	https://www.constitution.org/cons/india/const.html
2.	http://www.legislative.gov.in/constitution-of-india
3.	https://www.sci.gov.in/constitution
4.	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-ofindia/

BoS Chairman

B.E. / B.Tech.	B19HST301 - தமிழரும் தொழில்நுட்பமும்	T	P	TU	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

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
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.	B19HST301 - TAMILS AND TECHNOLOGY	T	P	TU	C
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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.

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B. TECH.	B19BTP301 – CELL BIOLOGY AND MICROBIOLOGY LABORATORY	T	P	TU	C
		0	3	0	3

Course Objectives	
1.	To understand the basics of cell biology and Microbiology.
2.	To develop basic skills on staining of biological samples and observing under microscopes.
3.	To enable students to understand the sterilization and disinfection practices.
4.	To develop the students to prepare various types of media and to use them for appropriate applications.
5.	To enable the students to equip their knowledge on enumeration of microorganisms and antibiotic sensitivity assay.

List of Experimentst	
Expt. No.	**Description of Equipment**
	Cell Biology
1.	Introduction to principles of sterile techniques and cell propagation.
2.	Principles of microscopy : Simple, phase contrast and fluorescent microscopy.
3.	Identification of given plant, animal and bacterial cells & their components by microscopy.
4.	Separation of peripheral blood mononuclear cells from blood.
5.	Cell viability assay.
6.	Staining for different stages of mitosis in Allium cepa (Onion).
	Microbiology
7.	Good laboratory practices.
8.	Sterilization techniques : Physical, chemical and radiation methods.
9.	Culture media - types and use; preparation of nutrient broth and nutrient agar.
10.	Culture techniques; isolation and preservation of cultures - Broth: flask, test tubes; Solid: pour plates, streak plates, slants, stabs.

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11.	Staining of microorganisms : Simple, Gram's, Endospore, Capsule staining.
12.	Motility test - Hanging drop method (Demonstration only).
13.	Quantification of microbes: Enumeration of total heterotrophic bacteria in soil.
14.	Effect of disinfectants - Phenol coefficient test (Demonstration only).
15.	Antibiotic sensitivity assay
16.	Microbial growth curve : Bacteria and Yeast (Demonstration only)
17.	Membrane filtration technique (Demonstration only).
18.	Effect of pH, temperature, UV radiation on bacterial growth.
	Total Instructional hours : 60

Course Outcomes : Students will be able	
CO1	Understand basics on laboratory bio-safety and preventive measures.
CO2	Understand the basic techniques to work with cells and various stages of mitosis.
CO3	Know the various sterilization procedures and preparation of culture media.
CO4	Isolate, culture, maintain various microorganisms, also staining and observing them under microscope.
CO5	Understand growth kinetics of microorganisms and to perform antibiotic sensitivity assay.

Reference Books	
1.	Rickwood D and Harris JR, "Cell Biology: Essential Techniques", John Wiley, 1996.
2.	Davis JM, "Basic Cell Culture: A Practical Approach", IRL, 1994.
3.	Cappuccino JG and Sherman N "Microbiology: A Laboratory Manual", 4th Ed, Addison-Wesley, 1999.
4.	Collee JG et al., "Mackie & McCartney Practical Medical Microbiology" 4th Ed, Churchill Livingstone, 1996.

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B. TECH.	B19BTP302 – CHEMICAL ENGINEERING LABORATORY FOR BIOTECHNOLOGIST	T	P	TU	C
		0	3	0	3

Course Objectives	
1.	To provide basic understanding of Chemical Engineering principles and operations.
2.	To enable students to apply the principles in bioprocess Engineering and Biotechnology subjects offered in higher semesters.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Measuring the fluid flow through a pipe using variable head flow meter – Orifice meter.
2.	Measuring the flow through a pipe using variable head flow meter – Venturimeter.
3.	Measuring the flow through a pipe using variable area flow meter – Rotameter.
4.	Determination of pressure drop and velocity in flow through pipes.
5.	Pressure drop in flow through packed column.
6.	Calculation of pressure drop across the fluidized beds.
7.	Characteristics of centrifuge pump.
8.	Filtration through plate and frame filter press.
9.	Filtration in leaf filter.
10.	Heat transfer coefficient in a double pipe heat exchanger.
11.	Verification of Rayleigh's equation - Simple and steam distillation.
	Total Instructional hours : 60

Course Outcomes : Students will be able	
CO1	Have knowledge on the basic principles of Chemical Engineering.
CO2	Apply the skill of material balance and energy balance in unit operations unit process of Chemical Engineering and Biotechnology.
CO3	Analyze the principles of Chemical Engineering and its applications in chemical, mechanical and biological perspectives.
CO4	Understand the design and working principles of fluid moving machinery and transport phenomena.

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B.E. / B. TECH.	B19CEP301 – SOFT SKILLS - II (Common to all Branches)	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To enhance communication skills through LSRW skills.
2.	To enrich interpersonal skills through integrated activities.
3.	To develop social and professional etiquette.
4.	To identify and apply employability skills for professional success.

UNIT - I	COMMUNICATION SKILLS	6

Define Listening Types of listening – Listening and filling information – Basis of phonetics – Strategies of effective reading – Reading and responding to business communications – e-mail.

UNIT - II	INTERPERSONAL SKILLS	6

Interpersonal Skills - Need & Components – Understanding Inter cultural Competence – Team Work - Problem Solving Skills – Workplace Conflict Management & Resolutions.

UNIT - III	EMOTIONAL INTELLIGENCE	6

Key Elements of Emotional Intelligence - Self Awareness – Self Performance - Psychometric Analysis - Relationship Management - Critical Thinking & Reasoning.

UNIT - IV	BUSINESS ETIQUETTE	6

Define Etiquette – Types & 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 - Professionalism in Today's Workforce.

Total Instructional hours : 30

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Course Outcomes : At the end of the course the student will be able to	
CO1	Develop professional communication through LSRW skills.
CO2	Apply systematic approach in problem solving skills.
CO3	Utilize leadership skills with ability to work in a team.
CO4	Demonstrate employability skills.
CO5	Analyze & adapt workplace etiquette.

Reference Books	
1.	Meenakshi Raman and Shalini Upadhyay, “Soft Skills”, Cengage Learning India Pvt. Ltd, New Delhi, 2018
2.	Rao MS, “Soft Skills Enhancing Employability”, IK International Publishing House Pvt. Ltd, New Delhi, 2010.
3.	Sabina Pillai and Agna Fernandez, “Soft Skills and Employability Skills’, Cambridge University Press, 2018.
4.	John Peter A, “Self-Development and Professional Excellence”, Cengage Learning India Pvt. Ltd, New Delhi, 2019.

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B.E.	B19CEP302 - UAV SYSTEMS & ITS APPLICATIONS	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To understand the basic concepts of UAV systems design.
2.	To introduce the basics of Airframe and Hardware for UAV.
3.	To study the preliminary design requirements for an UAV system.
4.	To understand the basic Avionics system required for UAV design.
5.	To identify the various applications of the UAV systems.

UNIT - I	INTRODUCTION TO UAV	6
History of UAV – Classification – Basic terminology – Introduction to UAS – Recent trends in Mini UAV and MAV – Models and Prototypes – UAV Pilot Training.		

UNIT - II	BASICS OF AIRFRAME & HARDWARE	6
Airframe – Dynamics – Structures – Aerodynamics – Control surfaces –Specifications – Autopilot – Sensors – Sensor calibration		

UNIT - III	PAYLOADS, CONTROLS & PATH PLANNING	6
Payloads – Ground controls software – Displays – Parameter settings – Simulation – System ground test – Waypoint navigation – GCS operation training.		

UNIT - IV	REMOTE SENSING, GIS & IT USES	6
Aerial remote sensing – DGPS – Software – Photogrammetry – Concepts of GIS –Applications of RS and GIS – Servers & nodes – Computing – Memory Capacity.		

UNIT - V	UAV APPLICATIONS & WEB GIS	6
Military – Agriculture – Forestry – Disaster – Mining – Construction – Transport – Water Resource Management – Urban Studies – Utilities etc. – Importance of Web GIS.		
		Total Instructional hours : 30

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Course Outcomes : Students will be able to	
CO1	Outline fundamentals of UAV systems. (K2)
CO2	Outline basic Airframe and Hardware systems used in the UAV. (K2)
CO3	Identify primary requirements for the designing of an UAV systems. (K3)
CO4	Relate Avionics systems required for UAV design. (K2)
CO5	Summarize the various applications of the UAV systems. (K2)

Text Books	
1.	Reg Austin “unmanned aircraft systems UAV design, development and deployment”, Wiley, 2010
2.	Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc,1998
3.	Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007

References Books	
1.	P.J.Swatton - Ground studies for pilots’ flight planning, Sixth edition, 2002.
2.	Ian Heywood., “An Introduction to GIS”, Pearson Education, New Delhi, 2001.
3.	Patel A.N & Surendra Singh, “Remote sensing principles & applications”, Scientific Publishers, Jodhpur 1992
4.	Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.
5.	Unmanned Aerial Vehicle (UAV) application for societal applications (https://www.cbinsights.com/research/drone-impact-society-uav/).

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Semester - IV

B. TECH.	B19MAT406 – BIOSTATISTICS (for B. TECH. Biotechnology)	T	P	TU	C
		3	0	1	4

Course Objectives : The aim of this course is to	
1.	Understand the concepts of Statistics.
2.	Introduce the testing of hypothesis for small and large samples.
3.	Provide the basic concepts of classifications of design of experiments and statistical quality control which plays major role in agriculture.
4.	Apply the knowledge of Time series analysis.

UNIT - I	INTRODUCTION TO STATISTICS	12

Statistics – Definition, Types. Types of variables – Organising data – Measures of central tendency – Mean, Median, Mode, Geometric mean and Harmonic mean. Measures of dispersion – Range, Quartile deviation, Mean deviation and Standard deviation – Coefficient of variation – Coefficient of Dispersion.

UNIT - II	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters - Statistical hypothesis Large sample tests based on Normal distribution for single mean and difference of means Tests based on t, Chi-square and F distributions for mean, variance - Contingency table (test for independent) Goodness of fit.

UNIT - III	DESIGN OF EXPERIMENTS	12

One way and two way classifications Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design.

UNIT - IV	TIME SERIES ANALYSIS	12

Time series analysis - Variations in time series - Trend analysis - Cyclical variations - Seasonal variations and Irregular variations Forecasting errors

UNIT - V	STATISTICAL QUALITY CONTROL	12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits Acceptance sampling

Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Interpret the statistical data using measures of central tendency and dispersion.
CO2	Identify Large and small samples of testing of hypothesis.
CO3	Construct the ANOVA tables for CRD, RBD and LSD.
CO4	Demonstrate knowledge of critical understanding of the main concepts of time series analysis.
CO5	Develop the sampling distributions and statistical quality control techniques used in engineering and management problems.

Text Books	
1.	Kapoor VK and Gupta SC, “Fundamentals of Mathematical Statistics”, S Chand & Sons, 9th Ed. 2014.
2.	Kandasamy P, Thilagavathy K and Gunavathy K., “Statistics and Numerical Methods’’, S. Chand & Company Ltd., 2018.
3.	Johnson RA, Miller I and Freund, “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 8th Ed. 2015.

Reference Books	
1.	Devore JL, “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Ed. 2014.
2.	Agarwal BL, “Basic Statistics”, New Age International publications, 6th Ed. 2013
3.	Walpole RE, Myers RH, Myers SL and Ye K, “Probability and Statistics for Engineers and Scientists”, Pearson Education, Asia, 9th Ed. 2013.
4.	Rao S and Richard J, “Introduction to Biostatistics and Research Methods” PHI Learning, 5th Ed. 2012.

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B. TECH.	B19BTT401 – INDUSTRIAL BIOTECHNOLOGY	T	P	TU	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 various products produced by fermentation.
5.	To prepare the students for 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, Process flow sheeting – block diagrams, pictorial representation. Industrially important microorganisms: Bacteria, fungus and yeast – Sources, isolation, identification, strain improvement and preservation. Growth of microorganisms under controlled environments – Medium optimisation: influence of carbon, nitrogen sources, temperature and pH.

UNIT - II	MICROBIAL METABOLITES	9

Microbial metabolites: Introduction, types: Primary and Secondary metabolites – Importance and strategies of industrial fermentation technology – 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 and B12).

UNIT - III	INDUSTRIAL BIOPRODUCTS	9

Production of industrial enzymes, biopreservatives, biopolymers, beer, wine, SCP, biosurfactants. Production of dairy products : yogurt, kumis and cheese; Technique of mass culture of algae – spirulina, Chlorella and hydrocolloids. Production of bread and vinegar.

UNIT - IV	RECOMBINANT PRODUCTS	9

Bio and thermoplastics, bio-PET, Sorona from bio-PDO, spider silk, Bio-isoprene, bulk chemicals, fine and speciality chemicals. Production of recombinant proteins (insulin, human growth hormone and interferon), vaccines and recombinant vaccines, monoclonal antibodies. Biofuel.

BoS Chairman

UNIT - V	AGRO - INDUSTRIAL BIOTECHNOLOGY	9
Biofertilizers in agro ecosystem; Biopesticides – bacteria, fungi and plant biopesticides, advantages. Composting – process, decomposition stages in compost preparation and methods; Vermicomposting. Organic farming. Bioremediation: Introduction, scope and applications – degradation of xenobiotics. Impacts of microbial Biotechnology.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basics of industrial bioprocess.
CO2	Have adequate knowledge on microbial products.
CO3	Understand the various food products produced through microbial fermentation.
CO4	Identify and debate the ethical, legal, professional, and social issues related to Biotechnology.
CO5	To design and deliver useful modern Biotechnology products to the society.

Text Books	
1.	Casida LE. “Industrial Microbiology”, New Age International Pvt. Ltd, 1968.
2.	Prescott SC. and Dunn CG, “Industrial Microbiology”, Agrobios (India), 2005.
3.	Stanbury PF, Whitaker A and Hall SJ, “Principles of Fermentation Technology”, 2nd Ed., Butterworth - Heinemann, 1995.
4.	Saikai R, “Microbial Biotechnology”, New India Publishing, 2008.
5.	Frazier WC, Westhoff DC and Vanitha NM, “Food Microbiology”, 5th Ed, McGraw Hill, 2017.
6.	Okafor N and BC Okeke, “Modern Industrial Microbiology and Biotechnology”, 2nd Ed., Taylor & Francis, 2017.

References Books	
1.	Glazer AN and Hiroshi N, “Microbial Biotechnology: Fundamentals of Applied Microbiology”, Cambridge University Press, 2nd Ed. 2007.
2.	Cruger W and Crueger A, “Biotechnology: A Textbook of Industrial Microbiology”, 2nd Ed., Panima Publishing, 2000.

BoS Chairman

B. TECH.	B19BTT402 – MOLECULAR BIOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To recollect the physical and chemical properties of nucleic acids and other macromolecules
2.	To describe the replication of prokaryotic and eukaryotic DNA.
3.	To familiarize the synthesis of RNA in eukaryotes and prokaryotes
4.	To expose students to genetic codes and translation machinery.
5.	To create deeper understanding on regulation of gene.

UNIT - I	NUCLEIC ACIDS	9

Macromolecules major classes, chemical structures and properties; Evidence of nucleic acids as genetic material – Griffith, Hershey and Chase, Avery McLeod & McCarty experiments; Physical and chemical structure of DNA; Conformations of DNA; RNA molecules – classes, structure and functions. Central dogma; Molecular organization of chromosomes.

UNIT - II	DNA REPLICATION AND REPAIR	9

DNA replication; Prokaryotic replication; Replication in eukaryotic chromosomes – machinery, untwisting of highly coiled DNA, de novo and covalent extension. Plasmids – characteristics, types and applications. DNA replication errors and their repair.

UNIT - III	TRASCRIPTION	9

Bacterial and eukaryotic RNA polymerases; Transcription in prokaryotes – initiation, elongation and termination; Inhibitors of transcription; Posttranscriptional modification – mRNA processing; splicing mechanism; miRNA, SiRNA, ncRNA.

UNIT - IV	GENETIC CODE AND TRANSLATION	9

The genetic code; Codon degeneracy, RNA and DNA codon tables; wobble hypothesis; Ribosomes – Prokaryotes and eukaryotes. Translation – initiation, elongation and termination. Inhibitors of protein synthesis; Post translational modifications.

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UNIT - V	REGULATION OF GENE EXPRESSION	9
Principles of gene regulation and operon concept; Transcriptional regulation – lac operon, tryptophan operon, arabinose operon, attenuation, autoregulation; Regulation of gene expression with reference to lambda phage life cycle. Transposable elements, Epigenetics, mutation and its repair mechanism.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Summarize the physical and chemical nature of DNA and RNA
CO2	Explain replication process in prokaryotes and eukaryotes
CO3	Demonstrate the mRNA synthesis mechanism
CO4	Interpret genetic codes and explain translation machinery
CO5	Illustrate 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.
3.	Lodish H, Berk A, Kaiser CA, Krieger M, Scott MP, Bretscher A, Ploegh H and Matsudaira P, “Molecular Cell Biology”, WH Freeman & Co., 2007.
4.	Weaver RF, “Molecular Biology” 2nd Ed. Tata McGraw-Hill, 2003

Reference Books	
1.	Tropp BE, “Molecular Biology: Genes to Proteins”. 3rd Ed. Jones and Bartlett, 2008.
2.	Glick BR and Pasternak JJ, “Molecular Biotechnology: Principles and Applications of Recombinant DNA”, 4th Ed. ASM, 2010.
3.	Friefelder D and Malacinski MG. “Essentials of Molecular Biology” 2nd Ed. Panima Publishing, 1993.

BoS Chairman

B. TECH.	B19BTT403 – ENZYMOLOGY AND ENZYME TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To recall the fundamentals of enzyme properties, nomenclature, characteristics and mechanisms.
2.	To familiarize biochemical calculation for enzyme kinetics.
3.	To compare different immobilization techniques with their pros and cons.
4.	To utilize the various analytical techniques available for enzyme analysis of different sources.
5.	To acquire knowledge of enzymes in different fields.

UNIT - I	INTRODUCTION TO ENZYMES	9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetic of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis, collision theory, transition state theory; role of entropy in catalysis.

UNIT - II	KINETICS OF ENZYME ACTION	9

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics.

UNIT - III	ENZYME IMMOBILIZATION	9

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., examples, advantages and disadvantages. Bioreactors for immobilized enzymes; Types of immobilized reactors.

UNIT - IV	PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES	9

Production and purification of crude enzyme extracts from plant, animal and microbial sources; Isolation of enzymes by various methods; Methods of characterization of enzymes. Assay of enzymes.

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UNIT - V	APPLICATIONS OF ENZYMES & BIOSENSORS	9
Design of enzyme electrodes, Application of enzymes in analysis, industry, healthcare and environment; Enzyme biosensor and its significance. Enzyme biosensors for biomedical and environmental applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	To outline the classification of enzymes and their characteristics.
CO2	To apply the knowledge of kinetics in the enzymatic reactions.
CO3	To illustrate the importance of immobilization for the shelf life of enzymes.
CO4	To summarize the different techniques used for the purification, characterization of enzymes from variant sources.
CO5	To apply the knowledge of enzymes in developing the products that are important to mankind.

Text Books	
1.	Palmer T, “Enzymes : Biochemistry, Biotechnology and Clinical Chemistry”, Affiliated East-West Press Pvt. Ltd, New Delhi, 2008.
2.	Blanch HW and Clark SD, “Biochemical Engineering”, Marcel Dekker Inc., 1997.

Reference Books	
1.	Lee JM, “Biochemical Engineering”, PHI, USA, 1992.
2.	Bailey JE and Ollis DF, “Biochemical Engineering Fundamentals”, McGraw Hill, 1986.

BoS Chairman

B. TECH.	B19BTT404 – ANALYTICAL METHODS IN BIOTECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To recall the concepts of errors and signal to noise ratio.
2.	To know the different molecular spectroscopic techniques and their analytical applications
3.	To understand the principles and operation of different structural elucidation techniques
4.	To expose the theory, instrumentation and use of chromatographic and electro-analytical techniques
5.	To enable students understand the principles and instrumentation of thermal methods and electro- analytical techniques

UNIT - I	PRINCIPLES OF MEASUREMENT	9

Concepts of precision, accuracy, reproducibility, linear range, sensitive type of measurement errors and methods to quantify measurement errors, method development: positive and negative controls, calibration approaches, Signal to noise ratio, Sources of noise – enhancement of signal to noise.

UNIT - II	MOLECULAR SPECTROSCOPY	9

Types of optical instruments – Fourier transform measurements – Theory and advantages. Measurement of transmittance and absorbance – Beer's law – Derivation and types of deviation. Spectrophotometer analysis – qualitative and quantitative absorption measurements – types of spectrometers – UV – visible, IR, Raman – theory, instrumentation and applications.

UNIT - III	STRUCUTRAL ELUCIDATION AND RADIOISOTOPE METHODS	9

Mass spectrometry: principle, instrumentation (electron spray ionization [ESI] and chemical ionization [CI] and applications; MALDI-TOF: principle and instrumentation; X-ray diffraction and nuclear magnetic resonance (NMR): principle, instrumentation and applications; Types of radioactive decay; Scintillation counters (ionization and excitation): principle, instrumentation and applications.

UNIT - IV	CHROMATOGRAPHY AND ELECTROPHORESIS	9

Chromatography - Principle, van Deemter equation, elution methods, analytical methods, HPLC, GC, Gel filtration, Ion exchange and affinity chromatography.

Electrophoresis – Principles, Isotachophoresis, Isoelectric focusing, Native/SDS-PAGE, enzyme zymography, agarose gel, Capillary electrophoresis.

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UNIT - V	THERMAL METHODS AND ELECTRO-ANALYTICAL TECHNIQUES	9
Thermo-gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) theory, instrumentation and applications. Electrodes, reference electrodes, ion selective electrodes and pH meter. Potentiometry, voltammetry, colorimetry and amperometry – theory, instrumentation and applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the calibration of electrical instruments.
CO2	Apply the spectroscopic techniques to identify, estimate and characterize analytes.
CO3	Experiment with different techniques to elucidate the structure of analytes.
CO4	Develop chromatography techniques for separation of desired compound.
CO5	Utilize thermal methods to study the characteristics of analyte.

Text Books	
1.	Skoog DA, Holler FJ and Crouch SR, “Instrumental Methods of Analysis”. Engage Learning, 2007.
2.	Willard HH and Merrit LL, “Instrumental Methods of Analysis”, Prentice Hall of India, 2005.
3.	Wilson K and Walker J, “Principle and Techniques of Practical Biochemistry", 5th Ed. Cambridge University Press. Oxford, 2002.
4.	Chatwal GR and Anand SK, “Instrumental Methods of Chemical Analysis”, 5th Ed. Himalaya Publishing House, India. 2012.

Reference Books	
1.	Sharma BK, “Instrumental Methods of Chemical Analysis”, 24th Ed. Goel Publishing House, India. 2014.
2.	Heftman E. “Chromatography” 6th Ed. Elsevier, Netherlands, 2004.
3.	Segel IH and Segel AH, “Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry”, Wiley, 1976.

BoS Chairman

B.E. / B. TECH.	B19MCT301 – ENVIRONMENTAL SCIENCES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the nature and facts about environment.
2.	To find and implement scientific, technological, economic and political solutions to Environmental problems.
3.	To study the interrelationship between living organism and environment.
4.	To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
5.	To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT - I	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY	9

Definition, scope and importance of environment – need for public awareness concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega- diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT - II	ENVIRONMENTAL POLLUTION	10

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

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UNIT - III	NATURAL RESOURCES	9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer- pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT - IV	SOCIAL ISSUES AND THE ENVIRONMENT	9

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT - V	HUMAN POPULATION AND THE ENVIRONMENT	9

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

Total Instructional hours : 45

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Course Outcomes : At the end of the course the student will be able to understand the	
CO1	Basic concepts of environment, ecosystem and biodiversity
CO2	Different types of pollution and their control measures.
CO3	Various natural resources.
CO4	Development and improvement in the standard of living that has lead to serious environmental disasters.
CO5	Causes of population and role of Information technology in environment.

Text Books	
1.	Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2006.
2.	Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, 2nd Ed, Pearson Education, 2004.

Reference Books	
1.	Sengar DS, “Environmental Law”, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
2.	Bharucha E, “Textbook of Environmental Studies”, Universities Press (I) Pvt. Ltd., Hyderabad, 2015.
3.	Rajagopalan R, “Environmental Studies - From Crisis to Cure”, Oxford University Press, 2005.
4.	Miller GT and Spoolman SE, “Environmental Science”, Cengage Learning India Pvt. Ltd, New Delhi, 2014.

BoS Chairman

B. TECH.	B19BTP401 – MOLECULAR BIOLOGY LABORATORY	T	P	TU	C
		0	4	0	4

Course Objectives	
1.	To provide basic understanding on molecular biology techniques.
2.	To acquire knowledge in competent cells preparation and gene transfection technique.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Isolation and analysis of genomic DNA from microbial source (bacteria)
2.	Genomic DNA isolation from plant source
3.	Isolation of genomic DNA from animal sample
4.	Qualitative and quantitative analysis of DNA using UV-spectrophotometer
5.	Preparation and analysis of plasmid DNA using agarose gel electrophoresis
6.	Restriction digestion of plasmid DNA
7.	DNA purification from gel ligation
8.	RNA extraction and analysis using electrophoresis
9.	Protein isolation and SDS-PAGE analysis
10.	Protein detection by Silver staining and Coomassie staining
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Utilize molecular biology tools in recombinant DNA technology
CO2	Construct vector for gene transfer and other applications in Industrial Biotechnology

Reference Books	
1.	Sambrook J and Russell DW, “The Condensed Protocols: From Molecular Cloning: A Laboratory Manual”, Cold Spring Harbor, 2006.

BoS Chairman

B. TECH.	B19BTP402 – ANALYTICAL METHODS LABORATORY	T	P	TU	C
		0	4	0	4

Course Objectives	
1.	To provide basic understanding on absorption spectrometry methods
2.	To acquire knowledge in all quantitative and qualitative analysis.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Precision and validity in an experiment using absorption spectroscopy
2.	Validating Lambert-Beer's law using $KMnO_4$
3.	Finding the molar absorbtivity and stoichiometry of the Fe^{3+} (1, 10 phenanthroline) using absorption spectrometry.
4.	Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5.	UV spectra of nucleic acids.
6.	Chemical actinometry using potassium ferrioxalate.
7.	Estimation of SO^{4-} by Nephelometry.
8.	Estimation of Al^{3+} by Flourimetry.
9.	Limits of detection using aluminium alizarin complex.
10.	Chromatography analysis using TLC.
11.	Chromatography analysis using column chromatography.
	Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Evaluate samples using spectroscopic techniques
CO2	Solve problems using different quantitative and qualitative methods

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Reference Books	
1.	Skoog A, Holler FJ and Crouch SR, “Principles of Instrumental Analysis”, 7th Ed. Thomson / Brooks – Cole, 2018.
2.	Braun RD, “Introduction to Instrumental Analysis”, Pharma Book Syndicate, 1987.
3.	Willard HH, Merritt Jr LL, Dean JA and Settle Jr. FA, “Instrumental Methods of Analysis”, 7th Ed. CBS, 1988.
4.	Ewing GW, “Instrumental Methods of Chemical Analysis”, 5th Ed. McGraw Hill, 1985.

BoS Chairman

B.E / B. TECH.	B19CEP401 – CAREER ABILITY COURSE - I	T	P	TU	C
		0	2	0	NC

Sl. No.	Topics	Hours
1.	**NUMBER SYSTEM** Numbers, HCF and LCM of Numbers, Decimal Fractions, Square Roots & Cube Roots, Problems on Numbers, Surds and Indices	6
2.	**SIMPLIFICATION** Addition, Subtraction, Multiplication, Division, Decimal Fractions BODMAS Rule.	6
3.	**ARITHMETIC ABILITY – I** Average, Problems on Ages, percentage, Profit & Loss, Ratio and Proportion, Partnership.	6
4.	**ARITHMETIC ABILITY – II** Chain Rule, Time and Work, Pipes and cisterns, Time and Distance.	6
5.	**ARITHMETIC ABILITY – III** Problems on trains, Boats and Streams, Allegation or Mixture, Simple interest, Compound Interest.	6
		Total Instructional Hours : 30

BoS Chairman

Semester - V

B. TECH.	B19BTT501 – HEAT AND MASS TRANSFER OPERATIONS	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	To enable students to design effective/ efficient bioprocesses involving heat and mass transfer.
2.	To realize different modes of heat transfer.
3.	To design heat exchange equipments.
4.	To learn the basic knowledge of mass transfer operation and its application.
5.	To design mass transfer equipments.

UNIT - I	CONDUCTION HEAT TRANSFER	9

Heat transfer phenomena Thermodynamics & heat transfer. Heat conduction – Fourier's equation – steady state conduction– resistance concept – combined resistances – unsteady state conduction – lumped capacity model – extended surfaces (Fins) – combined conduction and convection.

UNIT - II	CONVECTION HEAT TRANSFER	9

Forced and natural convection – Dimensional analysis, Correlations for convection in flow over surfaces and through pipes – Boiling and condensation phenomena, Film and drop wise condensation over tubes. Individual and overall heat transfer coefficients and solving related problems.

UNIT - III	RADIATION HEAT TRANSFER AND HEAT TRANSFER EQUIPMENTS	9

Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, Wien's displacement law, radiation between surfaces; Heat exchanger – Types – Single-pass and Multi-pass heat exchangers; Correction factors. Design of heat exchangers; NTU concept; Evaporators Types of evaporators - single effect, multiple effect mass and enthalpy balances. Factors affecting evaporator performance, solving simple problems.

UNIT - IV	FUNDAMENTAL CONCEPTS OF MASS TRANSFER AND ABSORPTION OPERATIONS	9

Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Mass Transfer theories; Analogies in Transport Phenomenon; Gas absorption, counter current multistage operation Calculation of NTU, HTU and number of stages, HETP. Various Industrial Absorbers.

BoS Chairman

UNIT - V	DISTILLATION AND OTHER MASS TRANSFER OPERATIONS	9
V-L Equilibria Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE Principles; L-L equilibria; Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles; Adsorption equilibria – Batch and fixed bed adsorption; Drying - Mechanism - Drying curves Time of Drying; Batch and continuous dryers.		
		Total Instructional hours : 45

Course Outcomes : Upon completion of the course, students will be able to	
CO1	Solve problems on situations involving heat and mass transfer operations by applying acquired facts and techniques.
CO2	Identify, formulate and solve engineering problems associated with heat and mass transfer in small-scale and large-scale bioprocesses.
CO3	Resolve problems for heat flow by conduction for various geometries.
CO4	Elucidate the convective heat transfer problems.
CO5	Design heat exchanger equipments.

Text Books	
1.	Incropera FP, “Fundamentals of Heat and Mass Transfer”. John Wiley, 7th Ed, 2011.
2.	Dutta BK, “Heat transfer : Principles and Applications”, PHI Learning Pvt. Ltd., New Delhi, 1st Ed, 2006.
3.	Treybal RE, “Mass Transfer - Principles and Operations”, 3rd Ed, McGraw-Hill. 2012.
4.	McCabe WL and Smith JC, “Unit Operations” In : Chemical Engineering, 7th Ed, McGraw Hill, 2005.

Reference Books	
1.	Geankoplis CJ, “Transport Processes and Unit Operations”. Prentice Hall India, 4th Ed, 2003.
2.	Green DW and ZM Southard, “Perry’s Chemical Engineers’ Handbook”, 9th Ed, (Kindle Edition), McGraw Hill Education 2018.

BoS Chairman

B.E.	B19BTT502 – BIOPROCESS TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on design and operation of fermentation processes with all its prerequisites and energetics.
2.	To provide the students with the design and scale up of bioreactors.
3.	To understand the primary steps in bioprocess industries.
4.	To select appropriate bioreactor configurations and operation modes based upon the nature of bio products and cell lines and other process criteria.
5.	To understand the methods to obtain pure proteins, enzymes and in general about product development.

UNIT - I	INTRODUCTION	9

Basic principles, scope and advantages of bioprocess technology. Fermentation systems: batch, fed batch and continuous. Isolation, screening, and maintenance of microbes for industrial process. Strain selection and improvement methods. Cell recycle cultivation.

UNIT - II	BIOREACTOR	9

Bioreactor, Types of bioreactors: CSTR, packed bed, batch, Air lift bioreactor, Bioreactors for immobilized cells, animal cells, waste water and effluent treatment. Specialized bioreactors: pulsed, fluidized-bed, photobioreactors and Circulating fluid bed bioreactors.

UNIT - III	UPSTREAM PROCESSING	9

Introduction, Media formulation and optimization. Sterilization: Methods of sterilization- Batch and continuous sterilization. Air sterilization, design and air filters, aseptic operation of fermenter. Thermal death kinetics. Inocula development for Industrial fermentations. Scale up and scale down.

UNIT - IV	TRANSPORT PHENOMENA AND BIOPROCESS MONITORING AND CONTROL	9

Transport phenomena: Mass and heat transfer mechanism. Mass, heat and oxygen transfer coefficients. Rheological properties of a fermentation broth. Bioprocess monitoring and control: On-line and Off-line analysis. Monitoring variables: pH, temperature, DO_2, agitation and foam level. PID control and computer aided control.

BoS Chairman

UNIT - V	DOWNSTREAM PROCESSING	9
Downstream processing: Introduction. Primary separation Cells, Solid matter and foam- precipitation, filtration, centrifugation, cell disruptions (Mechanical, enzymatic and chemical). Product isolation solvent extraction, adsorption, aqueous two-phase system and precipitations. Purification techniques: Chromatography (ion-exchange, gel-permeation and affinity), membrane separation (microfiltration, Ultrafiltration and reverse osmosis) and electrophoresis. Product recovery; product polishing (drying and crystallization), effluent treatment.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Relate the basics of microbial kinetics and metabolic stoichiometry
CO2	Illustrate problems and seek practical solutions for large scale implementation of Biotechnology.
CO3	Explain the advanced upstream processing methods for product development.
CO4	Utilize modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems
CO5	Summarize the Downstream processes to produce therapeutically important proteins.

Text Books	
1.	Stanbury PF and Whitaker A, “Principles of Fermentation Technology”, Pergamann Press, Oxford. 2016.
2.	Shuler ML and Kargi F, “Bioprocess Engineering: Basic Concepts”, Prentice Hall, Englewood Cliffs. 2003.
3.	Cruger W and Cruger A, “A Textbook of Industrial Microbiology”. Panima Pub. Corp., New Delhi. 2017.

Reference Books	
1.	Rajput RK, “Heat and Mass Transfer in SI units” S Chand and Co. Ltd., New Delhi. 2008.
2.	Casida LE, “Industrial Microbiology”, New Age International Pvt. Ltd., New Delhi. 2007.
3.	Primrose SB, “Molecular Biotechnology”, 2nd Ed, Blackwell Scientific Publishers, Oxford. 2001.

BoS Chairman

B. TECH.	B19BTT503 – GENETIC ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic knowledge on the milestones of Genetic Engineering.
2.	To understand the strategies of Transformation and selection of recombinants.
3.	To expose various techniques about DNA handling.
4.	To deliver fundamental facts of transgenic technology.
5.	To give a clear understanding about altered genomes techniques in Biotechnology field.

UNIT - I	SCOPE OF GENETIC ENGINEERING	9

Basics of Genetic Engineering. Molecular Tools in Genetic Engineering – DNA Exonucleases and Endonucleases- Restriction Enzymes – Type I, II, III, Restriction analysis of DNA, RNAses, Ligase, Polymerases, DNA Modifying enzymes. DNA, RNA, and Protein blotting techniques, CRISPR CAS. Real time PCR.

UNIT - II	VECTORS FOR CLONING AND EXPRESSION	9

Plasmids, lambda phage, Ti plasmids, Bacterial expression vectors, Yeast vectors, Baculoviruses, Plant, animal viral vectors. Gene expression – hybridization techniques, Northern blot analysis, Primer extension, S1 mapping, RNAase protection assays, Reporter assays), Nucleic acid microarrays.

UNIT - III	DNA MANIPULATIONS	9

Tailing, cohesive end, use of linkers, blunt end methods; Labeling and detection techniques PCR and its application, Restriction mapping of DNA fragments and Map construction, nucleic acid Amplification (PCR analysis) and its applications. Real time PCR. DNA Synthesis and Sequencing, site directed Mutagenesis, Protein engineering.

UNIT - IV	TRANSGENIC TECHNOLOGY	9

Principles of Transgene Technology. Scope of Transgenic Technology. Gene tagging (T-DNA tagging and Transposon tagging) in gene analysis (identification and isolation of gene), Transgenic and Gene Knockouts Technologies Targeted gene replacement, Gene Therapy, Strategies of gene delivery, gene replacement/ augmentation, gene correction, gene editing and silencing.

BoS Chairman

UNIT - V	APPLICATIONS OF TRANSGENICS	9
Transgenic plants, animals and gene therapy, Si RNA, Targeted drug delivery, Ethics, biosafety regulations, and GMOs status in India. Applications of transgenic plants- Crop development- genetically engineered traits- herbicide, insect, virus and transgenic animals- Xenografting- Vaccine safety- Pharmaceutical industries, antibodies and plantibodies		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand about various molecular tools in genetic engineering.
CO2	Explain the features of alteration and variety of recombinants.
CO3	Outline the innumerable DNA synthesis techniques elaborately.
CO4	Illustrate about the principles of transgene technology.
CO5	Make use of GMO's and biosafety regulations in transgenes.

Text Books	
1.	Brown TA, "Gene Cloning and DNA Analysis: An Introduction" 6th Ed, Wiley-Blackwell, 2010.
2.	Glick B, and Pasternak JJ, "Molecular Biotechnology Principles and Applications of Recombinant DNA", 5th Ed, Wiley, 2017.

Reference Books	
1.	Primrose SB and RM Twyman, "Principles of Gene Manipulation and Genomics", John Wiley & Sons, New York, 2006.

BoS Chairman

B. TECH.	B19BTT504 – BIOINFORMATICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic knowledge about Bioinformatics databases and computational biology.
2.	To understand sequence analysis and its alignments for biological perspectives.
3.	To deliver knowledge about phylogenetics and structure prediction.
4.	To afford fundamental facts on protein structure.
5.	To make a deep understanding in script language.

UNIT - I	BIOLOGICAL DATABASES	9

Introduction to Bioinformatics and Computational Biology. Biological databases – types of databases – DNA database: GenBank, EMBL – cDNA database: ESTs, STS, HTGS- NCBI, Pubmed, Entrez, BLAST, OMIM – Protein databases: SWISSPORT, PIR – DNA and protein sequences: ExPASy, Locus link, Unigene, Entrez, EBI, IMGT, Genome specific databases

UNIT - II	SEQUENCE ALIGNMENT	9

Sequence Analysis, Pair wise alignment- Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms. Dynamic programming algorithms for computing edit distance- Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, String similarity, shotgun DNA sequencing, end space free alignment.

UNIT - III	PHYLOGENETIC METHODS	9

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Protein Secondary structure and tertiary structure prediction methods, Homology modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction and Structural genomics.

UNIT - IV	PROTEIN STRUCTURE ANALYSIS	8

Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding. Microarray analysis, Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

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UNIT - V	PROGRAMMING IN BIOINFORMATICS	8
Introduction to PERL; UNIX basics; Basic I/O, Variables, and Scalar Data; Arrays, Lists, and Hashes; References, Control Structures, and Functions; Regular expressions; Modules; Writing simple programs using Bio-PERL.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Recall the basics of about Bioinformatics tools.
CO2	Outline the numerous algorithms for sequence alignments.
CO3	Explain about a brief knowledge on structural genomics of ancestry.
CO4	Illustrate about the machine learning techniques.
CO5	Make use of Bio- Perl for programming skills.

Text Books	
1.	David WM, “Bioinformatics: Sequence and Genome Analysis”, CBS Publishers, New York 2004.
2.	Tisdall JD, “Beginning Perl for Bioinformatics”, O’Reilly, Beijing, 2009.

Reference Books	
1.	Jin X, “Essential Bioinformatics”, Cambridge University Press, New York 2006.
2.	Bosu O and Simminder KT, “Bioinformatics: Databases Tools Algorithms”, Oxford UP, New Delhi, 2007.

BoS Chairman

Professional Elective - I

B. TECH.	B19BTE501 – PRINCIPLES OF FOOD PRESERVATION	T	P	TU	C
		3	0	0	3

Course Objectives : To enable the students	
1.	To know about the constituents and additives present in the food.
2.	To gain knowledge about the microorganisms, which spoil food and food borne diseases.
3.	To know different techniques used for the preservation of foods.

UNIT - I	CONSTITUENTS OF FOOD	9

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food. Contribution to texture, flavours and organoleptic properties of food. Food additives : Classification, intentional and non-intentional additives and their functions; enzymes in food processing.

UNIT - II	FOOD PROCESSING	9

Introduction, principles of food processing. Methods : Sterilization, Pasteurization, Blanching and Canning. Food Packaging : Introduction, containers, types. Shelf life of food products; Types of food based on its perishability. Food colourants – natural and artificial. Enzymes as food processing aids.

UNIT - III	MICROORGANISMS ASSOCIATED WITH FOOD	9

Bacteria, yeasts and moulds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein. Yogurt, Cheese, Fermented milk, soy products, fermented vegetables and meat products.

UNIT - IV	FOOD BORNE DISEASES	9

Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT - V	FOOD PRESERVATION	9

Traditional methods of preservation. Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Through this subject the student can understand about	
CO1	Different constituents present in food and microorganism involved in processing of food.
CO2	Principles and different preservations techniques of food can also be known.
CO3	Unit operations in modern food processing and impact of the process on food quality.

Text Books	
1.	Coultate TP, “Food – The Chemistry of its Components”, 2nd Ed. Royal Society, London, 1992.
2.	Sivasanker B, “Food Processing and Preservation”, Prentice-Hall of India Pvt. Ltd. New Delhi 2002.
3.	Frazier WC and Westhoff DC, “Food Microbiology”, 4th Ed., McGraw Hill Book Co., New York 1988.
4.	Jay JM, “Modern Food Microbiology”, CBS Publications, New Delhi, 1987.
5.	Ramaswamy H and Marcotte M, “Food Processing: Principles and Applications”, by Taylor & Francis, 2005.
6.	Subbulakshmi G and Shobha A Udipi. “Food Processing and Preservation”, New Age Publications, 2006.

Reference Books	
1.	Norman N Potter and Joseph H. Hotchkiss, “Food Science” CBS Publishers and Distributors
2.	Barbosa-Canovas, “Novel Food Processing Technologies”, Tapia & Cano CRC Press, 2004.
3.	Gould GW, “New methods of food preservation”, Springer Science & Business Media, 2012.
4.	Rahman MS, “Food Preservation”, In: Handbook of Food Preservation, 2nd Ed. CRC press, 1999.
5.	Shakuntala MN and Shadaksharaswamy M, “Foods: Facts and Principles”, 4th Ed, New Age Publishers, 2004.

BoS Chairman

B. TECH.	B19BTE502 – BIOPHYSICS	T	P	TU	C
		3	0	0	3

Course Objectives : To enable the students	
1.	To recall the basic concepts in physics.
2.	To understand the physical properties of various macromolecules.
3.	To get a clear understanding in the application of physics in life sciences.
4.	To acquire knowledge in concepts of thermodynamics applicable for biological systems.
5.	To understand biological processes in terms of energetics and dynamics.

UNIT - I	MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS	9

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures – general features – water structure – hydration – interfacial phenomena and membranes – self-assembly and molecular structure of membranes.

UNIT - II	CONFORMATION OF NUCLEIC ACIDS	9

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

UNIT - III	CONFORMATION OF PROTEINS	9

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index. Protein dynamics – structural motifs – contact maps – membrane proteins – intrinsically dissolved proteins (IDP) – protein folding mechanism – protein aggregation and neurotoxicity.

UNIT - IV	CELLULAR PERMEABILITY AND ION – TRANSPORT	9

Bioselective layers: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Microbial metabolism; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Methods for application of bio selective layers in desired patterns- pin-based spotting,

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UNIT - V	ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS	9
Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows. Electron transfer theories – electron transfer in mitochondria and chloroplasts.		
		Total Instructional Hours : 45

Course Outcomes : Through this subject the student can understand about to	
CO1	Explain the physical nature of biological compounds.
CO2	Illustrate different conformation of DNA and RNA.
CO3	Distinguish the conformations of proteins.
CO4	Demonstrate the cellular transportation mechanisms.
CO5	Outline the properties of fluids and biomaterials.

Text Books	
1.	Glaser R, “Biophysics”, Springer Verlag, 2000.
2.	Duane R, “Biophysics: Molecules in Motion”, Academic Press , 1999.

Reference Books	
1.	Charles CR and Schimmel PR, “Biophysical Chemistry”. Vol : 1-3, W.H. Freeman & Co.,1980.

BoS Chairman

B.E.	B19BTE503 – BIOSENSORS	T	P	TU	C
		2	0	1	3

Course Objectives	
1.	To understand the principle, operations and classification of biosensors
2.	To introduce transducers and physiological property measurement using biosensor
3.	To expose the science and engineering by application of biosensors in various fields
4.	To acquire knowledge in biomembranes and their fabrications
5.	To have a clear idea on the applications of biosensor in life sciences.

UNIT - I	ELECTROCHEMISTRY, CLASSIFICATION AND OPERATION	9

Electrochemistry single electrode potential- Nernst equation Tafel plot Electrical components DC and AC Circuits Operational amplifiers and functions desired characteristics of biosensors: reliability, simplicity, cost, and related parameters. Classification and components of Biosensor Advantages and limitations, biocatalysis based biosensors, Types of enzyme electrodes.

UNIT - II	TRANSDUCERS IN BIOSENSORS	9

Types of transducers, principles and applications Calorimetric, acoustic, optical (absorption, fluorescence, bio/chemiluminescence, surface Plasmon resonance (SPR)), potentiometric / amperometric, conductrometric / resistor metric, piezoelectric, semiconductor (ion sensitive field effect transistor (ISFET), enzyme field effect transistor (ENFET), impedimetric, mechanical and molecular electronics based transducers. Chemiluminiscence based biosensors.

UNIT - III	BIOSELECTIVE LAYERS	9

Bioselective layers: Enzymes; Oligonucleotides and Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Microbial metabolism; Tissue and organelles (animal and plant tissue); Cell culture; Immunoreceptors; Chemoreceptors; Methods for application of bio selective layers in desired patterns- pin-based spotting.

BoS Chairman

UNIT - IV	BIO MEMBRANES: MASS TRANSPORT AND FABRICATION	9
Mass transport: Mass transport effect of analytes to the surface of the biosensor transducer on the detected signal and associated kinetics. The design of micro fluid flow systems that interface with biosensors. Different assay types (Displacement, competitive, sandwich, and direct). Biosensor fabrication methods: self-assembled monolayers, Screen printing, photolithography, micro contact printing, micro-electromechanical system (MEMS).		

UNIT - V	BIOSENSOR ENGINEERING AND APPLICATIONS	9
Applications- Case studies: Glucose, urea and cholesterol biosensors; Clark electrode, Implantable sensors for long-term monitoring; Drug development and detection; Industrial on-line monitoring, Environmental monitoring; Technological process control; veterinary, agriculture, Food quality control.		
		Total Instructional Hours : 45

Course Outcomes : Through this subject the student can understand about to	
CO1	Explain the concepts of electrochemistry.
CO2	Summarize the transducers and its types in biosensors.
CO3	Demonstrate different bioselective layers.
CO4	Explain the mass transport effect in bio membranes.
CO5	Make use of the process control technology to develop biosensor systems.

Text Books	
1.	Ursula SK, “Chemical Sensors and Biosensors for Medical and Biological Applications”, Wiley-VCH, 1998.
2.	Skoog DA, Holler FJ and Timorthy AN, “Principles of Instrumental Analysis”, 6th Ed. 2006.
3.	Buerk DG, “Biosensors: Theory and Applications”, Technomic, Lancaster, 1993.
4.	Cooper J and Cass T, “Biosensors”, Oxford University Press, 2004.

BoS Chairman

B. TECH.	B19BTE504 – NANOBIOTECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of nanomaterials and their characteristics.
2.	To gain knowledge on the relationship between nano and biosystems.
3.	To acquire information on nanobiocomposites.
4.	To enhance skill and knowledge on analysis of nanomaterials and
5.	To apply the knowledge and skills of nanotechnology in medicine and related fields.

UNIT - I	NANOMATERIALS	9

Introduction and basics of Nanomaterials. Technological impact of nanoscale Systems. Micro and nano Systems. Synthesis and characterization of nanoscale materials. Strategies for nano architecture (top down and bottom up approaches); fabrication technologies and characterizations. Self-assembly system technologies. Biomaterials – proteins, lipids, RNA and DNA, biological networks; biological neurons; nanomaterials, bioelectronics – molecular processor; – DNA analyzer as biochip – molecular electronics.

UNIT - II	NANO BIOSYSTEMS	9

Nano-structured materials; fullerenes - Properties and Characteristics. Carbon nanotubes; characteristics and applications of Quantum Dots and nano wires. Gold nanoparticles; nanopores. Molecules of Life: Proteins, Lipids, RNA and DNA in nano technology; peptide coupled nanoparticles; proteins as components in nanodevices; DNA based artificial nanostructures; DNA as smart glue; DNA as wire template; DNA computer; nano cubes; nano hinges, nano crystals.

UNIT - III	NANO COMPOSITES	9

Natural nano composite materials; Nanofluidics: surfactants, polymers, emulsions and colloids, biologically inspired nano composites. Nanotechnology in Agriculture. Nanoparticle synthesis in plants, bacteria, and yeast. Natural nanobiocomposites and biomimic Nanocomposites.

UNIT - IV	NANO ANALYTICS	9

Nanotechnology for Imaging and Detection. Molecular Imaging, Cellular imaging, imaging of soft and hard tissues, quantum dot bio labeling; nanoparticle molecular labels; analysis of biomolecular structure by AFM and molecular pulling-force spectroscopy. Nanobiosensors.

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UNIT - V	NANO MEDICINE	9
Micro and nano electromechanical systems in medicine and surgery; nanoscale elements for delivery of materials into cells, nano carriers and drug delivery, nano capsules for drugs, nano bio devices and systems, nano motors and cellular navigation, smart drugs and nanotechnology in cancer. Nanoscale artificial platforms.		
	Total Instructional Hours : 45	

Course Outcomes : The students will be able to	
CO1	Understand the fundamentals of nanoscience and technology.
CO2	Assess the possible applications of bionanomaterials in in various fields.
CO3	Design and develop health related nanomaterials.
CO4	Applications of bionanomaterials in various fields.
CO5	Understand the basics of nanomedicines and their applications.

Text Books	
1.	Goser K, Glosekotter P and Dienstuhl J, “Nanoelectronics and Nanosystems: From Transistors to Molecular Devices”, Springer, 2004.
2.	Pradeep T, “Nano”, Tata McGraw Publishers. India. 2006.
3.	Ratner M and Ratner D, “Nanotechnology a Gentle Introduction to the Next Big Idea”, Pearson Education Inc. 2005.

Reference Books	
1.	Wilson M, Kamali K, Smith G, Simmons M and Raguse B, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas Press, 2005.
2.	Niemeyer CM and Mirkin CA, “Nanobiotechnology: Concepts, Applications and Perspectives”, Wiley-VCH, Weinheim, 2004.
3.	Goodsell DS, “Bionanotechnology: Lessons from Nature”, Wiley-Liss. 2004.

BoS Chairman

B. TECH.	B19BTE505 – DISASTER MANAGEMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide students an exposure to disasters, their significance and types.
2.	To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3.	To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
4.	To enhance awareness of institutional processes in the country and
5.	To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT - I	INTRODUCTION TO DISASTERS	9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of disasters.

UNIT - II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9

Disaster cycle Phases, culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, roles and responsibilities of community, Panchayat Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional processes and framework at State and Central level- State Disaster Management Authority (SDMA) – Early warning system – Advisories from appropriate agencies.

UNIT - III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9

Factors affecting vulnerabilities, differential impacts, impact of development projects such as dams, embankments, changes in Land-use etc. - Climate Change Adaptation IPCC scenario and scenarios in the context of India Relevance of indigenous knowledge, appropriate technology and local resources.

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UNIT - IV	DISASTER RISK MANAGEMENT IN INDIA	9
Hazard and vulnerability profile of India, components of disaster relief : water, food, sanitation, shelter, health, and waste management, institutional arrangements (Mitigation, Response and Preparedness), Disaster Management Act and Policy Other related policies, plans, programmes and legislation – Role of GIS and Information Technology components in preparedness, risk assessment, response and recovery phases of disaster – Disaster damage assessment.		

UNIT - V	DISASTER MANAGEMENT : APPLICATIONS AND CASE STUDIES AND FIELD WORKS	9
Landslide hazard zonation: Case studies, earthquake vulnerability assessment of buildings and infrastructure: Case studies, drought assessment : Case studies, coastal flooding: Storm surge assessment, floods: Fluvial and pluvial flooding: Case studies; forest fire: Case studies, manmade disasters: Case studies, space based inputs for disaster mitigation and management and field works related to disaster management. Quality assurance and Quality control in Biotechnology industries. Bhopal gas tragedy, Chernobyl disaster, Fukushima nuclear disaster.		
		Total Instructional hours : 45

Course Outcomes : The students will be able to	
CO1	Differentiate the types of disasters, causes and their impact on environment and society.
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context.
CO4	Disaster damage assessment and management.

Text Books	
1.	Singhal JP, “Disaster Management”, Laxmi Publications, 2010.
2.	Bhattacharya T, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.

BoS Chairman

3.	Gupta AK and Nair SS, “Environmental Knowledge for Disaster Risk Management”, NIDM, New Delhi, 2011.
4.	Kapur A, “Vulnerable India: A Geographical Study of Disasters”, IIAS and Sage Publishers, New Delhi, 2010.

Reference Books	
1.	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2.	Government of India, National Disaster Management Policy, 2009.

BoS Chairman

Open Elective - I

B. E. / B. TECH.	B19AEO501- BASICS OF FLIGHT MECHANICS (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts like lift, drag, pressure distribution and airfoil characteristics
2.	To understand the effect of weight and height, range and endurance of the aircraft.
3.	To know about the different aerobatics and manoeuvres performance in the aircraft.
4.	To get introduce to the basic concepts of shock waves, vortex formation and its effects on the aircraft.
5.	To understand the nature of supersonic flow, C-D nozzle expansion and Flight at hypersonic speeds.

UNIT - I	SUBSONIC SPEED AERO FOILS	9

Introduction to Lifting Surfaces - Lift and drag - Airflow and pressure over Airfoil - Chord line and angle of attack - Pressure distribution - Airfoil characteristics - Camber - Design and nomenclature of airfoil sections.

UNIT - II	LEVELING OF FLIGHT	9

Forces Acting on the Aircraft - Balancing the four forces- Loads on tail plane Effects of downwash- Tail load determination - Relation between air speed and angle of attack Effect of Weight and Height - Flying for maximum Range and Endurance.

UNIT - III	MANEUVERS	9

Introduction to Degrees of freedom- Diving- Turning- Angles of bank- Turning Problems- Controls on Steep Banks- Aerobatics- Loops, Spins, Rolls, Sideslips, and Nose-Dives Inverted maneuvers.

UNIT - IV	TRANSONIC FLIGHTS	9

Speed of Sound - Compressibility and Incompressibility - Shock waves - Effects of shock waves - Mach Number Critical Mach Number - Drag rise in the Transonic Region - Drag and Power Required - Behavior of airplane at shock stall - Shock – wave patterns - Pressure distribution - Slimness and Sweep Back - Area rule - Vortex generators.

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UNIT - V	SUPERSONIC FLIGHTS	9
Introduction to Supersonic flow - Supersonic flow over an aero foil - Convergent divergent nozzle Expanding – contracting duct - Supersonic wing shapes - Supersonic Wing and body shapes - Kinetic heating - Flight at hypersonic speeds.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the Characteristics, Design and Nomenclature of Airfoil Sections.
CO2	Identify the Forces Acting on the Aircraft and Its Effects to make the Aircraft Flying for Maximum Range and Endurance.
CO3	Illustrate the different types of Aircraft maneuvering during flight.
CO4	Outline the effect of shock waves, critical Mach number during transonic flights.
CO5	Identify the supersonic flow over an Aero foil and able to examine its effects.

Text Books	
1.	Kermode AC, “Mechanics of Flight”. Revised by Barnard RH and Philpott DR, Pearson Prentice Hall, 11th Ed. 2006.

Reference Books	
1.	Hull DG, “Fundamentals of Airplane Flight Mechanics”, Berlin: Springer; 2007.
2.	Cook MV, “Flight Dynamics Principles: A Linear Systems Approach to Aircraft Stability and Control”, Butterworth-Heinemann; 2012.
3.	Miele A, “Flight Mechanics: Theory of Flight Paths”, Courier Dover Publications, 2016.
4.	Kermode AC, “Mechanics of Flight”. Longman Scientific & Technical”, 1987.
5.	Von Mises R, “Theory of Flight”, Courier Corporation, 1959.

BoS Chairman

B. E. / B. TECH.	B19AGO501- ENVIRONMENT AND AGRICULTURE (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the importance of land, water and social structure in agriculture.
2.	To remember the impacts of mechanization, irrigation and urbanization in agriculture.
3.	To know the ecological issues, climate change, environmental policies and sustainable agriculture.
4.	To learn about the Ecological diversity in agricultural applications.
5.	To understand the emerging issues in environment and agriculture.

UNIT - I	ENVIRONMENTAL CONCERNS	8

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

UNIT - II	ENVIRONMENTAL IMPACTS	9

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT - III	CLIMATE CHANGE	8

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

UNIT - IV	ECOLOGICAL DIVERSITY AND AGRICULTURE	10

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural Biotechnology concerns.

UNIT - V	EMERGING ISSUES	10

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural Biodiversity Agricultural environment policies and its impacts – Sustainable agriculture.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Understand the environmental concerns and impacts in agriculture.
CO2	They are able to acquire knowledge on technological interventions like mechanization, watershed development and irrigation in agriculture.
CO3	They are able to apply climate change and its issue in agriculture.
CO4	They are able to create a Capacity building on the focus areas for ecological farming and agriculture Biotechnology issues.
CO5	They are able to apply agriculture environmental policies for sustainable agriculture.

Text Books	
1.	M. Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2.	Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

Reference Books	
1.	T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2.	Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st Century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994.
3.	Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.
4.	https://nptel.ac.in/courses/126/105/126105014/

BoS Chairman

B. E. / B. TECH.	B19BMO501 – INTRODUCTION TO MEDICAL PHYSICS (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To outline the effects of non-ionizing radiation and its application
2.	To summarize the principles of radioactive nuclides
3.	To explain the interaction of radiation with matter.
4.	To illustrate the radiation detectors
5.	To explain the radiation quantities.

UNIT - I	NON IONIZING RADIATION AND ITS MEDICAL APPLICATION	9

Overview of non-ionizing radiation effects - Low Frequency Effects - Higher frequency effects. Thermography – Application. Ultrasound Transducer - Interaction of Ultrasound with matter; Cavitations, Conditions for reflection, Transmission-Scanning systems – Artefacts - Ultrasound Doppler - Double Doppler shift Clinical Applications.

UNIT - II	PRINCIPLES OF RADIOACTIVE NUCLIDES	9

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology, Decay series, Production of radionuclides – Cyclotron produced Radionuclide - Reactor produced Radio-nuclide-fission and electron Capture reaction, radionuclide Generator - Milking process (Technetium generator).

UNIT - III	INTERACTION OF RADIATION WITH MATTER	9

Interaction of charged particles with matter – Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter - Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.

BoS Chairman

UNIT - IV	PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS	9
Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge, TLD, OSLD.		

UNIT - V	BASIC RADIATION QUANTITIES	9
Introduction - exposure - Inverse square law - KERMA - Kerma and absorbed dose -stopping power relationship between the dosimetric quantities Bremsstrahlung radiation, Bragg's curve- concept of LD 50- Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Recall the effect of non-ionizing radiation in human body and applications in the field of medicine
CO2	Interpret radioactive decay and production of radio nuclides
CO3	Discuss the interaction of radiation with matter
CO4	Illustrate the measurement of ionizing radiation
CO5	Express the radiation quantities

Text Books	
1.	Cameron JR and Skofronick JG, "Medical Physics", John-Wiley & Sons, 1978.
2.	Maqbool M, "An Introduction to Medical Physics", Springer International Publishing AG 2017.

Reference Books	
1.	Uma Devi P, Nagarathnam A, Satish Rao BS, "Introduction to Radiation Biology", BI Churchill Livingstone Pvt. Ltd, 2000.
2.	Brown BH, Smallwood RH, Barber DC, Lawford PV, Hose DR and Woodcock JP, "Medical Physics and Biomedical Engineering", CRC Press, 1998.
3.	Meire HB and Farrant P, "Basic Ultrasound", John Wiley & Sons, 1995.

BoS Chairman

B.E. / B. TECH.	B19CSO501 – FUNDAMENTALS OF DBMS (Common to all Except CSE, AI & DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of database management systems.
2.	To acquire basic knowledge about database models and its design.
3.	To reveal the role and functionalities of database in business community.
4.	To learn about the Structured Query Language (SQL).
5.	To learn the client / server relation.

UNIT - I	INTRODUCTION	9
Database Systems – An Over View – Meaning, Definition – Components – Objectives – Advantages and Disadvantages – Evolution.		

UNIT - II	MODELS	9
DBMS Architecture – Associations – Relationship – Generalization – Classifications – Conceptual Data Modeling – File Organization.		

UNIT - III	DATABASE DESIGN	9
Relational Data Model – ER Diagram – Data Dictionary – Normalization – Boyce Code Normal Form Integrity – Relational Database Languages – Database Administration.		

UNIT - IV	UNDERSTANDING SQL	9
SQL Data Definition and Data Types - SQL - Specifying Constraints Key and Referential Integrity Constraints Basic Retrieval Queries in SQL- Joins – Sub queries – Nested subquery.		

UNIT - V	OPERATIONS AND MANAGEMENT	9
Client/Server and Databases – Data Warehousing – Query Processing – Heterogeneous and Homogeneous – Distributed Databases – Controls.		
		Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Infer the basics of database management systems.
CO2	Demonstrate basic knowledge about database and its design with models.
CO3	Translate ER model to Relational model to perform database design effectively.
CO4	Apply SQL for DB creation and updation.
CO5	Construct client / server relation.

Text Books	
1.	Elmasri R and Navathe SB, “Fundamentals of Database Systems”, 7th Ed. Pearson Education, 2017.

Reference Books	
1.	Silberschatz A, Korth HF and Sudarshan S, “Database System Concepts”, 6th Ed. McGraw-Hill, 2011.
2.	Gruber M, “Understanding SQL”, Sybex Inc, 1990. (4th unit 50%).
3.	Date CJ, Kannan A, Swamynathan S, “An Introduction to Database Systems”, 8th Ed. Pearson Education, 2006.
4.	Ramakrishnan R, “Database Management Systems”, 4th Ed. McGraw-Hill College Publications, 2015.

BoS Chairman

B. E. / B. TECH.	B19ECO501 – LOGIC AND DISTRIBUTED CONTROL SYSTEMS (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To give an introductory knowledge on Programmable Logic Controller (PLC) and their programming languages
2.	To give adequate knowledge about applications of PLC
3.	To give basic knowledge about Computer Controlled Systems
4.	To give basic knowledge on the architecture and local control unit of Distributed Control System (DCS)
5.	To give adequate information with respect to interfaces used in DCS

UNIT - I	PROGRAMMABLE LOGIC CONTROLLER	9

Evolution of PLCs – Components of PLC – Architecture of PLC – Discrete and analog I/O modules – Programming languages - Ladder diagram – Function block diagram (FBD) Programming timers and counters.

UNIT - II	APPLICATIONS OF PLC	9

Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions – Case studies in PLC.

UNIT - III	COMPUTER CONTROLLED SYSTEMS	9

Basic building blocks of computer controlled systems – Data acquisition system – Supervisory control - Direct digital control- SCADA Hardware and software, Remote terminal units, Master Station and Communication architectures.

UNIT - IV	DISTRIBUTED CONTROL SYSTEM	9

DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities.

BoS Chairman

UNIT - V	INTERFACES IN DCS	9
Operator interfaces - Low level and high level operator interfaces – Displays Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies in DCS.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the PLC
CO2	Apply PLC in various applications
CO3	Understand the concepts of Computer Controlled Systems
CO4	Acquire knowledge about various architectures of DCS
CO5	Analyze the various interfaces in DCS

Text Books	
1.	Petruzella ED, “Programmable Logic Controllers”, Tata McGraw Hill, 3rd Ed. 2010.
2.	Lukas MP, “Distributed Control Systems: Their Evaluation and Design”, Van Nostrand Reinhold Co., 1986.
3.	Popovic D and Bhatkar VP, ‟ Distributed Computer Control for Industrial Automation‟ Marcel Dekker Inc., New York, 1990.

Reference Books	
1.	Hughes TA, “Programmable Controllers”, 4th Ed. ISA press, 2005.
2.	Krishna Kant, “Computer Based Industrial Control”, 2nd Ed. Prentice Hall of India, New Delhi, 2010.
3.	Webb JW and Reis RA, “Programmable Logic Controllers”, 5th Ed. Prentice Hall of India, New Delhi, 2010.
4.	Hackworth JR and Hackworth Jr FD, “Programmable Logic Controllers”, Pearson, New Delhi, 2004.
5.	Clarke G, Reynders D and Wright E, “Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems”, Newnes, 1st Ed. 2004.
6.	Parr EA, “Programmable Controllers - An Engineer’s Guide”, Elsevier, 2013.

BoS Chairman

B. E. / B. TECH.	B19EEO501 - ROTATING MACHINES AND TRANSFORMERS (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impact knowledge on magnetic-circuit analysis and introduce magnetic materials.
2.	To understand the working principles of DC generator.
3.	To understand the working principles of DC motor.
4.	To understand the working principles of Induction and synchronous machines.
5.	To understand the working principles of transformer.

UNIT - I	MAGNETIC CIRCUITS AND MAGNETIC MATERIALS	9

Magnetic circuits – Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically and Dynamically induced EMF – Torque – Properties of magnetic materials, Hysteresis and Eddy Current losses AC excitation, introduction to permanent magnets - Transformer as a magnetically coupled circuit (Qualitative Only).

UNIT - II	DC GENERATORS	9

Construction and components of DC Machine – Principle of operation Lap and wave windings - EMF equations – circuit model – armature reaction – methods of excitation commutation – inter poles compensating winding – characteristics of DC generators (Qualitative Only).

UNIT - III	DC MOTORS	9

Principle and operations types of DC Motors – Speed Torque Characteristics of DC Motors starting and speed control of DC motors –Plugging, dynamic and regenerative braking testing and efficiency – Permanent Magnet DC (PMDC) motors - applications of DC Motor (Qualitative Only).

UNIT - IV	INDUCTION AND SYNCHRONOUS MACHINES	9

Single phase motor - Double revolving field theory - starting methods - no load and block rotor test equivalent circuit - types of single phase motor - 3 Phase induction motor – Construction – types principle of operation - speed control of 3 phase motor starting methods for 3 phase induction motor. Synchronous Machine Alternator, Construction and Basic principle - Synchronous motor Basic principle, methods of starting, applications (Qualitative Only).

BoS Chairman

UNIT - V	TRANSFORMERS	9
Transformers - Construction and types - Operation of single phase transformers - EMF equation Voltage regulation - Losses and Efficiency - All day efficiency Parallel operation Testing: Open circuit and Short circuit tests - 3 Phase transformers: (Construction & connections) Autotransformers (Qualitative Only).		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the magnetic - circuits and materials.
CO2	Explain the construction and operation of DC generator.
CO3	Explain the construction and operation of DC motor.
CO4	Explain the construction and operation of induction and synchronous machines.
CO5	Explain the construction, working principle of transformer and autotransformer.

Text Books	
1.	Nagrath, IJ and Kothari DP, “Electrical Machines”, Tata McGraw Hill Publishing Company Ltd., 4th Ed, 3rd Reprint, New Delhi, 2011.
2.	Sen PC, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 3rd Ed, 2013.

Reference Books	
1.	Bhattacharya SK, “Electrical Machines” McGraw – Hill Education, New Delhi, 3rd Ed, 2009.
2.	Gupta BR, “Fundamental of Electric Machines” New Age International Publishers, 3rd Ed, 2015.
3.	Toro VD, “Basic Electric Machines” Pearson India Education, 2016.
4.	Surinder Pal Bali, “Electrical Technology Machines & Measurements”, Vol. II, Pearson, 2013.

BoS Chairman

B.E. / B. TECH.	B19MEO501 – ROBOTICS (Common to all Except MECH)	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of the basic components of a robot.
2.	To apply the distinct drive systems and end effectors to control the robot actuation.
3.	To study the role and application of various types of sensors and machine vision system.
4.	To make use of the knowledge in the robot kinematics and to write Robot Programs.
5.	To identify the social and economic challenges while implementing the robot systems.

UNIT - I	FUNDAMENTALS OF ROBOT	9

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification - Specifications Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions - Different Applications - A view on Global and Indian manufacturers of Robots Need for Robots in Indian environment.

UNIT - II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9

Drives - hydraulic, pneumatic, mechanical, electrical, Servo motors, Stepper motors - salient features, application; End effectors – types; Grippers- mechanical, pneumatic, hydraulic, magnetic, vacuum limitations, Multiple grippers.

UNIT - III	SENSORS AND MACHINE VISION	9

Requirements of sensors, principles, types and applications of Proximity (Inductive, Hall effect, Capacitive, Ultrasonic and Optical); – Range (Triangulation, Structured light approach); Speed, Position (resolvers, optical encoders); – Force – Torque – Touch sensors (binary, analog sensor). Introduction to Machine Vision; applications, functions; image processing and analysis; training the vision system.

UNIT - IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9

Forward kinematics and Reverse kinematics of manipulators; two, three degrees of freedom, homogeneous transformation matrix; introduction to manipulator dynamics, trajectory generator, manipulator mechanism, Degeneracy and Dexterity; Lead through programming, Robot programming languages; VAL programming, motion commands, sensor commands, end effecter commands, simple programs (for loading, unloading and palletizing operations), introduction to advances in Robot Programming.

BoS Chairman

UNIT - V	APPLICATION, IMPLEMENTATION AND ROBOT ECONOMICS	9
Robot cell design; types, application of robots in processing, assembly, inspection, material handling in automobile, medical, Nuclear Industries, RGV, AGV; Implementation of Robots in Industries; Safety considerations for robot operations, safety codes, Economic analysis of robots.		

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the concepts of industrial robots, classification, specifications and coordinate systems.
CO2	Illustrate the different types of robot drive systems as well as robot end effectors.
CO3	Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4	Develop robotic programs for different operations and familiarize with the kinematics motions of robot.
CO5	Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

Text Books	
1.	Groover M, “Industrial Robotics - Technology Programming and Applications”, McGraw Hill, 2012.
2.	Deb SR and Deb S, “Robotics Technology and Flexible Automation”, Tata McGraw Hill, 2010.
3.	Saha SK, “Introduction to Robotics”, Tata McGraw Hill, 2nd Ed, 2014.

Reference Books	
1.	Craig JJ, “Introduction to Robotics Mechanics and Control”, Pearson Education, Global Edition, 3rd Ed, 2014.
2.	Deb SR, “Robotics Technology and Flexible Automation” Tata McGraw Hill, 2013.
3.	Ghoshal A, “Robotics - Fundamental Concepts and Analysis”, Oxford University Press, 6th Impression, 2010.

BoS Chairman

B. TECH.	B19BTP501 – BIOPROCESS LABORATORY	T	P	TU	C
		0	0	3	2

Course Objectives	
1.	To expose the students on enzyme characterization, immobilization and medium optimization methods.
2.	To acquire knowledge on the methods to investigate the growth of microorganisms in different systems under different conditions.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Growth of bacteria and yeast – estimation of biomass, calculation of specific growth rate, yield coefficient.
2.	Enzyme kinetics – Determination of Michaelis Menten parameters
3.	Enzyme activity – effect of temperature and pH
4.	Enzyme inhibition kinetics
5.	Medium optimization using Plackett Burman design
6.	Enzyme immobilization – gel entrapment, cross linking
7.	Preparation of bioreactor, utilities for bioreactor operation (Batch, Fed batch, continuous)
8.	Sterilization kinetics
9.	Thermal death kinetics
10.	Reactor kinetics (Batch, Fed batch & Continuous) – estimation of reaction rate constant.
11.	Estimation of kLa by (i) dynamic gassing method in batch fermenter, (ii) sulphite oxidation method (iii) power correlation method.
12.	Residence time distribution using Continuous stirred tank reactor.
13.	Residence time distribution in PFR using immobilized enzyme system.
14.	Estimation of overall heat transfer coefficient in batch fermenter.
	Total Instructional hours : 60

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Apply the laboratory skills to solve complex bioprocess engineering problems.
CO2	Design and carry out bioprocess engineering experiments, and to interpret fundamental data to do the design.

Text Books	
1.	Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, Springer Verlag. 2011.
2.	James EB and DF Ollis, “Biochemical Engineering Fundamentals”, McGraw Hill, 2nd Ed. 1986.

BoS Chairman

B. TECH.	B19BTP502 – GENETIC ENGINEERING LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To deliver hands-on experience in performing basic recombinant DNA techniques.
2.	Demonstrate about the theory behind in each techniques and to describe common applications of each methodology in biological research.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Preparation of plasmid DNA.
2.	Elution of DNA from agarose gels.
3.	Restriction enzyme digestion and Ligation of DNA into expression vectors.
4.	Transformation & Selection of recombinants – Blue white screening assay.
5.	Optimisation of time of inducer for recombinant protein expression.
6.	Western blotting and Southern blotting.
7.	PCR amplification of genes.
8.	Colony lysate PCR.
9.	Agrobacterium mediated transformation and expression analysis.
10.	Electroporation.
	Total Instructional hours : 60

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Outline the major principles, methods for preparation and cloning of DNA in various organisms.
CO2	Illustrate clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
CO3	Make use of genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.

Text Books	
1.	Old RW and SB Primrose, “Principles of Gene Manipulation : An Introduction to Genetic Engineering”, Blackwell Science, 2001.
2.	Ausubel FM, R Brent, RE Kingston and DD Moore, “Current Protocols in Molecular Biology”, Greene Publishing Associates, NY, 2010.
3.	Berger Sl and Kimmer AR, “Methods in Enzymology”, Vol. 152, Academic Press, 1987.

BoS Chairman

B.E. / B. TECH.	B19CEP501 - CAREER ABILITY COURSE- II	T	P	TU	C
		0	2	0	NC

Sl. No.	Topics	Hours
1.	**GENERAL MENTAL ABILITY - I** Analogy, Classification, Series Completion, Coding and Decoding, Blood Relations.	6
2.	**GENERAL MENTAL ABILITY - II** Direction Sense Test, Logical Venn Diagram, Data Sufficiency, Assertion and Reason.	6
3.	**NON VERBAL REASONING – I** Mirror Images, Water Images, Embedded Figures, Paper folding and paper cutting, Cubes and Dice.	6
4.	**NON VERBAL REASONING – II** Completion of incomplete pattern, Dot Situation, Construction of Squares and Triangles.	6
5.	**DATA INTERPRETATION** Tabulation, Bar Graphs, Pie Chart, Line Graphs	6
		Total Instructional Hours : 30

BoS Chairman

Semester - VI

B. TECH.	B19BTT601 – CHEMICAL REACTION ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To apply the concepts of reaction mechanism and kinetics for biochemical reactions
2.	To choose an appropriate reactor type and operating conditions to achieve a desired output such as reactant conversion, selectivity and yield.
3.	To make the students to design a reactor for biological reactions.

UNIT - I	REACTION KINETICS	9

Classifications of chemical reactions, Variables affecting rate of reactions. Order and molecularity, rate equation, rate constant; Concentration and temperature dependence, Activation energy; Reaction kinetics of enzymatic reactions.

UNIT - II	IDEAL REACTORS	9

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, Recycle reactor and autocatalytic reactions, Reactors for bioprocess industries.

UNIT - III	NON-IDEAL REACTORS	9

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, Non-ideal models for bioreactors.

UNIT - IV	HETEROGENEOUS REACTING SYSTEM	9

Heterogeneous reacting system: Introduction, Ideal contacting patterns, Solid catalysed reactions: Classification of catalysts, catalyst preparation and catalyst deactivation. Surface kinetics and pore resistance; Determination of rate controlling step, Rate controlling step in adsorption.

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UNIT - V	INDUSTRIAL REACTORS	9
Reactors to carry out G/L reactions on solid catalysts Trickle bed, slurry, three phase fluidized bed, fluid-fluid and fluid-particle reactors, Multiphase bioreactors, contacting patterns in the fixed bed and fluidized bed catalytic reactors.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Outline the basic laws on chemical kinetics and their applications in reactions.
CO2	Compare the various ideal reactors and their design equations
CO3	Describe the non-ideal behaviour of reactors and their models
CO4	Explain the kinetics for heterogeneous reacting systems
CO5	Describe the industrial reactors used to carry out Gas-Liquid reactions on solid catalysts.

Text Books	
1.	Levenspiel O, “Chemical Reaction Engineering”, 3rd Edition, Wiley, 2014.
2.	Fogler HS, “Elements of Chemical Reaction Engineering”, PHI Learning Private Limited, 1999.
3.	Nauman EB, “Chemical Reactor Design, Optimization, and Scale up”, John Wiley & Sons, 2008.

Reference Books	
1.	Missen RW, Mims CA and Saville BA, “Introduction to Chemical Reaction Engineering and Kinetics”, John Wiley 1999.
2.	Dawande, SD, “Principles of Reaction Engineering”, 1st Edition, Central Techno Publications, 2001.
3.	Smith, JM, “Chemical Engineering Kinetics”, 3rd Edition, Mcgraw Hill, 1981.

BoS Chairman

B. TECH.	B19BTT602 – IMMUNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the general concepts of immune system, immune organs and cells.
2.	To know about antigens and antibodies.
3.	To get familiarize with the mechanisms related to cell and antibody mediated immunity MHC and complement system.
4.	To know about the types of hypersensitivity reaction and also immune responses to different infectious agents.
5.	To understand autoimmunity, immunology behind graft acceptance and rejection and immuno deficiency diseases/disorders.

UNIT - I	INTRODUCTION TO IMMUNE SYSTEM	9

Historical perspective, classification of immune system,innate immunity – four type of defensive barriers; Adaptive immunity four characteristic attributes, Cells and organs of the immune system – hematopoiesis, Cells of immune system, organs of immune system.

UNIT - II	ANTIGENS AND ANTIBODIES	9

Immunogenicity versus antigenicity, factors that influence immunogenicity, adjuvants, epitopes, haptens, pattern- recognition receptors. Basic structure of antibodies, immunoglobulin fine structure, and antibody mediated effector functions, antibody classes and biological activities, antigenic determinants on immunoglobulins. B-cell and T-cell receptor. Immunoglobulin superfamily. Monoclonal antibodies. Antigen- antibody interaction: cross-reactivity, precipitation and agglutination.

UNIT - III	HUMORAL AND CELLULAR IMMUNITY	9

Classification of T and B cells,T-cell maturation and the thymus, TH-cell activation, T-cell differentiation, cell death and T-cell populations, peripheral γδ T cells.B-Cell maturation, activation and proliferation, humoral response, regulation of B-cell development. Cytokines, major histocompatibility complex, complements.

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UNIT - IV	HYPERSENSITIVE REACTIONS AND IMMUNE RESPONSE TO INFECTIOUS DISEASES	9
Gell and Coombs classification of hypersensitivity. Protective immune response to viral infections, bacterial infections,fungal infections, protozoan diseases, diseases caused by parasitic worms (Helminths) and emerging infectious disease.Cancer and the immune system.		

UNIT - V	AUTOIMMUNITY, TRANSPLANTATION IMMUNOLOGY AND IMMUNODEFICIENCY	9
Organ-specific and systemic autoimmune diseases.Immunologic basis of graft rejection, clinical manifestation of graft rejection, general and specific immunosuppressive therapy, immune tolerance to allografts and clinical transplantation.Primary immunodeficiency, AIDS and other secondary immuno deficiencies.		
Total Instructional hours : 45		

Course Outcomes : The students will be able to	
CO1	Outline the general concepts of immune system and describe the cells and organs of the immune system
CO2	Describe the properties of antigens and antibodies; and demonstrate various antigen-antibody interactions
CO3	Explain the concept of cell and antibody mediated immunity and outline the mechanism of complement system
CO4	Illustrate the mechanism behind hypersensitivity and molecular mechanisms involved in pathogenesis of diseases caused by various pathogenic organisms.
CO5	Outline the mechanism behind transplantation immunology, concept of autoimmunity and immuno deficiencies.

Text Books	
1.	Delves PJ, Martin SJ, Burtn DR and Roitt IM, “Roitt’s Essential Immunology”, 13th Edition, Wiley – Blackwell, 2016.

BoS Chairman

2.	Owen JA, Punt J and Stranford SA, “Kuby Immunology”, Macmillan International, 8th Edition, 2019.
3.	Chakravarthy AK, “Immunology”, Tata McGraw-Hill, 2006.

Reference Books	
1.	Richard C, “Immunology: A Short Course” 6th Edition, John Wiley, 2008.
2.	Khan FH, “Elements of Immunology” Pearson Education, 2009.

BoS Chairman

B. TECH.	B19BTT603 – DOWNSTREAM PROCESSING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the methods of separation technology.
2.	To expose students to techniques of product fractionation.
3.	To utilize various isolation methods for developing new products.
4.	To apply various chromatographic techniques for product purification.
5.	To create deeper understanding of final product purification.

UNIT - I	DOWNSTREAM PROCESSING	9

Introduction to downstream processing principles, characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilization of bioproducts.

UNIT - II	PHYSICAL METHODS OF SEPERATION	9

Unit operations for solid-liquid bioproducts separation using filtration, centrifugation, flocculation, precipitation, settling and sedimentation.

UNIT - III	ISOLATION OF PRODUCTS	9

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT - IV	PRODUCT PURIFICATION BY CHROMATOGRAPHY	9

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT - V	FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS	9

Crystallization equipments with working principles - Drying equipments with working principles Equipments for Lyophilization with working principles in final product formulation.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : Students will be able to	
CO1	Apply separation techniques used in downstream process for the purification of biomolecules.
CO2	Analyze techniques of insoluble removal and predict the parameters for large scale operations.
CO3	Analyze the techniques used in bulk product isolation.
CO4	Evaluate the techniques of high-resolution product purification based on product characteristics and cost effectiveness.
CO5	Evaluate the techniques of final product formulation.

Text Books	
1.	Belter PA, Cussler EL and Wei-Houhu, "Bioseparations – Downstream Processing For Biotechnology", Wiley Interscience Pun.1988.
2.	R.O. Jenkins, (Ed.), "Product Recovery in Bioprocess Technology" Biotechnology by Open Learning Series, Butterworth-Heinemann, 1992.

Reference Books	
1.	Janson JC and Ryden L, (Ed.), "Protein Purification – Principles, High Resolution Methods and Applications", Wiley-VCH, 1989.
2.	Scopes RK, "Protein Purification – Principles and Practice", Narosa Publishers, 1994.

BoS Chairman

Professional Elective - II

B. TECH.	B19BTE601 - BIOPOLYMERS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To enable students to understand the types of biopolymers and its environmental impact.
2.	To measure biodegradation of polymers.
3.	To learn the basics of bioplastics and biocomposites.
4.	To understand about biomaterials.
5.	To modify biomaterials for better functionality.

UNIT - I	INTRODUCTION	9

Introduction: Definition of Biopolymers and types of biopolymers, definition of bioplastics, Types of bioplastics, such as starch based, cellulose based plastics and some aliphatic polyesters (PLA, PHB), polyamides, bio-derived polyethylene and genetically modified bioplastics. Environmental impact such as Bioplastics and biodegradation.

UNIT - II	POLYMER BIODEGRADATION	9

Biodegradable polymer classes, Natural biodegradable polymer, Synthetic biodegradable polymer and modified naturally biodegradable polymer. Non-biological and biological degradable polymer. Measuring of biodegradation of polymers - Enzyme assays, Plate test, Respiratory test, Natural environment, Field trial, Gas evolution test (CO_2 and CH_4).

UNIT - III	BIOPLASTICS AND BIOCOMPOSITES	9

Introduction of bioplastics and biocomposites, processing of bioplastics and biocomposites, applications of bioplastics and their composites. Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with estrogenic fillers (e.g. hydroxyapatite).

UNIT - IV	BIOMATERIALS	9

Introduction of biomaterials, Material choice implications based on device design. General biomaterial evaluation procedures. Replacement of skeletal hard tissues. Polymer used as cosmetic implants, controlled drug delivery system artificial heart valves, bone replacement, artificial organs, dental applications.

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UNIT - V	SURFACE MODIFICATION OF BIOMATERIALS	9
Enhancement of biocompatibility by the use of Corona discharge and plasma processes. Surface coatings Silver/silver oxide silicone hydrogels UV curable systems PC coatings Heparin loaded systems. Recycling and reuse of biopolymers.		
		Total Instructional hours : 45

Course Outcomes : Upon completion of the course, students will be able to	
CO1	Classify, formulate and access biopolymers for its environmental impact.
CO2	Measure biodegradability of biopolymers.
CO3	Formulate bioplastics and biocomposites.
CO4	Formulate and evaluate biomaterials for medical and cosmetic implants
CO5	Modify biomaterials for supreme functionality such as biocompatibility.

Text Books	
1.	Byrom D, “Biomaterials: Novel Materials from Biological Sources”, Springer, 1991.
2.	Williams R (Ed.), “Surface modification of biomaterials: Methods analysis and Applications”, Elsevier, 2010.

Reference Books	
1.	Bastioli C. (Ed.), “Handbook of biodegradable polymers”, Walter de Gruyter GmbH & Co KG. 2020.
2.	Johnson R.M., Mwaikambo LY and Tucker N, “Biopolymers”, Smithers Rapra Technology, 2020.
3.	Pilla S., (Ed.), “Handbook of Bioplastics and Biocomposites Engineering Applications” (Vol. 81). John Wiley & Sons, 2011.

BoS Chairman

B. TECH.	B19BTE602 – PHYTOCHEMICALS AND HERBAL MEDICINE	T	P	TU	C
		3	0	0	3

Course Objectives - Upon completion of this course, the students will be able to	
1.	Acquire the basic knowledge of Indian herbal medicine systems.
2.	Enable to understand the importance of various phytochemicals and their extraction methods.
3.	Identify suitable method for the processing of herbs.
4.	Choose a suitable formulation on the development of herbal medicines.
5.	Analyse the applications of herbal products for various applications.

UNIT - I	BASICS AND PROCESSING OF HERBAL MEDICINES	12

Herbal medicines : Definition, sources, history, importance and future prospects. Identification and authentication of herbs. Methods of collection, harvesting, garbling, packing and storage of herbs. Natural and artificial drying methods. Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions, Methods of drying – Natural and artificial drying methods with their merits and demerits. Medicinal plants – past and present status in world and India.

UNIT - II	PHYTOCHEMICALS	7

Introduction to phytochemicals : Medicinally important plant parts: Fruits, Leaves, Stem and its modifications (underground and aerial), Roots. Isolation and identification of phytochemicals, types and their applications. Classification of major secondary metabolites, Qualitative and Quantitative estimation of active principles from standardized extracts

UNIT - III	GENERAL METHODS OF PROCESSING OF HERBS	6

Definition, sources, identification and authentication of herbs, Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions, Methods of drying – Natural and artificial drying methods with their merits and demerits.

UNIT - IV	PREPARATION OF EXTRACTS AND HERBAL FORMULATIONS	8

Principles of extraction and selection of suitable extraction method, Different methods of extraction including maceration, percolation, hot continuous extraction, pilot scale extraction and supercritical fluid extraction with their merits and demerits, purification and recovery of solvents. Selection of herbal ingredients, different dosage forms of herbal drugs, Evaluation of different dosage forms, stability studies of herbal formulations.

BoS Chairman

UNIT - V	HERBAL PRODUCTS IN COSMETIC AND MEDICAL APPLICATIONS	12
Herbal cosmetics as skin care and hair care preparations – various herbal materials used in the preparations. Active principles and cosmetic properties of Aloe vera, Neem, Henna, Acacia concinnapods, Citrus aurantium peel, Liquorice, Sandal wood, Olive oil, Wheat germ oil, Almond oil and Tea – tree oil. National Medicinal Plant Board and State Medicinal Plant Boards objectives and functions. Medicinal plant conservation – issues and approaches. Medicinal plant conservation areas (MPCA), Herbal industries.		
		Total Instructional hours : 45

Course Outcomes : Upon completion of the course, students will be able to	
CO1	Attain the basics and applications of herbal medicines and phytochemicals.
CO2	Identify an appropriate method for the extraction and processing of phytochemicals.
CO3	Develop a suitable phytochemical and herbal formulation method(s).
CO4	Conclude a suitable combination of phytochemicals for therapy.

Text Books	
1.	Agarwal SS and Paridhavi M. “Herbal Drug Technology”. Universities Press Pvt Limited, 2007.
2.	Wallis TE. “Textbook of Pharmacognosy” 5th Edition, CBS Publishers and Distributors, 2005.
3.	Indian System of Medicine and Homeopathy, Planning and Evaluation Cell, Government of India, New Delhi, 2001.
4.	Yoga VK. “Yoga - The Science of Holistic Living”. VKY Prakashna Publishing, Bangalore, 2005.
5.	Quality Control Methods for medicinal plant material, WHO Geneva, 1998.

Reference Books	
1.	Evans WC. “Trease and Evans Pharmacognosy” 15th Edition, Elsevier Health Sciences, 2001.
2.	Pulok K Mukherjee. “Quality Control of Herbal Drugs”. Business Horizons, New Delhi, 2012 (Reprint Edition).
3.	Daniel M. “Herbal Technology : Concepts and Advances”. Satish Serial Publishing House, 2008.

BoS Chairman

B. TECH.	B19BTE603 – METABOLIC ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of metabolic engineering.
2.	To expose transport mechanisms and models to regulate enzymes.
3.	To utilize the tools used for metabolic pathway manipulation.
4.	To relate the regulation of enzyme activity with different inhibition
5.	To apply metabolic flux in various applications.

UNIT - I	BASICS OF METABOLIC REGULATION	11

Basic concepts of Metabolic Engineering – Overview of cellular metabolism – Different models for cellular reactions, induction – Jacob Monod model and its regulation, feedback regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feedback regulation, cumulative feedback regulation, amino acid regulation of RNA synthesis, permeability control passive diffusion, facilitated diffusion, active transport, group transportation.

UNIT - II	METABOLIC ENGINEERING OF PRIMARY METABOLITES	9

Alteration of feedback regulation for enhanced production of primary metabolites: glutamic acid. Mutants which do not produce feedback inhibitors or repressors-auxotrophs-lysine, isoleucine, arginine, purine nucleotides. Mutants that do not recognize inhibitors and repressors-resistant mutants- production of biotin, threonine, methionine

UNIT - III	METABOLIC ENGINEERING OF SECONDARY METABOLITES	9

Producers of secondary metabolites, Precursor effects, trophophase- idiophase relationship, applications of secondary metabolites, metabolic pathways and regulation for production of antibiotics (penicillin, cephalosporin, erythromycin, streptomycin)and vitamins (Vit B2, Vit B12).

UNIT - IV	REGULATION OF ENZYME ACTIVITY	7

Overview of enzyme kinetics-simple, reversible inhibition system, irreversible inhibition, un competitive, non-competitive inhibition, allosteric regulation, co-operativity-regulation of enzyme concentration-transcription initiation,translation, regulation at whole cell level.

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UNIT - V	METABOLIC FLUX	9
Integration of anabolism and catabolism, metabolic flux distribution analysis in bioprocess, material balance, kinetic types, equilibrium reaction. Experimental determination method of flux distribution, Metabolic flux analysis and its applications amino acid production by glutamic acid bacterium.		
		Total Instructional hours : 45

Course Outcomes	
CO1	Apply cellular metabolism in growth regulation.
CO2	Analyze the need and scope of metabolic engineering.
CO3	Analyze the scheme of regulatory pathways.
CO4	Evaluate the tools used in metabolic engineering.
CO5	Evaluate the strategies used in metabolic pathway manipulation.

Text Books	
1.	Stanbury PF, Hall SJand Whitaker A, “Principles of Fermentation Technology”, Butterworth - Heinemann, An imprint of Elsevier India Pvt Ltd., 2nd Edition,2005.
2.	Stephanopoulos G, Aristidou AA and Nielson JH, “Metabolic Engineering: Principles and Methodologies”, Academic Press,1998.

Reference Books	
1.	Wang DIC, Cooney CL, Demain AL, Dunnil P, Humphrey AE and Lilly MD, “Fermentation and Enzyme Technology”, John Wiles and Sons., 1980.
2.	Crueger W and Crueger A, “A text book of Industrial Microbiology”, Panima Publishing Corporation,2005.
3.	Zubay G, “Biochemistry”, MacMillan Publishers, 1989.

BoS Chairman

B. TECH.	B19BTE604 – BIOPROCESS PLANT DESIGN AND ECONOMICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of engineering economics.
2.	To draft a project budget to develop and apply problem solving and bioprocess plant design techniques.

UNIT - I	MASS AND ENERGY BALANCE	9

Introduction: General design information, material with component balance equations and energy balance equations for evaporators, absorbers, dryers, distillation column, extractors and heat exchangers. Material and energy balance calculations Process Flow sheeting.

UNIT - II	SCALE UP AND SCALE DOWN OF EQUIPMENTS	9

Bioreactor scale-up constant power consumption per volume, mixing time, impeller tip speed (shear) - mass transfer coefficients. Scale up of downstream processes - Adsorption, Chromatography, Filtration Centrifugation - Extractors Scale-down related aspects.

UNIT - III	DESIGN OF EQUIPMENTS	9

Selection of bioprocess equipment (upstream and downstream) - Specifications of bioprocess equipment Mechanical design of reactors (CSTR and Plug flow reactor), heat exchanger, evaporators and mass transfer equipments (distillation, absorber and extractor). Design considerations for maintaining sterility of process streams and process equipment - Piping and instrumentation Materials of construction for bioprocess plants.

UNIT - IV	GENERAL DESIGN CONSIDERATION	9

Market ability of the product, availability of technology, raw materials, equipment's, human resources, land and utilities, site characteristics, waste disposal, government, regulations and other legal restrictions, community factors and other factors affecting investment and production costs.

UNIT - V	COST ESTIMATION	9

Capital investments- fixed capital investments including land, building, equipment's and utilities, installation costs, working capital investments, inventory cost, payback period, break-even point. Manufacturing costs-Direct Production costs, fixed charges, Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc.

Total Instructional hours : 45

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Course Outcomes : Upon completion of the course, students will be able to	
CO1	Learn about the mass and energy balance of bioprocess.
CO2	Apply design factors for scale up and scale down in the industry.
CO3	Develop and optimize the design parameters for equipments.
CO4	Evaluate the process plant design for regulatory compliance.
CO5	Estimate cost for setting up bioprocess plant.

Text Books	
1.	Perry RH and Green DW (Eds.), "Perry's Chemical Engineers' Handbook", 7th Edition, McGraw Hill Book Co., 1997.
2.	Peters MS and Timmerhaus KD, "Plant Design and Economics for Chemical Engineers", 4th Edition, McGraw-Hill Book Co., 1991.
3.	Shuler M and Kargi F, "Bioprocess Engineering: Basic Concepts", 2nd Edition, Prentice Hall, Englewood Cliffs, NJ, 2002.

Reference Books	
1.	Harrison RG, Todd PW, Rudge SR and Petrides DP, "Bioseparations Science and Engineering", Oxford University Press, 2003.
2.	Coulson JM and Richardson JF (Eds.) Sinnott RK. "Chemical Engineering, Volume 6: An Introduction to Chemical Engineering Design", 2nd Edition, Butterworth-Heinemann Ltd., UK. (Indian Edition: Asian Books Private Limited, New Delhi)
3.	Joshi MV and Mahajani VV, "Process Equipment Design", 3rd Edition, Macmillan India Ltd., 2000.
4.	Ladisch MR, "Bioseparations Engineering: Principles, Practice and Economics", 1st Edition, Wiley, 2001.
5.	Rudd DF and Watson CC, "Strategy of Process Engineering", Wiley. 1987.

BoS Chairman

B. TECH.	B19BTE605 – VACCINE TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the need for vaccine and how it imparts immunity.
2.	To learn the different methods of vaccine preparation.
3.	To understand the mode of vaccine development
4.	To discover various vaccine delivery methods.
5.	The regulatory and safety measures associated with vaccine development.

UNIT - I	INTRODUCTION	9

Vaccines - definition, History of vaccine development, vaccine preventable infectious diseases, bacterial and viral vaccines and their importance to public health. Principles of vaccination. Basics of immunization; Immunization programs and role of WHO in immunization programs.

UNIT - II	TYPES OF VACCINES AND BIOLOGICALS	11

Vaccinology : Active and passive immunization; Live attenuated, killed, toxoid vaccines, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, immuno modulators, recombinant DNA and proteinbased vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, retro vaccinology, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Cell based vaccines. Uses of nanoparticles in vaccine application.

UNIT - III	GENERAL REQUIREMENTS AND TECHNIQUES IN VACCINE PRODUCTION	9

Importance of cGMP in vaccine production. General manufacturing requirements: control of source materials, single harvest, purity and inactivation, control of vaccine in final bulk and final lot. Purification, preservation and formulation techniques. Commercial production of DPT, TT, polio, rabies and hepatitis vaccines. Commercial production of malarial vaccine.

UNIT - IV	DELIVERY METHODS	8

Needle free vaccine delivery, ISCOMS, adjuvant delivery systems, intranasal and inhaled vaccine delivery, liquid jet and solid dose injectors, development of gene-based vectors. Delivery of immunogens through microspheres.

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UNIT - V	REGULATORY AND BIOSAFETY MEASURES	8
Quality assurance in vaccine production. Regulatory issues Environmental concerns with the use of recombinant vaccines Disease security and biosecurity principles and OIE guidelines . Biosafety aspects of vaccine production.		
		Total Instructional hours : 45

Course Outcomes : At the end of this course students will be able to	
CO1	Understand the notion of immunogenicity, vaccines and WHO immunization programs
CO2	Infer the several types of vaccine formulation approach.
CO3	Identify the commercial production of vaccines and its storage conditions.
CO4	Discover the various delivery methods for vaccinations.
CO5	Examine the numerous biosafety rules to be followed during production.

Text Books	
1.	Plotkin S, Orenstein W, Offit P, and Edwards K M, "Plotkin's Vaccines", 7th Edition, Elsevier, 2017.
2.	Fox C B., "Vaccine Adjuvants: Methods and Protocols", Humana Press, 2017.

Reference Books	
1.	Ramadass P, "Animal Biotechnology - Recent Concepts and Developments", MJP Publications, 2008.
2.	Kindt T J, Goldsby RA, Osborne BA and Kuby J, "Kuby Immunology", W.H. Freeman & Company, 2007.
3.	Barton C, "Advances in Vaccine Technology and Delivery", Espicom Business Intelligence, 2009.
4.	Ellis RW, "New Vaccine Technologies", Landes Bioscience, 2001.

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Professional Elective - III

B. TECH.	B19BTE606 – DEVELOPMENTAL BIOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives - Upon completion of this course, the students will be able to	
1.	Enable students to understand the basics and concepts of Developmental Biology.
2.	Learn the process of gametogenesis, fertilization and embryo development.
3.	Understand the concepts of morphogenesis.
4.	Learn organogenesis and its concepts.
5.	Enable the concepts of apoptosis.

UNIT - I	BASIC CONCEPTS ON DEVELOPMENTAL BIOLOGY	9

Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

UNIT - II	GAMETOGENESIS AND FERTILIZATION	12

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

UNIT - III	MORPHOGENESIS AND ORGANOGENESIS IN ANIMALS	12

Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

UNIT - IV	MORPHOGENESIS AND ORGANOGENESIS IN PLANTS	6

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum.

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UNIT - V	APOPTOSIS AND STEM CELL	6
Programmed cell death, aging and senescence. Medical implications of developmental biology - genetic errors, teratogenesis, stem cell therapy – recent developments and applications in stem cell therapy.		
		Total Instructional hours : 45

Course Outcomes : Upon completion of the course, students will be able to	
CO1	Understand various concepts of Developmental Biology.
CO2	Relate the process of gametogenesis, fertilization and embryogenesis.
CO3	Compare the morphogenesis and organogenesis among plant and animal systems.
CO4	Understand the process of apoptosis.
CO5	Construct basic knowledge on stem cell therapy.

Text Books	
1.	Barresi MJF and SF Gilbert. “Developmental Biology” 12th Edition Sinauer Associates, 2019.
2.	Slack JMW. “Essential Developmental Biology”. 3rd Edition, Wiley-Blackwell 2012.
3.	Wolpert LC Tickle and AM Arias. “Principles of Development”, 6th Edition Oxford University Press, 2019.
4.	Müller WA. “Developmental Biology”. 1997th Edition, Springe, 2012.

Reference Books	
1.	Tyler MS “Developmental Biology: A Guide for Experimental Study”, 2nd Edition. Sinauer Associates, 2000.

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B. TECH.	B19BTE607 – MOLECULAR MODELLING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic knowledge on molecular modelling.
2.	To understand about proper molecular arrangement for modelling.
3.	To give specific view on molecular dynamics and simulations.
4.	To deliver brief knowledge about protein structure modelling in omics field.
5.	To make a wide understanding on designing a drug.

UNIT - I	QUANTUM MECHANICS & CONCEPTS IN MOLECULAR MODELING	9

Introduction – coordinate systems – potential energy surfaces – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation, introduction to computer hardware and software.

UNIT - II	MOLECULAR MECHANICS AND ENERGY MINIMIZATION	11

Empirical force field models – Bond stretching – angle bending – torsional term, nonbonding interactions – thermodynamics properties using a force field – derived and non-derived energy minimization method – simplex – sequential univariate method – steepest descent method – conjugate gradient method - Newton - Rapson method.

UNIT - III	MOLECULAR DYNAMICS AND MONTE CARLO SIMULATION	9

Using single Model – time steps, multiple steps – Setting up Molecular Dynamics energy conservation in Molecular Dynamics simulation. Examples – Monte Carlo – Random number generation – Difference in Molecular Dynamics & Monte Carlo.

UNIT - IV	HOMOLOGY MODELING	7

Comparative modeling of proteins – comparison of 3Dstructure – Homology – steps in homology modeling – tools – databases – side chain modeling – loop modeling.

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UNIT - V	DRUG DESIGN	9
General approach to discovery of new drugs lead discovery – lead modification – physiochemical principles of drug action – drug stereo chemistry –drug action 3D database search – computer aided drug design – docking molecular modeling in drug design – structure based drug design – pharmacophores QSAR.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Recall the basic concepts of quantum mechanics and modelling
CO2	Outline the process of finding an arrangement in space of a molecule.
CO3	Explain about a brief knowledge on analyzing the physical movements of atoms and molecules.
CO4	Illustrate about the comparative modeling of proteins.
CO5	Make use of brief understanding of finding new medications based on the knowledge of a biological target.

Text Books	
1.	Leach AR, “Molecular Modeling Principles and Application”, 2nd Edition Longman Publications, 2001.
2.	Baxivanis D and Foulette, “Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins”, Wiley Indian Edition, 2001.

Reference Books	
1.	Attwood T.K., D.J. Parry-Smith, “Introduction to Bioinformatics”, Pearson Education, 1st Edition, 11th Reprint, 2005.

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B. TECH.	B19BTE608 – PROTEIN ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic knowledge about proteins.
2.	To understand protein architecture for structural perceptions.
3.	To give specific view on various protein structures and their predictions.
4.	To deliver brief knowledge about relation of protein structure and its function.
5.	To make a wide understanding on emerging proteomics field.

UNIT - I	INTRODUCTION TO PROTEIN ENGINEERING	9

Bonds-Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions, Amino acids (the students should be thorough with three and single letter codes)-Primary structure, Secondary structure, molecular properties (size, solubility, charge, pKa), tertiary structure, quaternary structure, Ramachandran plots, Elucidation of protein structure.

UNIT - II	PROTEIN ARCHITECTURE	10

Primary structure - peptide mapping, peptide sequencing automated Edman method & mass spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites.

UNIT - III	PROTEIN STRUCTURE PREDICTION	9

Strategies for design of novel proteins-strategies for the design of structure and function, computer methods in protein modeling- overview of methods to determine 3D structures, Modular nature, formation of complexes. Computer exercise on the above aspects.

UNIT - IV	STRUCTURE - FUNCTION RELATIONSHIP	10

DNA - binding proteins : prokaryotic transcription factors, Trp Repressor, Eukaryotic transcription factors, Zn fingers, types of motifs; Membrane proteins : General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and photosynthetic reaction center; Immunoglobulins: IgG Light chain and heavy chain architecture, Abzymes- Serine proteases, trypsin, chymotrypsin and elastase, substrate - assisted catalysis other commercial applications.

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UNIT - V	PROTEOMICS	9
Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Recall the basics of Protein Structure
CO2	Outline the numerous architectures and its models
CO3	Explain about a brief knowledge on structure prediction.
CO4	Illustrate about the Structural and Function Relationship of Protein.
CO5	Make use of brief understanding of entire protein content in a specific organism.

Text Books	
1.	Branden C. and Tooze J., "Introduction to Protein Structured" 2nd Edition, Garland Publishing, 1999.
2.	Creighton T E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3.	Pennington, S.R and M.J. Dunn, "Proteomics: Protein Sequence to Function". Viva Books, 2002.
4.	Liebler, "Introduction to Proteomics" Humana Press, 2002.

Reference Books	
1.	Voet D and Voet G., "Biochemistry", 3rd Edition. John Wiley and Sons, 2008.
2.	Haggerty LM (Ed.). "Protein Structure: Protein Science and Engineering". Nova Science Publications, 2011.
3.	Williamson MP, "How Proteins Work". Garland Science, 2012.

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B. TECH.	B19BTE609 – LIFESTYLE DISEASES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the idea of lifestyle oriented disease
2.	To know about the risk factors associated with the disease.
3.	To know about cancer and its treatment.
4.	To understand the causes and lifestyle changes for diabetes and cardiovascular disease.
5.	To learn about the respiratory diseases and the preventive measures.

UNIT - I	INTRODUCTION	9

Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Control and Prevention – Diet and exercise.

UNIT - II	CANCER	9

Types –Colon cancer, Lung cancer, Mouth cancer, Skin cancer, cervical cancer, Carcinoma esophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment. Control and prevention.

UNIT - III	CARDIOVASCULAR DISEASES	9

Coronoary atherosclerosis - Coronary artery disease; Causes -Fat and lipids, Alcohol abuse - Diagnosis Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation. Control and prevention.

UNIT - IV	DIABETES AND OBESITY	9

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity; Control and prevention Weight control and BMI.

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UNIT - V	RESPIRATORY DISEASE	9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis Pulmonary function testing. Control and prevention.		
		Total Instructional hours : 45

Course Outcomes : At the end of this course, students will be able to	
CO1	Understand the lifestyle changes that bring about many diseases.
CO2	Demonstrate the types of cancer and its treatment.
CO3	Explain the causes of cardiovascular diseases and its recovery habits.
CO4	Interpret the effects of diabetes mellitus and its control by weight management.
CO5	Summarize the causes of respiratory disease and its effects.

Text Books	
1.	Kumar R and M I Kumar, “Guide to Prevention of Lifestyle Diseases”, Deep & Deep Publications, 2003.
2.	Sagner M, Egger G, Binns A and S Rossner, “Lifestyle Medicine”, 3rd Edition, Academic Press, 2017.

Reference Books	
1.	James MR, “Lifestyle Medicine”, 2nd Edition, CRC Press, 2013.
2.	Miyazaki A and I. Michio (Eds.),“New Frontiers in Lifestyle-Related Disease”, Springer, 2008.

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B. TECH.	B19BTE610 – NEUROBIOLOGY AND COGNITIVE SCIENCE	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn about the neuroanatomy.
2.	To learn about the neurophysiology.
3.	To understand the concept of synaptic transmission.
4.	To know about the basic sensation mechanisms.
5.	To understand the disorders related to nervous system.

UNIT - I	NEUROANATOMY	9

Overview of central and peripheral nervous system, Neurons: structure, types and functions; Glial cells: types; Synapses: types and functions; Myelination; Blood Brain barrier; Neural Development; Cerebrospinal fluid: origin and composition; Spinal cord: functions.

UNIT - II	NEUROPHYSIOLOGY	9

Resting and action potential; Properties and mechanism of action potential conduction; Voltage dependent channels: sodium and potassium channels; Electrical transmission; information representation and coding by neurons.

UNIT - III	NEUROPHARMACOLOGY	9

Synapse formation; Synaptic transmission: Principles of Chemical synaptic transmission, neurotransmitters and their mechanism of action: acetyl choline, serotonin and dopamine; Nicotinic and muscarinic acetyl choline receptors; Transmitter gated channels; hypothalamic control of neuronal function.

UNIT - IV	APPLIED NEUROBIOLOGY	9

Basic mechanisms of sensations: touch, pain, smell, taste; neurological mechanisms of vision and audition; skeletal muscle contraction (neuromuscular junction).

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UNIT - V	BEHAVIOURAL SCIENCE	9
Basic mechanisms associated with motivation; regulation of feeding, sleep, hearing and memory; Disorders associated with nervous system: Parkinson's disease, Alzheimer's disease, Schizophrenia, Epilepsy; Anxiety and mood disorders: Depression, Agrophobia.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the basis of central and peripheral nervous system and describe the structure of neurons and supporting cells.
CO2	Discuss the mechanism of action potential conduction and working of voltage dependent channels.
CO3	Illustrate the synaptic transmission and mechanism of action of neurotransmitters.
CO4	List the basic mechanisms of sensations and skeletal muscle contraction.
CO5	Enumerate the mechanisms associated with motivation behaviours and describe various disorders of nervous system.

Text Books	
1.	Bear MF, BW Connors and MA Paradiso, "Neuroscience – Exploring the Brain", 2nd Edition, USA, Lippincott Williams & Wilkins, 2001.
2.	Mathews GG, "Neurobiology", 2nd Edition, Blackwell Science, 2000.

Reference Books	
1.	https://ocw.mit.edu › Courses

BoS Chairman

Open Elective - II

B. E. / B. TECH.	B19AEO601 - AIRCRAFT ELECTRICAL AND ELECTRONIC SYSTEMS (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the working principles of aircraft engine and fuel systems.
2.	To understand the lighting technologies and pressurization system of the aircraft cabin.
3.	To realize the warning and protection systems of the aircraft.
4.	To expose on terrain warning systems of the safety of the aircraft.
5.	To gain knowledge on FDR and anti-fire protection system.

UNIT - I	AERO ENGINE AND FUEL MANAGEMENT SYSTEMS	9

Introduction to Starting and Ignition Systems - Primary, secondary and Electronic Indicating Systems. Fuel Management system - Fuel quantity measurement and indication - Fuel feed and distribution - Fuel transfer - Refueling and defueling - Fuel jettison - Fuel Tank Venting and Inerting.

UNIT - II	LIGHTS AND CABIN SYSTEMS	9

Overview of Lighting technologies - Flight compartment lights - Passenger cabin lights - Exterior lights. Cabin systems - Passenger address system - Galley equipment - In-flight entertainment - Satellite communications - Air conditioning – Pressurization - Airstairs.

UNIT - III	WARNING AND PROTECTION SYSTEMS	9

Stall warning and protection - Airframe ice and rain protection - Windscreen ice and rain protection - Anti-skid - Configuration warning - Aural warnings.

UNIT - IV	TERRAIN AWARENESS WARNING SYSTEM	9

System overview - System warnings and protection - External references - Ground proximity modes - Forward - looking terrain avoidance - Rotorcraft TAWS - Architecture and configurations.

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UNIT - V	FLIGHT DATA RECORDER AND FIRE PROTECTION SYSTEM	9
Introduction to FDR - Equipment Requirement - FDR Specifications - Cockpit Voice Recorders - Health and usage monitoring system. Fire Protection - Engine fire Detection - Cargo Bay Area- Fire Extinguishing systems.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the Basics of Ignition and Fuel System of an Aircraft. (K2)
CO2	Illustrate the Flight Compartment Lighting Technologies and Cabin Air Conditioning system. (K2)
CO3	Identify the Warning and Protection Systems for the Ice Formation and Rain in the Airframe of the Aircraft During Flight. (K3)
CO4	Apply the Terrain Warning Systems to avoid the Terrain Collision of an Aircraft. (K3)
CO5	Examine the FDR and Fire Protection System to Monitor the Flying Performance of the Aircraft. (K4)

Text Books	
1.	“Aircraft Electrical and Electronic Systems”, Principles, operation and maintenance by Mike Tooley and David Wyatt.

Reference Books	
1.	Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
2.	Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1993.
3.	Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000.

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B.E. / B. TECH.	B19AGO601- INTEGRATED WATER RESOURCES MANAGEMENT (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the key elements of IWRM.
2.	To know about the water economics and policies related to IWRM.
3.	To understand the water supply with reference to human health.
4.	To learn the concept of water security for agriculture practices.
5.	To know the water regulation acts and international water scenarios.

UNIT - I	CONTEXT FOR IWRM	9

Water as a global issue: key challenges and needs – Definition of IWRM within the broader context of development – Complexity of the IWRM process – Examining the key elements of IWRM process.

UNIT - II	WATER ECONOMICS	9

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments, policy options for water conservation and sustainable use – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT - III	WATER SUPPLY AND HEALTH WITHIN THE IWRM CONSIDERATION	9

Links between water and human health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Health impact assessment of water resources development.

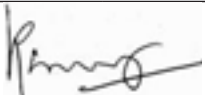
UNIT - IV	AGRICULTURE IN THE CONCEPT OF IWRM	9

Water for food production: blue" versus "green" water debate – Conjunctive use of surface and groundwater - Virtual water trade for achieving global water security –- Irrigation efficiencies, irrigation methods and current water pricing.

UNIT - V	WATER LEGAL AND REGULATORY SETTINGS	9

Basic notion of law and governance: principles of international and national law in the area of water management. Understanding UN law on non-navigable uses of international water courses – Development of IWRM in line with legal and regulatory framework.

Total Instructional hours : 45



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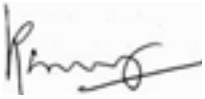
Course Outcomes : Students will be able to	
CO1	Explain the concepts of IWRM.
CO2	Build an economic conservation of water under PPP and IWRM.
CO3	Identify the linkages between human health and water
CO4	Summarize the water use effectiveness in agriculture.
CO5	Make use of knowledge on regulatory acts and policies of water

Reference Books	
1.	Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
2.	Technical Advisory Committee, Poverty Reduction and IWRM, Technical Advisory Committee Background paper no: 8. Global water partnership, Stockholm, Sweden, 2003.
3.	Technical Advisory Committee, Regulation and Private Participation in Water and Sanitation section, Technical Advisory Committee Background paper No:1. Global water partnership, Stockholm, Sweden, 1998.
4.	Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
5.	Technical Advisory Committee, Water as social and economic good: How to put the principles to practice". Technical Advisory Committee Background paper No: 2. Global water partnership, Stockholm, Sweden, 1998.
6.	Technical Advisory Committee, Effective Water Governance".Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.
7.	Cech Thomas V., "Principles of water resources: history, development, management and policy", John Wiley and Sons Inc., New York. 2003.
8.	Mollinga .P. etal, "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
9.	Iyer R. Ramaswamy, "Towards Water Wisdom: Limits, Justice, Harmony", Sage Publications, New Delhi, 2007.
10.	https://nptel.ac.in/courses/105/105/105105110/



BoS Chairman

B.E. / B. TECH.	B19BMO601 - INTRODUCTION TO BIOMEDICAL ENGINEERING (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of biomedical engineering technology
2.	To learn the working principles of diagnostic devices
3.	To study the principles of therapeutic devices
4.	To know the concepts of medical imaging techniques present in biomedical field.
5.	To learn various prevention and safety tools

UNIT - I	INTRODUCTION TO BIOMEDICAL ENGINEERING	9

Introduction – History of medical devices – Characteristics of human anatomy and physiology that relate to medical devices – Electrical signals and conductivity – Physiological monitoring systems.

UNIT - II	DIAGNOSTIC DEVICES AND MEASUREMENTS	9

ECG Machine – Blood pressure measurements – Temperature measurements – Pulse oximeters – Biochemical analysers – Blood flow detectors – Respiration monitor.

UNIT - III	THERAPEUTIC DEVICES AND MEASUREMENTS	9

Introduction – Defibrillators- Pacemakers – Ventilators – Heart lung machine – CPAP/BPAP – Humidifiers.

UNIT - IV	DIAGNOSTIC IMAGING	9

Basic Principles of X-ray- CT -MRI – PET – SPECT

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UNIT - V	PREVENTION AND PATIENT SAFETY TOOLS	9
Electrical Safety – testing methods – other safety considerations – Troubleshooting techniques – general test equipment – Specialized biomedical test equipment – tools.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the basics of biomedical Engineering
CO2	Discuss about the diagnostic devices and measurements
CO3	Summarize about the therapeutic devices and measurements
CO4	Explain about diagnostic imaging
CO5	Describe about prevention and patient safety tools

Reference Books	
1.	Laurence J. Street, "Introduction to Biomedical Engineering Technology", 3rd Edition, CRC Press, 2017.
2.	John Enderle, "Introduction to Biomedical Engineering", 3rd Edition, Academic Press, 2011.
3.	Germin Nisha. M, John Robert Prince. M, Sivagama Sundari Meenakshi Sundaram, "Bio-Medical Instrumentation: Medical Applications", Lambert Academic Publishing, 2020
4.	Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation Systems", Thomson Press (India) Ltd, 2012

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B.E. / B. TECH.	B19CSO601 - E-COMMERCE TECHNOLOGY AND MANAGEMENT (Common to all Except CSE, AI&DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the E-Commerce Platform and its concepts.
2.	To understand the Technology, infrastructure and Business in E-Commerce.
3.	To understand the Security and Challenges in E-Commerce.
4.	To build an own E-Commerce using Open Source Frameworks.
5.	To apply the security and learn the payment systems.

UNIT - I	INTRODUCTION	9

Infrastructure : Working of Web – Web Browsers - Traditional commerce and E commerce – Internet and WWW – role of WWW – value chains – strategic business and Industry value chains – role of E commerce.

UNIT - II	BUILDING E-COMMERCE SITES AND APPS	9

Systematic approach to build an E-Commerce - Planning - System Analysis - System Design - Building the system - Testing the system - Implementation and Maintenance, Optimize Web Performance – Choosing hardware and software – Other E-Commerce Site tools – Developing a Mobile Website and Mobile App.

UNIT - III	E-COMMERCE SECURITY AND PAYMENT SYSTEMS	9

E-Commerce Security Environment – Security threats in E-Commerce – Technology Solutions: Encryption - Securing Channels of Communication - Protecting Networks - Protecting Servers and Clients – Management Policies - Business Procedure and Public Laws - Payment Systems.

UNIT - IV	BUSINESS CONCEPTS IN E-COMMERCE	9

Digital Commerce Marketing and Advertising strategies and tools – Internet Marketing Technologies – Social Marketing – Mobile Marketing – Location based Marketing – Ethical- Social - Political Issues in E-Commerce

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UNIT - V	TOOLS FOR E-COM	9
Web server – performance evaluation - web server software feature sets – web server software and tools – web protocol – search engines – intelligent agents – EC software – web hosting – cost analysis - Mini Project: Develop E-Commerce project in any one of Platforms like Woo-Commerce, Magento or Opencart.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Build Website using HTML CSS and JS.
CO2	Develop Responsive Sites.
CO3	Infer Manage, Maintain and Support Web Applications.
CO4	Choose the marketing and advertising strategies and tools for marketing.
CO5	Identify the security technique and learn the payment systems.

Text Books	
1.	Kenneth C.Laudon, Carol Guercio Traver “E-Commerce”, Pearson, 10th Edition, 2016.
2.	Harvey M. Deitel, Paul J.Deitel, Kate Steinbuhler, e-business and e-commerce for managers, Pearson, 2011.

Reference Books	
1.	Robbert Ravensbergen, “Building E-Commerce Solutions with Woo Commerce”, PACKT, 2nd Edition
2.	Parag Kulkarni, Sunita Jahirabad kao, “Pradeep Chande, e-business”, Oxford University Press, 2012.
3.	Kala kota et al, “Frontiers of Electronic Commerce”, Addison Wesley, 2004.
4.	Micheal Papaloelon and Peter Robert, “E-business”, Wiley India, 2006.
5.	Efraim Turban, Jae K.Lee, avid King, Ting Peng Liang, Deborrah Turban, “Electronic Commerce – A managerial perspective”, Pearson Education Asia, 2010.

BoS Chairman

B.E. / B.TECH.	B19ECO601 – GEOGRAPHIC INFORMATION SYSTEM (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the fundamentals and components of Geographic Information System.
2.	To provide details of spatial data models.
3.	To understand the input topology.
4.	To study the data analysis tools.
5.	To introduce the marketing and business applications.

UNIT - I	FUNDAMENTALS OF GIS	9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales / levels of measurements.

UNIT - II	SPATIAL DATA MODELS	9

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models - TIN and GRID data models - OGC standards - Data Quality.

UNIT - III	DATA INPUT AND TOPOLOGY	9

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input – Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT - IV	DATA ANALYSIS	9

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

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UNIT - V	APPLICATIONS	9
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic idea about the fundamentals of GIS
CO2	Summarize the types of data models
CO3	Analyse about data input and topology
CO4	Analyse about tools and models used for data analysis
CO5	Interpret the data management functions and data output

Text Books	
1.	Kang - Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 2nd Edition, 2011.
2.	Ian Heywood, Sarah Cornelius, Steve Carver, SrinivasaRaju, "An Introduction Geographical Information Systems", Pearson Education, 2nd Edition, 2007.

Reference Books	
1.	Lo.C.P, Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice - Hall India Publishers, 2006.

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B.E. / B.TECH.	B19EEO601 - FUNDAMENTALS OF POWER ELECTRONICS (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To get an overview of different types of power semiconductor devices and their switching.
2.	To understand the operation, characteristics and performance parameters of controlled rectifiers.
3.	To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
4.	To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
5.	To understand the operation of AC Voltage controller and Cyclo converter with various Configurations.

UNIT - I	POWER SWITCHING DEVICES	9

Study of switching devices - Diode, SCR, DIAC,TRIAC, GTO, BJT, MOSFET, IGBT - Static and Dynamic characteristics – Gate triggering circuit and commutation circuit for SCR - Introduction to Driver and snubber circuits - Heat sink calculation.

UNIT - II	AC TO DC CONVERTERS	9

Introduction - Single Phase and Three Phase controlled Rectifiers - Effect of source inductance – performance parameters - Firing Schemes for converter – Dual converters, Applications - Solar PV Systems, Light Dimmer.

UNIT - III	DC TO DC CONVERTER	9

Step-down and step-up chopper - control strategy – Introduction to types of choppers - A, B, C, D and E - Switched mode regulators - Buck, Boost, Buck - Boost regulator, Introduction to Resonant Converters, Applications - Battery operated vehicles.

UNIT - IV	DC TO AC CONVERTERS	9

Single phase half bridge inverter and Full bridge inverter - Three phase voltage source inverters (both 120° mode and 180° mode) - Voltage & harmonic control - PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM - Introduction to Space Vector. Pulse Width Modulation - Current Source Inverter - Multilevel Inverter - Applications-Induction heating, UPS.

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UNIT - V	AC TO AC CONVERTERS	9
Single phase and three phase AC voltage Controllers – Control strategy - Power Factor Control – Multistage sequence control - Single Phase and Three Phase Cyclo Converters – Introduction to Matrix converters, Applications: welding.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the operation, characteristic and turn on methods of different types of power semiconductor devices.
CO2	Explain theoperation of phase controlled Converters and its performance parameters.
CO3	Classify different types of DC-DC converter and switching regulators and explain its operation with control techniques.
CO4	Choose the different modulation techniques for pulse width modulated inverters and to infer the harmonic reduction methods.
CO5	Explain the operation of AC voltage controller and Cycloconverter with various configurations.

Text Books	
1.	M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Fourth Edition, New Delhi, 2014.
2.	P.S. Bimbra "Power Electronics" Khanna Publishers, Fifth Edition, 2012.
3.	M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.

Reference Books	
1.	Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2.	L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.
3.	Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.
4.	S. Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.
5.	J.P. Agarwal," Power Electronic Systems: Theory and Design" 1e, Pearson Education, 2002

BoS Chairman

B.E. / B.TECH.	19MEO601 - ENTREPRENEURSHIP DEVELOPMENT (Common to all Except MECH)	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To interpret the entrepreneurial aspects.
2.	To comprehend the distinct inspirational practices to execute entrepreneurial plans.
3.	To introduce various elements involved in establishing a business.
4.	To understand the sources of finance and accounting.
5.	To throw the light on various supporting institutions for the entrepreneurs.

UNIT - I	ENTREPRENEURSHIP	9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT - II	MOTIVATION	9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT - III	BUSINESS	9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT - IV	FINANCING AND ACCOUNTING	9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

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UNIT - V	SUPPORT TO ENTREPRENEURS	9
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Classify and compare the entrepreneurship in society.
CO2	Identify the interpersonal attributes needed to become entrepreneur.
CO3	Demonstrate the various facets of business.
CO4	Summarize the components of finance and accounting.
CO5	Outline the comprehensive business entities.

Text Books	
1.	Donald F Kuratko, — Entrepreneurship – Theory, Process and Practice, 9th Edition, Cengage Learning, 2014.
2.	Khanka. S.S., —Entrepreneurial Developmentll S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

Reference Books	
1.	Hisrich R D, Peters M P, — Entrepreneurship 8th Edition, Tata McGraw-Hill, 2013.
2.	Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.

BoS Chairman

B. TECH.	B19BTP601 - IMMUNOLOGY LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To develop skills of students in immunological techniques by performing simple experiments in the laboratory.
2.	To perform techniques like blood grouping, ELISA and identification of T-cells.

List of Experiments	
Expt. No.	**Description of the Experiments**
	Haematology and Immune Cells
1.	Blood smear preparation and identification of leucocytes by Giemsa stain
2.	Serum separation and storage
3.	Separation of Mononuclear cells by Ficoll-hypaque.
4.	Separation of leucocytes by dextran methods
	Immunology – Agglutination
5.	Identification of ABO blood group with Rh-factor
6.	Haemagglutination and Latex agglutination test
7.	Widal and VDRL test
8.	Complement fixation
	Immunology – Precipitation
9.	Ouchterlony double immune diffusion
10.	Immunoelectrophoresis
11.	Single radial immunodiffusion
12.	Rocket Immunoelectrophoresis
13.	Enzyme Linked Immuno Sorbent Assay (ELISA)
	Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Utilize the knowledge for identification of immunological cells in our circulatory system
CO2	Apply immunological techniques to know about different Ag-Ab interaction during microbial pathogenesis

Reference Books	
1.	Hudson L. and Hay HC, “Practical Immunology” Blackwell Scientific Publications, 2008.
2.	Hay FC, Westwood OMR, Nelson PN and Hudson L, Practical Immunology, Wiley-Blackwell Publications, 2006.
3.	Rollins DM, Temenak JJ, Shields P and Joseph SW, “Microbial Pathogenesis Laboratory Manual” 2nd Edition, Published and Available Online, 2003.

BoS Chairman

B. TECH.	B19BTP602 - DOWNSTREAM PROCESSING LABORATORY	T	P	TU	C
		0	2	0	1

Course Objectives	
1.	To implement the techniques of bioseparation.
2.	To expose students to the techniques of final product purification.
3.	To utilize various isolation methods for developing new products.
4.	To apply various chromatographic techniques for product purification.
5.	To create deeper understanding of final product purification.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Solid liquid separation – centrifugation and microfiltration
2.	Cell disruption techniques – ultrasonication or French press
3.	Extraction of Tyrosinase from potato or mushroom
4.	Precipitation – ammonium sulphite precipitation
5.	Protein purification by isoelectric point precipitation.
6.	Ultra filtration separation
7.	Aqueous two phase extraction of biologicals
8.	High resolution purification – affinity chromatography
9.	High resolution purification – ion exchange chromatography
10.	Product polishing – spray drying or freeze drying
11.	Size exclusion chromatography
12.	Purification of α– Amylase from Bacillus.
13.	Adsorption of antibiotics on activated carbon.
	Total Instructional hours : 60

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Course Outcomes	
CO1	Apply the separation techniques for the recovery of biomolecules from fermentation broth.
CO2	Evaluate the techniques used for final purification and product formulation.
CO3	Apply the chromatography techniques in bio molecules separation.
CO4	Analyze techniques of insoluble removal and predict the parameters for large scale operations.
CO5	Evaluate the techniques of high-resolution product purification based on product characteristics and cost effectiveness.

Reference Books	
1.	Harrison RG, Todd P, Rudge SR and Pterides DP, “Bioseparations Science and Engineering”, Oxford University Press, 2003.
2.	Jenkins RO, (Ed.), “Product Recovery in Bioprocess Technology – Biotechnology”, Open Learning Series, Butterworth-Heinemann, 1992.

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B. TECH.	B19BTP603 – MINI PROJECT	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To develop the capability to address a specific problem comprehensively, starting from its identification and literature review and continuing until a successful solution is achieved.
2.	To equip students with the skills to create project reports, publications, and initiate patent applications.

Students in a group of 3 or 4 shall work on a topic approved by the Head of the Department under the guidance of a faculty member and submit a comprehensive project report duly approved by the project supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner

Total Hours- 60

Course Outcomes : Students will be able to	
CO1	Identify and propose a Biotechnology project addressing a specific research problem.
CO2	Design and implement experiments to reduce the technological gaps.
CO3	Analyze experimental data and draw evidence-based conclusions.
CO4	Develop scientific writing and presentation skills.

BoS Chairman

B. TECH.	B19CEP601 - CAREER ABILITY COURSE – III	T	P	TU	C
		0	2	0	NC

Course Objectives	
1.	To acquire basic and fundamental knowledge on laboratory safety and calculations.
2.	To understand quality control and quality assurance.
3.	To get hands on experience with laboratory equipments.
4.	To plan, execute and interpret research programmes.
5.	To learn the basics of molecular diagnosis techniques.

UNIT - I	LABORATORY SAFETY AND CALCULATIONS	9

Biosafety levels : BSL – I, II, III and IV. Biosafety cabinets, aseptic techniques. Media preparation and sterilization. Calculations : Molarity, Molality and Normality, buffer preparation.

UNIT - II	QUALITY CONTROL AND QUALITY ASSURANCE	9

Quality control and Quality assurance techniques – Quality parameters of air, water, soil and food. HACCP techniques.

UNIT - III	LABORATORY EQUIPMENTS AND ANALYSIS	9

Handling of glassware, chemicals, equipments and analysis of samples.

UNIT - IV	DESIGN OF EXPERIMENTS	9

Experiment design : Sample collection, data analysis and data interpretation. Preparation of report.

UNIT - V	MOLECULAR DIAGNOSIS TECHNIQUES	9

Diagnosis and interpretation of plant, animal and human diseases, identification of causative sources and report preparation.

Total Instructional hours : 45

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Course Outcomes : Upon completion of the course, students will be able to	
CO1	To understand the basic and fundamental on laboratory safety and calculations.
CO2	To evaluate quality control and quality assurance.
CO3	To develop hands on experience with laboratory equipments.
CO4	To design the experiments
CO5	To develop the basic knowledge on molecular diagnosis techniques.

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Semester - VII

B. E. / B. TECH.	B19MGT701 - TOTAL QUALITY MANAGEMENT	L	P	TU	C
		3	0	1	3

Course Objectives	
1.	To understand the need for quaility, its evolution, basic concepts, contribution of quality gurus, TQM Framework, Barriers and Benefits of TQM.
2.	To Explain the TQM Principles for application.
3.	To define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarkting and FMEA.
4.	To describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM and 5S.
5.	To illustrate and apply ISO 9000 and ISO 14000 in any organization.

UNIT - I	INTRODUCTION TO TQM	9

Definatyion of quality - dimensions of quality, Quality planning - quality costs Total Quality Management histroical review and principles - leadership - quality council - quality statements - stategic planning - Derning philosophy Barriers to TQM implementation.

UNIT - II	QUALITY PRINCIPLES	9

Customers focus - Customer orietation, Customer satisfaction, Customer - complaints Customer retention - Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork Recognition and Reward, Performance appraisal - Continous process improvement.

UNIT - III	TOOLS AND TEHNIQUES	9

The seven traditional tools of quality - New management tools - Six sigma : Concepts Methodology, applications to manufacturing, service sector including IT - Bench marking Bench marking process - FMEA - Stages, Types.

UNIT - IV	ADVANCED TECHNIQUES	9

Quality Circles - Costs of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - 5S - TPM - Concepts, Improvement needs - Performance measures.

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UNIT - V	QUALITY MANAGEMENT SYSTEM	9
Need for quality systems - ISO 9000 :2000 - Elements of quality systems (such as ISO 9000:2000). Implementation of quality system - documentation - quality auditing - QS 9000 - ISO 14000.		

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Ability to apply TQM concepts in a selected enterprise
CO2	Ability to apply TQM principles in a selected enterprise.
CO3	Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4	Ability to understand Taguchi's Quality Less Function, Performance Measures and apply QFD, TPM and SS.
CO5	Ability to apply ISO 9000 and ISO 14000 in any organization

Text Books	
1.	Date H-Besterfiled, Carol B.Michna.Glen H Besterfield Mary B.Sacre. Hemant Urdhwareshe and Rashmi Urdhwareshe. "Total Quality Management". Pearson Educations Asia, Revised Third Edtion, Indian Reprint, Sixth Impression, 2013.
2.	Janakiraman B and Gopal RK. "Total Quality Management - Text and Cases" Prentice Hall (India) Pvt Ltd, 2016.
3.	V.S. Bagad, "Total Quality Management", Technical Publications - First Edition, Jan 2018.

Reference Books	
1.	James R. Evans and William M. Lindsay. "The Management and Control of Quality" 8th Edition, First Indian Edition, Cengage Learning 2012.
2.	Suganthi, L. and Anand Samuel, "Total Quality Management" Prentice Hall (India) Pvt. Ltd. 2016.
3.	S. Rajaram, "Total Quality Management", Dreamtech Press, First Edition, Jan. 2018

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B.E.	B19BTT701 - BIOETHICS, BIOSAFETY AND IPR	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To get familiarize with the relationship between Biotechnology and society
2.	To understand ethical theory, codes of ethics and rights in Biotechnology
3.	To understand the concepts of biosafety.
4.	To provide knowledge on various aspects if intellectual property
5.	To learn procedures for patenting

UNIT - I	BIOTECHNOLOGY AND SOCIETY	9

Introduction to science, technology and society, issues of access-Ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public Vs. private funding, Public acceptance issues for Biotechnology: Biotechnology and hunger: Challenges for the Indian Biotechnological research and industries.

UNIT - II	BIOETHICS	9

Principles of bioethics - bioethics vs. business ethics- General issues related to the release of transgenic plants - animals and microorganism- Bioethics and animal rights - human cloning - ethical issues - Designer babies - Ethical social implications - Biowarfare. Kohlberg's and Gilligan's theory - uses of ethical theories.

UNIT - III	BIOSAFETY	9

Introduction and Historical background of biosafety - Primary Containment for Biohazards - Biological Safety Cabinets - Recommended Biosafety Levels for Infectious Agents and Infected Animals - Biosafety guidelines – Government of India - GMOs and LMOs: Concerns and challenges - Environmental release of GMOs – Roles of Institutional Biosafety Committee.

UNIT - IV	INTELLECTUAL PROPERTY RIGHTS	9

Introduction and the need for intellectual property right (IPR)-Types of IP – Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge and Geographical Indications-Legal protection of Biotechnological inventions - Agreements and Treaties – History of GATT & TRIPS - Agreement - IPR and WTO regime – Consumer protection and plant genetic resources.

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UNIT - V	PATENT SYSTEM IN INDIA	9
Patent and kind of inventions protected by a patent- Indian Patent Act 1970 and Recent amendments - Role of a Country Patent office; Patent applications - Forms and guidelines, fee structure, time frames; Types of patent application; Patent specification - provisional and complete specification; Patent databases-India, USPTO, and EPO; Patent infringement – Turmeric, Neem etc.,		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the implication of Biotechnology on society.
CO2	Explain the concepts of bioethics.
CO3	Understand the need of biosafety in Biotechnology industries and laboratories.
CO4	Understand different forms of Intellectual property.
CO5	Apply for patents in India.

Text Books	
1.	Thomas JA, and RL Fuch, “Biotechnology and Safety Assessment”, 3rd Ed., Academic Press, 2002.
2.	Fleming DA and D Hunt, “Biological safety Principles and practices”, 3rd Ed. ASM Press, 2000.
3.	Mepham B, “Bioethics”, Oxford University Press, 2008.
4.	Rallapalli R and Geetha Bali, “Bioethics & Biosafety”, APH Publication, 2007.

Reference Books	
1.	Fleddermann CD, “Engineering Ethics”, Pearson Education / Prentice Hall of India, New Jersey, 2004.
2.	Singh K, “Intellectual Property Rights in Biotechnology”, 2nd Ed., BCIL, New Delhi, 2011.
3.	Rajiv Jain and Rakhee Biswas, “Law of Patents, Procedure & Practice”, Vidhi Publication, 2010.

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B. TECH.	B19BTT702 - BIOPHARMACEUTICAL TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic knowledge on pharmaceutical industry.
2.	To acquire knowledge on pharmacokinetics.
3.	To deliver elementary facts on antibody based therapeutics and diagnosis.
4.	To know the fundamental process of drug manufacture.
5.	To understand the facts of biopharmaceuticals.

UNIT - I	INTRODUCTION TO PHARMACEUTICAL INDUSTRY	9

Introduction to Biopharmaceuticals and pharmaceutical Biotechnology, Biopharmaceuticals: current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals. Discovery of protein or peptide based therapeutics: in-silico, pharmaco-informatics. Pre-clinical toxicity assessment, Clinical trial phases and design, clinical data management, concept of Pharmacovigilance.

UNIT - II	PHARMACOKINETICS AND PHARMACODYNAMICS	9

Definition, rationales, absorption, distribution and metabolism pathway. Factors governing absorption of drug. Pharmacokinetics and Pharmacodynamics of therapeutic peptides. Dose response relationship, interspecies scaling, and heterogeneity of therapeutic proteins. Chemical modification of therapeutic proteins.

UNIT - III	IMMUNOTHERAPEUTIC & IMMUNODIAGNOSTICS	9

Overview of antibody based therapeutics, biologics for autoimmunity and inflammation, vaccine- adjuvant technology, genetically engineered vaccines, cancer vaccines, present and future biologics. Principles of immunodiagnostic assay based on solid phase system: Malarial & HIV diagnostic kits as case study. Fluorescent ligands and radio-isotope tracers, principles and instrumentation for molecular diagnostics (Time resolved fluorescence immunoassay, light scattering principles), PCR and nucleic acid based diagnostics, imaging techniques.

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UNIT - IV	PRINCIPLES OF DRUG MANUFACTURE, PROCESS AND APPLICATIONS	9

Types of reaction process and special requirements for bulk drug manufacture. Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oral liquids – vegetable drugs – topical applications, formulation; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

UNIT - V	BIOPHARMACEUTICALS AND ITS FORMULATION	9

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals. Rational for formulation of biotherapeutics, formulation recipients: solubility enhancers, anti-aggregating agents, buffers, cryoprotectants, antioxidants and preservatives etc. Significance with relevant examples. Methods to enhance shelf life protein based therapeutics. Packaging techniques and quality analysis of product.

Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the basic knowledge about pharmaceutical Biotechnology.
CO2	Explain pharmacokinetics and pharmacodynamics.
CO3	Understand the functions of immunotherapeutic in pharmaceutical industry.
CO4	Explain the principles of drug manufacture process.
CO5	Understand the concept of biopharmaceuticals and its formulation.

Text Books

1. Harvey RA, MA Clark, R Finkel, Jose A Rey and K Whalen, “Lippincott’s Illustrated Reviews Pharmacology”, 4th Ed., Lippincott Williams & Wilkins, 2009.

Reference Books

1. Thomas G, “Medicinal Chemistry: An introduction”, John Wiley, 2000.
2. Katzung BG, “Basic and Clinical Pharmacology”, Prentice Hall of International, 1995.
3. Ho Rodney JY and M Gibaldi, “Biotechnology and Biopharmaceuticals : Transforming Proteins and Genes into Drugs”, 2nd Ed., John Wiley & Sons, Inc., 2013.

BoS Chairman

Professional Elective - IV

B. TECH.	B19BTE701 - TISSUE ENGINEERING AND BIOMATERIALS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To apply the concepts of tissue engineering and biomaterials in cell culture techniques
2.	To analyze the existing and recent developments in stem cell technology
3.	Develop cell based scaffolds using different delivery vehicles for tissue engineering applications
4.	Classify different types of biomaterials and identify their significant utility in tissue engineering applications
5.	Design different biological implants using bioreactors for soft and hard tissue replacement

UNIT - I	INTRODUCTION AND CELL CULTURE TECHNIQUES	9

Regulatory issues concerning tissue engineering, Cell culture; primary cultures &cell lines; cell quantification; bioreactors for cell cultures; Growth factors and signals for tissue engineering; extra cellular matrix (ECM) (structure, function and applications); typical tissue engineered device. Epithelial cell culture (cornea).

UNIT - II	STEM CELL CULTURE	9

Importance and unique properties of stem cells; Stem cell markers; FACS analysis. Similarities and differences between embryonic and adult stem cells; Pluripotent stem cells; Hematopoietic stem cells and lymphoid stems cells; Potential uses of human stem cells and the strategies to overcome

UNIT - III	CELL DELIVERY VEHICLES	9

Definition and purpose of delivery vehicles; Types of vehicles and comparative performance; Natural polymers: Collagen; Synthetic polymers: alginate hydrogels; Microencapsulation: agarose microbeads. Polymeric scaffolds for tissue engineering applications; Drug delivery in Tissue engineering; Animal models for the evaluation of orthopedic implants

UNIT - IV	BIOMATERIALS AND CLASSIFICATION PROPERTIES	9

Biomaterials: Definition, Classification: Polymers, ceramics (biosorbable and bio active) and composites. Surface, physical and chemical properties of materials - mechanical properties of implants. Bulk analysis - FTIR, SEM; Surface analysis - AES. Sterilization techniques: ETO, gamma radiation, autoclaving. Effects of sterilization on material properties.

BoS Chairman

UNIT - V	BODY IMPLANTS FROM BIOMATERIALS	9
Hard tissue replacement implant; Orthopedic implants, (Hip, Knee, etc.), Soft tissue replacement implant; skin implants, Burn (wound) dressings Synthetic Skin, Heart valve implants. Blood and tissue compatibility of biomaterials, biomimetics, inflammation and Wound healing process - Tissue response to biomaterials, toxicity of biomaterials. Enhancement of biocompatibility.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the cell culture techniques.
CO2	Demonstrate the nature of stem cells and its culture methods
CO3	Apply various molecules and strategies to produce delivery vehicles
CO4	Understand the concept of biomaterials and its properties
CO5	Analyse the utilization of biomaterials as a body implant.

Text Books	
1.	Palsson BO and SN Bhatia, “Tissue Engineering”, Pearson Publishers, 2009.
2.	Meyer U, J Handschel, HP Wiesmann and T Meyer, “Fundamentals of Tissue Engineering and Regenerative Medicine”, Springer, 2009.
3.	Ikada Y, “Tissue Engineering: Fundamentals and applications”, Elsevier International, 2006.
4.	Wagner W, S Sakiyama-Elbert, G Zhang and M Yaszemski, “Biomaterials Science - An Introduction to Materials in Medicine”, Elsevier, 2020.

Reference Books	
1.	Gorodetsky R and R Schäfer, “Stem Cell-based Tissue Repair”, RSC Publishing, 2011.
2.	Mao JJ, G Vunjak-Novakovic, AG Mikos and A Atala (Eds.), “Translational Approaches in Tissue Engineering & Regenrative Medicine”, Artech House Publishers, 2007.
3.	Habib NN, MY Levicar, LG Jiao and N Fisk, “Stem Cell Repair and Regeneration”, Vol. 2, Imperial College Press, 2007.

BoS Chairman

B. TECH.	B19BTE702 - MOLECULAR PATHOGENESIS AND DISEASE DIAGNOSIS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand about the microbial toxins and modern molecular pathogenesis.
2.	To know about the host pathogen interaction and identifying virulence factors.
3.	To control pathogens by modern approaches.

UNIT - I	OVERVIEW OF PATHOGENESIS	5

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, general concepts of diseases, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

UNIT - II	HOST - DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES	8

Attributes and components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT - III	MOLECULAR PATHOGENESIS	16

Virulence, virulence factors, virulence - associated factors and virulence lifestyle factors, molecular mechanism and gene regulation in pathogens. Sources, entry, multiplication, toxins, symptoms, diseases caused by E. coli, Salmonella, Shigella, Vibrio cholera, Aspergillus, Candida, Plasmodium and Influenza virus.

UNIT - IV	EXPERIMENTAL STUDIES ON HOST - PATHOGEN INTERACTIONS	8

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria and tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction and host responses.

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UNIT - V	APPROACHES TO CONTROL PATHOGENS	8
Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno and DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the types of pathogens and its modes of entry.
CO2	Explain the host pathogen interactions at the level of cellular and molecular networks.
CO3	Explain pathogenesis in molecular level.
CO4	Diagnosis of diseases through the examination of molecules.
CO5	Modern therapeutic strategies on various pathogens.

Text Books	
1.	Iglewski BH and VL Clark, “Molecular basis of Bacterial Pathogenesis“, Academic Press, 1990.
2.	Williams P, J Ketley and G Salmond, “Methods in Microbiology: Bacterial Pathogenesis”, Vol. 27, Academic Press, 1998.
3.	Anderson DG, S Salm and D Allen, “Nester’s Microbiology: A Human Perspective”, 8th Ed., McGraw Hill, 2015.
4.	Groisman EA, “Principles of Bacterial Pathogenesis”, Academic Press, 2001.

BoS Chairman

B. TECH.	B19BTE703 - SYSTEMS BIOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of systems biology
2.	To know the concepts of systems microbiology and developmental systems biology.
3.	To understand enzyme kinetics and noise in gene expression
4.	To know gene expression networks.
5.	To use the systems biology tools.

UNIT - I	SYSTEMS BIOLOGY - FUNDAMENTALS	8

Systems Biology - An overview; overview of gene control- gene switching, gene control in eukaryotes; Gene control mechanisms at transcriptional and translational levels, Biochemical, Genetics and systems biology paradigms.

UNIT - II	SYSTEMS MICROBIOLOGY AND DEVELOPMENTAL SYSTEMS BIOLOGY	8

Quorum sensing- the language of bacterial, Quorum sensing in Gram-negative and Gram-positive bacteria, Hybrid quorum sensing in Vibrio harveyi, Programmed population control by cell-cell communication and regulated killing.

UNIT - III	ENZYME KINETICS, NOISE IN GENE EXPRESSION	10

Kinetic modelling of biochemical reactions; enzyme binding and cooperativity, enzyme inhibition, identical independent binding sites, sequential model of cooperativity, non-identical interacting binding sites. Noise in gene expression, quantifying noise in gene regulatory networks, noise based switches and amplifiers in gene expression, bacterial chemotaxis, signaling pathway in chemotaxis.

UNIT - IV	GENE EXPRESSION NETWORKS	10

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT - V	TOOLS FOR SYSTEMS BIOLOGY	9

Pathway mapping through KEGG – KEGG PATHWAY, KEGG LIGAND, KEGG BRITE / KEGG GENES / KEGG ENZYMES; Cytoscape-Creating a network using cytoscape, Basics of Systems Biology Markup Language (SBML), SBML editors

Total Instructional hours : 45

BoS Chairman

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the fundamentals of gene control.
CO2	Explain quorum sensing in bacterial and developmental systems biology.
CO3	Understand enzyme cooperativity and noise in gene expression.
CO4	Apply different techniques for gene expression analysis.
CO5	Apply systems biology tools for pathway and network mapping.

Text Books	
1.	Alon U, "An Introduction to Systems Biology: Design Principles of Biological Circuits", 2nd Ed., CRC Press, 2006.
2.	Latchman DS, "Gene Control", Garland Science Publications, 2010.
3.	Alberts B, A Johnson, J Lewis, M Raff, K Roberts and P Walter, "Molecular Biology of the cell", 4th Ed., 2002.

Reference Books	
1.	Ptashne M, "A Genetic Switch-Phage Lambda Revisited", CSHL Press, U.S.A, 2004.
2.	Bassler BL, "How bacteria talk to each other: regulation of gene expression by quorum sensing", Current Opinion in Microbiology, Vol 2, Page no: 582-587, 1999.
3.	Charu Gera and S Srivastava, "Quorum- sensing: The phenomenon of microbial communication", Current science, 90, Page no: 666-676, 2006.
4.	Wolpert L, "Principles of Development", 2nd Ed., Oxford University Press, 2002.
5.	Ashburner M, "Drosophila-A laboratory Handbook", CSHL Press, 1989.
6.	Bisswanger H, "Enzyme Kinetics, Principles and Methods", WILEY-VCH, 2002.
7.	Murray JD, "Mathematical Biology", Springer-Verlag, 1989.
8.	Berg JM, JL Tymoczko and L Stryer, "Biochemistry", 5th Ed., W H Freeman, (2002).

BoS Chairman

B.TECH.	B19BTE704 - ENVIRONMENTAL BIOTECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic concepts and scope of ecosystem and environmental problems.
2.	To apply the concepts on various aspects of wastewater treatment.
3.	To understand biodegradation of various components.

UNIT - I	BASICS OF ECOSYSTEM AND ENVIRONMENTAL BIOTECHNOLOGY	9

Concept of Environmental Biotechnology: Definition, Concept and Scope. Biogeochemical cycling in ecosystem and its effects in environment. Environmental problems - ozone depletion, greenhouse effect, water, air and soil pollution. Response of microbes, plant and animals to environmental stresses. Microbial ecology. Environmental impact assessment.

UNIT - II	WASTE WATER TREATMENT	9

Wastewater Treatment – Primary - Coagulation, Sedimentation, Secondary - UASB, Trickling filter, Tertiary – Chlorination and Ozonization. Microbial system for heavy metal accumulation, Biosorption, Biotransformation, Bioleaching (Copper, Uranium). Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

UNIT - III	BIODEGRADATION OF ENVIRONMENTAL POLLUTANTS	9

Xenobiotic compounds - recalcitrant, hazardous wastes, and genetic engineering approach for biodegradation. Solid-waste management (4R principle), sewage-sludge disposal and utilization, Composting process and techniques. Biodegradation of wastes from pesticide, textile, tannery, paper, food, pharmaceutical and distillery industries.

UNIT - IV	BIOMASS CONVERSION AND BIOREMEDIATION	9

Biomass from wastes - ethanol from lignocellulosic wastes and SCP. Biofuels: Sources and applications, Biogas, biohydrogen, biodiesel, biomethanol, biobutanol and bioethanol production. Bioremediation: in-situ and ex-situ bioremediation, applications and examples. Bio indicators and Biosensors.

BoS Chairman

UNIT - V	MANAGEMENT OF BIOMEDICAL WASTES	9
Biomedical waste: Sources, Categories of biomedical waste, colour coding and type of container used for disposal of biomedical wastes. Biomedical waste management facilities: incinerator / autoclave / microwave system, form I, II and III. Environmental significance of genetically modified microbes, plants and animals.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the concepts of ecosystem and to learn about the different environmental problems.
CO2	Understand the waste water treatment process, biological oxygen demand and chemical oxygen demand.
CO3	Explain the biodegradation of xenobiotic compounds using solid waste management principles.
CO4	Analyze the biodegradation of waste using various biological processes.
CO5	Apply the management strategies to evaluate the impact of biomedical waste on the environmental deterioration

Text Books	
1.	Vallero DA, “Environmental Biotechnology - A Biosystems Approach”, 2nd Ed., Academic Press, 2015.
2.	Agarwal SK., “Environmental Biotechnology”, APH Publishing Corporation, New Delhi, 2002.

Reference Books	
1.	Sathyanarayana U., “Biotechnology”, Books and Allied (P) Ltd. Kolkata, 12th Ed., 2019.
2.	Evans GM and JC Furlong, “Environmental Biotechnology: Theory and application”, 2nd Ed., John Wiley & Sons, 2011.
3.	Dubey, R.C., “A textbook of Biotechnology”, S. Chand and Company Ltd, New Delhi, 2010.
4.	Wang LK, V Ivanov, JH Tay and YT Hung “Environmental Biotechnology”, 1st Ed., Humana Press.
5.	Pradipta Kumar Mohapatra, “Textbook of Environmental Biotechnology”, I. K International, 2006.
6.	Cheremisinaff, NP, “A textbook for waste and wastewater treatment”, Prentice Hall, New Delhi, 2003.
7.	Cruger, W and A Cruger, “A Textbook of Industrial Microbiology”, Panima Publishing Corporation, New Delhi, 2003.

BoS Chairman

B.TECH.	B19BTE705 - BIOFUELS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To show the students to acquire knowledge on biofuels.
2.	To understand and explore the scope of biofuels the most efficient renewable source of energy.
3.	To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development.
4.	To give way to the bolster green technology and incline towards more ecofriendly options.
5.	To have knowledge about microbial fuel cell.

UNIT - I	BIOMASS AND BIOREFINERIES	9

Biomass generation and utilization, types, properties, biomass for biorefinery; Biorefinery concept, Bioproducts from biorefinery; Physico-chemical biorefinery: Oil extraction and transesterification; Thermo-chemical biorefinery: Pyrolysis, Carbonization, liquefaction, gasification, Combustion; Bio-chemical biorefinery: Anaerobic digestion and fermentation. Food vs energy.

UNIT - II	BIODIESEL	9

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Transesterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel – Density, cloud point, pour point, cold filter plugging point, flash point, fire point, viscosity and cetane number.

UNIT - III	BIOETHANOL	9

Ethanol as a fuel; Microbial and Enzymatic production of bioethanol from biomass lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling operations, physical and chemical pre-treatment of lignocellulosic biomass. Saccharification of biomass.

UNIT - IV	BIOGAS AND BIO OIL	9

Biogas technology, Microbiology and Biochemistry of biogas production, factors affecting generation of biogas, biogas plant types with constructional details, comparison between plant types, bio oil – production sources, approaches, factors affecting bio oil production from biomass. Life cycle assessment and techno-economic analysis.

BoS Chairman

UNIT - V	MICROBIAL FUEL CELLS	9
Microbial fuel cells; Need of microbial fuel cells (MFC), working principles of MFC, construction and components of MFC, substrates and microbes used in MFC, factors affecting in MFC operations, types of MFC, applications of MFC, challenges and problems of MFC.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand major unit processes/operations of an integrated biorefinery.
CO2	Explain the physical and chemical properties of the biofuels.
CO3	Understand the pretreatment, production process and estimation of bioethanol.
CO4	Explain the technology and challenges of biohydrogen and biomethane production.
CO5	Understand the design and fabrication of microbial fuel cells.

Text Books	
1.	Mousdale DM, “Introduction to Biofuels”, 1st Ed., CRC Press, 2017.
2.	Ahindra Nag, “Principles of Biofuels and Hydrogen Gas: Production and Engine Performance”, 1st Ed., McGraw-Hill, 2020.

Reference Books	
1.	Drapcho C, J Nghiem and T Walker, “Biofuels Engineering Process Technology”, McGraw Hill, 2008.
2.	Olsson L, “Biofuels - Advances in Biochemical Engineering / Biotechnology”, Springer, 2007.
3.	Zhen F, “Pretreatment Techniques for Biofuels and Biorefineries”, Springer, 2013.

BoS Chairman

Professional Elective - V

B.TECH.	B19BTE706 - RESEARCH METHODOLOGY	L	P	TU	C
		3	0	0	3

Course Objectives	
1.	To outline the methodology for research in Biotechnology.
2.	To understand the significance of research design.
3.	To outline methods of data collection, data analysis and data interpretation
4.	To understand the significance of technical writing.

UNIT - I	INTRODUCTION TO RESEARCH AND PROBLEM DEFINITION	9

Meaning, sources, objective and importance of research problems, Types of research, steps involved in research, defining research problem, approaches for investigation, finding solutions, instrumentation for research problems.

UNIT - II	RESEARCH DESIGN	9

Research design, Methods of research design, research process and steps involved, collection of literature based on relevant previous research work, effective literature survey analysis, finding research gaps and novelty in the research work.

UNIT - III	DATA COLLECTION	9

Classification of data, methods of data collection, sampling of sources, intermediate and final products, sampling techniques procedure and methods, sample collection techniques, procedures as per sample analysis methods, data collection and data entry. Ethical considerations in research.

UNIT - IV	DATA ANALYSIS AND INTERPRETATION	9

Data analysis, Statistical techniques and choosing an appropriate statistical technique, error analysis with standard deviation, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS and Excel and R, etc.), statistical inference, Interpretation of results.

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UNIT - V	TECHNICAL WRITING AND REPORTING OF RESEARCH	9
Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference proceedings, patents etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, plagiarism – tools for detection of plagiarism.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the significance of research and problem identification in Biotechnology and
CO2	Understand methods used in scientific research and to emphasize on the importance of statistical concepts.
CO3	Understand about research design and data collection.
CO4	Apply statistical techniques for data analysis and result interpretation.
CO5	Apply writing skills for technical reporting of research.

Text Books	
1.	Kothari CR and G Garg, “Research Methodology Methods and Techniques”, New Age International Publishers, 3rd Ed. 2016.
2.	Ranjit Kumar, “Research Methodology: A Step-by-Step Guide for Beginners”, 2nd Ed., SAGE, 2005.
3.	Cooper D and P Schindler, “Business Research Methods”, 9th Ed., TMGH, 2006.
4.	Creswell JD and JW Creswell, “Research Design: Qualitative, Quantitative, and Mixed Methods approaches”, Sage Publications, 2013.

BoS Chairman

B.TECH.	B19BTE707 - CANCER BIOLOGY	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To develop in depth knowledge in molecular biology of cancer.
2.	To identify different cancer causing agents in our day to day life.
3.	To compute about the diagnosis and prevention of cancer.
4.	To assess the recent techniques in cancer treatment.
5.	To develop new techniques in identification and mitigation of cancer based on high throughput Screening.

UNIT - I	FUNDAMENTALS OF CELL CYCLE AND CANCER	9

Mitosis, Regulation of cell cycle - Check points, Cell proliferation and Apoptosis, Hall marks of cancer, infection and inflammation, theory and mechanism of carcinogenesis- Chemical, physical & radiation carcinogenesis, Causes of cancer - Radiation, Stress, Tobacco, alcohol & coffee/Tea

UNIT - II	BIOLOGY OF CANCER	9

Effects on receptor, signal switches, signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, mechanism of oncogenes activation, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity; tumor suppressor genes - Rb, p53, APC, BRCA paradigms; Telomerases

UNIT - III	PRINCIPLES OF CANCER METASTASIS	9

Mechanism of spread; Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion; Angiogenesis

UNIT - IV	CANCER DETECTION	9

Cancer detection : Detection using biochemical assays and molecular; Different types of tumour markers, tumour imaging and molecular imaging, Gene expression profiling, Diagnostics- Imaging (MRI, PET) and Biopsy. Monoclonal antibodies in cancer diagnosis.

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UNIT - V	CANCER THERAPY	9
Therapy forms surgery, chemotherapy & radiation, Hyperthermia and magnetic hyperthermia: basic principle with examples, advantages and limitations New approaches of cancer therapy; hormone therapy, vaccines, gene therapy, stem cell therapy.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Apply profound knowledge in molecular biology of cancer.
CO2	Analyze the role of signaling pathways in causing cancer.
CO3	Analyze the relationship between genes and cancer.
CO4	Evaluate the recent advancements in cancer diagnosis.
CO5	Develop new strategies for the treatment of cancer.

Text Books	
1.	Maly BWJ, “Virology : A Practical Approach”, IRL Press, Oxford, 1987.
2.	Tannock IF, “The Basic Science of Oncology” 2nd Ed., Richard P. Hill, 1992.

Reference Books	
1.	Dunmock NJ and SB Primrose, “Introduction to Modern Virology”, Blackwell Scientific Publications, Oxford, 1988.
2.	Knowles MA and PJ Selby, “An Introduction Top Cellular and Molecular Biology of Cancer”, Oxford Medical Publications, 1991.

BoS Chairman

B. TECH.	B19BTE708 - STEM CELL TECHNOLOGY	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To gain knowledge on the basics of stem cells and their origin.
2.	To analyze the differentiation process of premature stem cells.
3.	To compare the characteristic features of Embryonic and adult stem cells.
4.	To learn the methods of stem cell identification and various sources.
5.	To give way to the therapeutic treatment using stem cells.

UNIT - I	INTRODUCTION TO STEM CELL	9

Introduction to stem cells; Stem cell niche - embryonic stem cells, hematopoietic stem cells, bone marrow stem cells, germline stem cells, cancer stem cells, neural stem cells, adult stem cells, muscle and cardiac stem cell; Properties potency and self-renewal Epigenetics.

UNIT - II	DIFFERENTIATION OF STEM CELLS	9

Differentiation status of cells - Primordial germ cell, Skin cell, gastrointestinal cells; embryonic stem cell differentiation as a model to study hematopoietic cell development. Endothelial cell development

UNIT - III	GENERATION OF STEM CELLS	9

Testing and generation of embryonic stem cells; testing for adult stem cells and differentiation. Animal models and regeneration, induced pluripotent stem cells, FACS analysis.

UNIT - IV	MANIPULATION OF EMBRYONIC STEM CELLS	9

Integration of transgenes into a defined locus in human embryonic stem cells; Genetic manipulation of embryonic stem cells; Genetic manipulation through DNA delivery by electroporation, , chemical-based reagents and viruses Nucleofection.

UNIT - V	APPLICATIONS OF STEM CELLS	9

Uses of Stem cells; Human stem cells; Renewal of stem cells; Stem cells and Tissue engineering; Embryonic stem cells and Gene therapy; Therapeutic cloning, cryobiology, virtification technology.

Total Instructional hours : 45

BoS Chairman

Course Outcomes : At the end of the course student will be able to	
CO1	Compare the characteristics of different types of stem cells and their origin
CO2	Analyze the differentiation process of premature stem cells
CO3	Compare the characteristic features of Embryonic and adult stem cells
CO4	Evaluate the methods of stem cell identification and various sources
CO5	Implement the therapeutic applications of stem cells in human diseases

Text Books	
1.	Gilbert SF, “Developmental Biology”, 6th Ed., Sinauer Associates Inc. NY, 2000.
2.	Kiessling AA and CS Anderson, “Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential”, Amazon Publishers, 2003.
3.	Alberts B, “Molecular Biology of the Cell”, 4th Ed. Garland Publishing Inc., NY, 2002.

Reference Books	
1.	Sell S, “Stem Cells”, Human Press Inc., 2004.
2.	Bongso A and EH Lee, “Stem Cells”, World Scientific Publication Co. Pvt. Ltd., 2005.
3.	Lanza RP, “Essentials of Stem Cell Biology”, Academic Press, 2006.
4.	Lodish HF, A Berk and CA Kaiser, “Molecular Cell Biology”, WH Freeman and Co., 2008.

BoS Chairman

B. TECH.	B19BTE709 - FORENSIC BIOTECHNOLOGY	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To provide basic knowledge about history of forensic science.
2.	To outline about tools and techniques in forensic science.
3.	To deliver actual facts on technological methods in forensic science.
4.	To know the vital evidence of DNA forensics studies.
5.	To gain knowledge about forensic dermatoglyphics.

UNIT - I	HISTORY OF DEVELOPMENT OF FORENSIC SCIENCE IN INDIA	9

Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science. Frye case and Daubert standard.

UNIT - II	TOOLS AND TECHNIQUES IN FORENSIC SCIENCE	9

Branches of forensic science. Forensic science in international perspectives, including set up of INTERPOL and FBI. Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists. Data depiction. Report writing.

UNIT - III	TECHNOLOGICAL METHODS IN FORENSIC SCIENCE	9

Instrumentation- Technological Methods in Forensic Science- Chromatographic methods- Spectroscopic methods- Electrophoresis- Neutron activation analysis- Microscopy- Electron microscope- Forensic applications of microscopy- Forensic photography- Basic principles and applications of photography in forensic science.

UNIT - IV	DNA FORENSICS	9

Basic Principles DNA as biological blueprint of life. Extraction of DNA for analysis. Quantification of DNA – yield gel quantification and slot blot quantification. Mitochondrial DNA – sequence analysis. Forensic DNA Typing Collection of specimens. PCR– historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role in DNA forensics. RFLP– role in DNA forensics. Parentage Testing Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mandelian laws of parentage testing. Missing body cases.

BoS Chairman

UNIT - V	FORENSIC DERMATOGLYPHICS	9
Basics of fingerprinting- Biological basis of fingerprints, Fundamental principles of fingerprinting-Types of fingerprints- Fingerprint patterns. Fingerprint characters- Plain and rolled fingerprints- Development of Fingerprints- Latent prints- Constituents of sweat residue. Detection by physical and chemical techniques- Mechanism of detection of fingerprints by different developing reagents. Application of light sources in fingerprint detection. Preservation of developed fingerprints. Importance of footprints.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Recall the basics of historical aspects of forensic science.
CO2	Outline about techniques applied forensic science.
CO3	Describe about instrumentation methods used in forensic science.
CO4	Explain the principle evidence of DNA forensic studies.
CO5	Make use of the concept of forensic dermatoglyphics.

Text Books	
1.	Tilstone WJ, ML Hastrup and C Hald, “Fisher’s Techniques of Crime Scene Investigation”, CRC Press, Boca Raton, 2013.
2.	James SH and JJ Nordby, “Forensic Science: An Introduction to Scientific and Investigative Techniques”, 2nd Ed., CRC Press, Boca Raton, 2005.
3.	Redsicker DR, “The Practical Methodology of Forensic Photography”, 2nd Ed., CRC Press, 2000.

Reference Books	
1.	Tilstone WJ, ML Hastrup and C Hald, “Fisher’s, Techniques of Crime Scene Investigation”, CRC Press, 2013.
2.	Butler JM, “Forensic DNA Typing”, Elsevier, Burlington, 2005.
3.	Ramotowski RS (Ed.), “Lee and Gaensleen’s, Advances in Fingerprint Technology”, 3rd Ed. CRC Press, 2013.

BoS Chairman

B. TECH.	B19BTE710 - TELEMEDICINE	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	Learn the key principles for telemedicine and health
2.	Understand telemedical technology.
3.	Know telemedical standards, mobile telemedicine and it applications.

UNIT - I	FUNDAMENTALS OF TELEMEDICINE	9

History, definition and introduction of telemedicine system, tele-health, tele-care, scope, Telemedicine systems, management of patient's health care information, benefits & limitations of telemedicine.

UNIT - II	TYPE OF INFORMATION & COMMUNICATION STRUCTURE FOR TELEMEDICINE	9

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, antennas, mobile health and ubiquitous healthcare. Real-time Telemedicine, Video Conferencing.

UNIT - III	ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE	9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT - IV	PICTURE ARCHIVING AND COMMUNICATION SYSTEM	9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture. Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, Phases of encryption.

UNIT - V	APPLICATIONS OF TELEMEDICINE	9

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery, e-Health and Cyber medicine, mobile health.

Total Instructional hours : 45

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Course Outcomes : At the end of the course student will be able to	
CO1	Explain the basic principles of healthcare in telemedicine.
CO2	Discuss the role of telecommunication in Healthcare.
CO3	Discuss the ethical & legal issues involved in telemedicine.
CO4	Explain the different types of data storage and communication standards used in telehealth system.
CO5	Discuss the various applications of telemedicine.

Text Books	
1.	Norris AC, “Essentials of Telemedicine and Telecare”, John Wiley, New York, 2002.
2.	Huang HK, “PACS and Imaging Informatics: Basic Principles and Applications”, Wiley, New Jersey, 2010.
3.	Olga Ferrer-Roca and M Sosa Ludicissa, “Handbook of Telemedicine”, IOS press 2002.
4.	Wootton R and JC Patterson, “Introduction to Telemedicine”. 2nd Ed., Royal Society of Medicine Press Ltd., 2006.

Reference Books	
1.	Bashshur RL and GW Shannon, “History of Telemedicine”’ New Rochelle. NY, Mary Ann Liebert Publishers, 2009.
2.	Khandpur RS, “Telemedicine – Technology and Applications”, PHI Learning Pvt. Ltd., New Delhi, 2017.
3.	Maheu MM, P Whitten and A Allen, “E-Health, Telehealth, and Telemedicine”, Jossy Bass, 2001. Latifi R, “Current Principles and Practices of Telemedicine and e-Health”, Washington DC: I

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Open Elective - III

B.E. / B.TECH.	B19AEO701 - UNMANNED AIRCRAFT SYSTEMS OPERATION & MRO (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To apprehend the concepts of UAV and its types.
2.	To gain knowledge regarding the control and communications.
3.	To observe the aerodynamics performance and navigation operation.
4.	To know about the drone alignment maintenance.
5.	To recognize the safety take-off and landing and to manage failure factors.

UNIT - I	DRONE RULES & BASIC PRINCIPLES OF FLIGHT	9

International Rules - Regulations, Standards & Practices, Dos and Do not – Civil Aviation Requirements – AIPs, NOTAM, Classification & Categorization of drones – Type Certification of Drones – Registration – Sale & De-Registration of Drones – Operations of Drones – Dos and Don"ts – Remote Pilot Licensing – Drone Insurance Fundamentals of flight – Aerodynamics – Take-off, flight, and landing – Maneuvers turns and circuit pattern.

UNIT - II	ATC PROCEDURES & RADIO TELEPHONY (NON FRTOL) WEATHER AND METEOROLOGY	9

Understanding ATC operations – Airspace structure and Airspace – Restrictions with knowledge of no drone zones – RT Phraseology & Communicating with ATC including Position and Altitude Reporting – Flight Planning Procedures including Altimeter setting procedures – Collision avoidance – Radio Telephony (RT) techniques – The standard atmosphere, Measuring air pressure, Heat and temperature, Wind – Moisture, cloud formation, icing and its effects – Effect of atmosphere on RPAS operation & hazardous weather avoidance – Met Terminal Aviation Routine Weather Report (METAR).

UNIT - III	FIXED - WING & ROTORCRAFT OPERATIONS AND AERODYNAMICS	9

Types of fixed wing drones, make, parts, terminology, Operation and maneuvers of fixed wing drones, Flight Performance. Intro to Mission Planning, Instrument Flying & Navigation (GCS) – Applications of fixed-wing UAVs. Pros and Cons of Fixed Wing Drones Rotorcraft- Basic drone terminology & parts, Types of drones, material used and size of drones, Drone Anatomy: Different parts of drones, Avionics & C2 Link, Intro to Mission Planning, Instrument Flying & Navigation (GCS). Applications and operations of Multirotor, Flight Performance. Pros and Cons of Rotorcraft Drones.

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UNIT - IV	HYBRID OPERATIONS, AERODYNAMICS & EQUIPMENT MAINTENANCE	9

Principles of Aerodynamics – Types of Hybrid Drones & Parts – Intro to Mission Planning – Instrument Flying & Navigation (GCS) – Applications of Hybrid UAVs – Comparison with Rotorcraft & Aero plane Drone Equipment Maintenance – Maintenance of drone – flight control box – ground station – Maintenance of ground equipment – batteries and payloads – Scheduled servicing, Repair of equipment, Fault finding and rectification.

UNIT - V	SAFTY MANAGEMENT, PAYLOAD, & DATA & ANALYSIS	9

Drothe Emergency & Handling – Loss of C2-link – Fly-aways (Straying) – Loss of power, Other Emergencies, Control surface failures, Human Performance & Pilot Incapacitation – Fail - Safe Features – Types of payloads – What to carry , what not to carry – Parts of payloads – Installation – Features of payloads – Utilization, Principles of Observation, Elements of Image & Video Interpretation – Introduction to Photogrammetry – Types of Image & Video Data – Analysis.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Summarize the basic operations and principles of flight (K2)
CO2	Explain about the various avionics hardware operation and ATC procedure (K2)
CO3	Apply the aerodynamic principle on the airframe configuration (K3)
CO4	Examine the operations of the hybrid drones and maintenance of equipment (K4)
CO5	Determine the payload distribution and safety management procedure of the UAV (K5)

Text Books	
1.	Reg Austin “unmanned aircraft systems UAV design, development and deployment”, Wiley, 2010
2.	Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, UAV Systems, Inc,1998.
3.	Kimon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007

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Reference Books	
1.	P.J.Swatton —Ground studies for pilots„ flight planning‖, Sixth edition, 2002.
2.	Ian Heywood., “An Introduction to GIS”, Pearson Education, New Delhi, 2001.
3.	Patel A.N & Surendra Singh, “Remote sensing principles & applications”, Scientific Publishers, Jodhpur 1992.
4.	Lillesand, T. M., and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2000.
5.	Unmanned Aerial Vehicle (UAV) application for societal applications (https://www.cbinsights.com/research/drone-impact-society-uav/).

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B. E. / B. TECH.	B19AGO701- PRODUCTION TECHNOLOGY FOR AGRICULTURAL MACHINERY (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of engineering materials
2.	To know the principles of machining and welding concepts
3.	To remember the farm mechanization and sowing implements
4.	To learn about the plant protection equipment
5.	To create knowledge on harvesting machinery

UNIT - I	ENGINEERING MATERIALS	9

Engineering materials - classification - Mechanical properties of materials, strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification - low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

UNIT - II	MACHINING AND WELDING	9

Basic principles of lathe - machine and operations - Basic description of machines and operations of Shaper - Planner, Drilling, Milling & Grinding - classification of welding processes. Gas welding, types of flames and their applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

UNIT - III	TILLAGE AND SOWING IMPLEMENTS	9

Mould board plough - attachments – mould board shapes and types. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough - Rotary plough – Chisel plough - Cultivators - types - construction. Disc harrows - Bund former – Rotavator - ridger – leveller. Basin lister - Wetland preparation implements – Crop Planting – methods – row crop planting systems – Devices for meeting seeds – furrow openers – furrow closers – types – Types of seed drills and planters – Seed cum fertilizer drills – paddy transplanters.

UNIT - IV	WEEDING AND PLANT PROTECTION EQUIPMENT	9

Weeding equipment – hand hoe – long handled weeding tools – dryland star weeder – wetland conoweeder and rotary weeder – Engine operated and tractor weeders Sprayers – types - classification – methods of atomization, spray application rate, droplet size determination – volume median diameter, numerical median diameter – drift control.

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UNIT - V	HARVESTING AND THRESHING MACHINERY	9
Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder, combine harvesters, balers, threshers, combine losses.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand concepts of engineering materials and steel properties
CO2	Outline the different machining and welding process
CO3	Understand the different tillage and sowing implements
CO4	Illustrate the concepts of plant protection equipments.
CO5	Summarize the knowledge on harvesting mechanism

Text Books	
1.	"Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010.
2.	Hajra Choudry, "Elements of workshop technology - Vol II", Media promoters, 2002.
3.	Jagdishwar Sahay. Elements of Agricultural Engineering. Standard Publishers Distributors, Delhi 6.,2010.
4.	Michael and Ohja. Principles of Agricultural Engineering. Jain brothers, New Delhi., 2005.

Reference Books	
1.	Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights, Daryaganj, New Delhi.
2.	Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3.	Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.
4.	Kepner, R.A., et al. Principles of farm machinery. CBS Publishers and Distributers, Delhi. 99, 1997.
5.	Harris Pearson Smith et al. Farm machinery and equipment. Tata McGraw-Hill pub., New Delhi.,1996.
6.	Srivastava, A.C. Elements of Farm Machinery. Oxford and IBH Pub. Co., New Delhi, 1990.
7.	https://nptel.ac.in/courses/126/105/126105009/

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B. E. / B. TECH.	B19BMO701 - TELEMEDICINE (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To gain the knowledge on the basic principles for telemedicine.
2.	To understand the legal aspects of telemedicine.
3.	To learn the key principles for telemedicine standards.
4.	To study the concepts for secure transmission of data.
5.	To know health education, mobile telemedicine and it applications.

UNIT - I	INTRODUCTION TO TELEMEDICINE	9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine.

UNIT - II	ETHICAL, SECURITY AND LEGAL ASPECTS OF TELEMEDICINE	9

Confidentiality, patient rights and consent : confidentiality and the law, the patient - doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights, Security in Telemedicine systems - Access control, Fire wall, Encryption, Authentication, Digital certificate, Digital Timestamp.

UNIT - III	TELEMEDICINE STANDARDS	9

Principles of Multimedia - Text, Audio, Video, data, PSTN, POTS, ANT, ISDN, Internet, Wireless Communication - GSM satellite and Micro wave, Modulation techniques, Types of Antenna, Satellite communication, Mobile hand-held devices and mobile communication. Internet technology and telemedicine using worldwide, Video and audio conferencing.

UNIT - IV	DATA ACQUISTION AND STORAGE SYSTEM	9

Acquisition System - Camera, Scanners, Display Systems - Analogue Devices, LCD, Laser Displays, Holographic Representation, Virtual Screen devices, Storage System - Magnetic System, Optical System, Solid State Disk.

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UNIT - V	APPLICATIONS OF TELEMEDICINE	9
Telemedicine access to health care services, health education and self-care. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course, the student should be able to	
CO1	Recall the basic concepts of telemedicine and health
CO2	Interpret the legal aspects of Telemedicine
CO3	Explain telemedicine standards in communication
CO4	Make use of data acquisition and storage.
CO5	Illustrate about the medical applications and usage of telemedicine

Text Books	
1.	Norris, A.C. “Essentials of Telemedicine and Telecare”, Wiley, 2002.
2.	Wootton, R., Craig, J., Patterson, V. (Eds.), “Introduction to Telemedicine. Royal Society of Medicine” Press Ltd., Taylor & Francis 2006.
3.	O’Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), “Public Health Informatics and information Systems”, Springer, 2003.

Reference Books	
1.	Ferrer - Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.
2.	Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.
3.	Mohan Bansal, “Medical Informatics”, Tata McGraw-Hill, 2004.

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B. E. / B. TECH.	B19CSO704 - FUNDAMENTAL OF CLOUD COMPUTING (Common to all Except CSE, AI & DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the basic concepts of Computer Networks and Cloud Computing.
2.	To understand the broad perceptive design of cloud architecture and model.
3.	To study the concept of Virtualization and design of cloud Services
4.	To be familiar with the storing data in cloud and secure to data in cloud.
5.	To apply different cloud programming model as per need and design the trusted cloud Computing system.

UNIT - I	CLOUD COMPUTING FUNDAMENTALS	9

Introduction to computer networks - evolution of computer networks and its uses – Types of Networks - Advantages and Disadvantages of Computer Network - Introduction to Cloud Computing - Essential characteristics, Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT - II	CLOUD ARCHITECTURE AND MODELS	9

NIST Cloud Computing Reference Architecture - Cloud Models: Characteristics – Cloud Services – IaaS, PaaS, SaaS – Public vs Private Cloud – Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.

UNIT - III	CLOUD VIRTUALIZATION	9

Basics of Virtualization - Types of Virtualizations - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data - Center Automation.

UNIT - IV	CLOUD COMPUTING STORAGES AND SECURITY	9

Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3 - Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

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UNIT - V	CLOUD TECHNOLOGIES AND ADVANCEMENTS	9
Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine - Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Compare the strengths and limitations of cloud computing
CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Outline various virtualization concepts.
CO4	Summarize the core issues of cloud such as storage, security, and privacy.
CO5	Show Cloud Services with appropriate tools.

Text Books	
1.	Curtis Franklin, Jr. ,Brian J.S. Chee, “Securing the Cloud: Security Strategies for the Ubiquitous Data Center”, CRC Press, 2019.
2.	Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security ll, CRC Press, 2017.

Reference Books	
1.	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, TMH, 2013.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009.

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B. E. / B. TECH.	B19ECO701 – INTRODUCTION TO COMMUNICATION SYSTEMS (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To develop an understanding of computer networking basics.
2.	To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.
3.	To understand the division of network functionalities into layers.
4.	To be familiar with the components required to build different types of network layers.
5.	To learn about network security algorithms.

UNIT - I	DATA COMMUNICATIONS	9

Introduction to networks –Topologies – Protocols and Standards – ISO/OSI model TCP/IP- Transmission Media and Connectors, Switching Techniques, Connecting devices – Switches, Routers, Gateways.

UNIT - II	DATA LINK LAYER	9

LAN: Ethernet IEEE 802.3, IEEE802.5, IEEE802.11, FDDI, Bridges. Error detection and correction – Forward Error Correction – Flow Control and Error control techniques Stop and wait – Go back N ARQ – Selective repeat ARQ sliding window techniques – HDLC.

UNIT - III	NETWORK LAYER	9

Internetworks – Packet Switching and Datagram approach – IPv4 addressing methods – Subnetting & Supernetting – IPv6. Routing – Distance Vector Routing, Link State Routing, Path Vector Routing, Quality of services (QOS) – methods to improve QOS parameters Trunking, VPN.

UNIT - IV	TRANSPORT LAYER AND APPLICATION LAYER	9

Functions of transport layer – Multiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Differentiated and Integrated Services – RSVP, Application layer: Domain Name Space (DNS), SMTP, FTP, HTTP, WWW.

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UNIT - V	NETWORK SECURITY	9
Symmetric key cryptography – Data Encryption standard & Advanced Encryption Standard, Asymmetric key cryptography – RSA & Diffie-Hellman algorithms, Internet Security – Application layer security and firewalls Case study on NV, SDN for IoT Systems.		
		Total Instructional hours : 45

Course Outcomes	
CO1	Explain about the network topologies, protocols and models
CO2	Demonstrate and analyze data link layer protocols and LAN standards
CO3	Analyze routing algorithms and methods to improve QoS
CO4	Summarize transport layer protocols and congestion controls methods
CO5	Build and Analyze cryptographic and security techniques.

Text Books	
1.	Behrouz. A. Foruzan, — Data Communication and Networking, Fifth Edition, Tata McGraw - Hill, 2013.
2.	Andrew S. Tannenbaum, — Computer Networks, Fourth Edition, PHI, 2003.

Reference Books	
1.	James.F.Kurouse & W. Rouse, — Computer Networking: A Top down Approach Featuring, Addison Wesley, 2009.
2.	Larry.L.Peterson & Peter .S. Davie, — Computer Networks, Third Edition, Harcourt Asia Pvt.Ltd, 2007.
3.	Leon, Garica, Widjaja, — Communication Networks, TMH.
4.	Walrand, — Communication Networks, TMH.
5.	Comer, — Internetworking with TCP / IP, vol. 1, 2, 3, 4th Edition, Pearson Education / PHI.

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B.E. / B.TECH.	B19EEO701 – HYBRID ELECTRIC VEHICLE (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To present a comprehensive overview of Electric and Hybrid Electric Vehicles.
2.	To understand the concept of hybrid electric vehicles and its operations.
3.	To impart knowledge on applications of drives in hybrid electric vehicles.
4.	To impart knowledge on vehicular communication in hybrid electric vehicles.
5.	To provide knowledge about various possible energy storage technologies that can be used in hybrid electric vehicles.

UNIT - I	INTRODUCTION TO HYBRID ELECTRIC VEHICLES	9

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics and mathematical models to describe vehicle performance.

UNIT - II	HYBRID ELECTRIC DRIVE - TRAIN	9

Basic concept of electric traction, Transmission configuration - Components - Gears - Differential - Clutch – Brakes, Regenerative braking, motor sizing. Hybrid traction: Various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel Efficiency Analysis.

UNIT - III	ELECTRIC COMPONENTS IN HYBRID AND ELECTRIC VEHICLES	9

Electric Drives in HEV/EVs, Classification and Characteristics, configuration and Control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives and Switched Reluctance Motor drives for HEV/EVs applications, Drive System efficiency.

UNIT - IV	SIZING THE DRIVE SYSTEM	9

Performance matching of Electric Machine and the Internal Combustion Engine (ICE), Sizing the propulsion motor, Communications, supporting subsystems, sizing the power electronic devices and Energy Storage Technology.

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UNIT - V	ENERGY MANAGEMENT STRATEGIES	9
Introduction to energy management strategies used in hybrid and electric vehicle, classification – implementation issues. Battery based energy storage: fuel cell based and super capacitor based energy storage and its analysis. Hybridization of different energy storage devices. Case study: Volvo XC90 T8 Plug-In Hybrid, Nissan X-Trial hybrid		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Infer the hybrid electric vehicles and its impact on environment.
CO2	Outline the working of hybrid electric drive train.
CO3	Interpret the electric components used in hybrid and electric vehicles.
CO4	Illustrate the various communication protocols and technologies used in vehicle. networks
CO5	Explain the different energy storage systems for vehicle applications.

Text Books	
1.	M. Ehsani, Y. Gao, S. Gay and Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2015.
2.	Iqbal Hussain, “Electric & Hybrid Vechicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
3.	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2009.

Reference Books	
1.	Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
2.	Chris Mi, MA Masrur, and D W Gao, "Hybrid Electric Vehicles- Principles and Applications with Practical Perspectives", Wiley, 2011.
3.	Davide Andrea, "Battery management Systems for Large Lithium-Ion Battery Packs", Artech House, 2010.
4.	Sira -Ramirez, R. Silva Ortigoza, ‘Control Design Techniques in Power Electronics Devices’, Springer, 2006.
5.	James Larminie and John Lowry, “Electric Vehicle Technology”, Wiley Publishers, 2003.

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B.E. / B.TECH.	B19MEO701 – 3D PRINTING AND TOOLING (Common to all Except MECH)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To explore the technology used in additive manufacturing.
2.	To develop CAD models for 3D printing.
3.	To acquire knowledge, techniques and skills to select relevant additive manufacturing process.
4.	To select a 3D printing process for an application.
5.	To produce a product using 3D Printing or Additive Manufacturing (AM).

UNIT - I	INTRODUCTION TO ADDITIVE MANUFACTURING (AM)	9

Overview – History – Need – classification - Additive Manufacturing Technology in product development – Materials for Additive Manufacturing.

UNIT - II	CAD AND REVERSE ENGINEERING	9

Basic concept – 3D scanning – digitization techniques – Model reconstruction – data processing for reverse engineering - Additive Manufacturing Technology: CAD model preparation – Part orientation and support generation – Model slicing – Tool path generation.

UNIT - III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING	9

Classification – liquid based system – stereo lithography apparatus (SLA) – principle, process, advantages and applications – solid based system – Fused Deposition Modeling – principle, process, advantages.

UNIT - IV	LASER BASED ADDITIVE MANUFACTURING SYSTEMS	9

Selective laser sintering – principles of SLS process – process, advantages and applications, 3D Printing - principle, process, advantages - Laser Engineered Net Shaping (LENS).

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UNIT - V	RAPID TOOLING AND APPLICATIONS OF ADDITIVE MANUFACTURING	9
Principles and typical process for quick batch production of plastic and metal parts through quick tooling – applications for Aerospace, defence, automobile, Bio-medical and general engineering industries		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the importance of Additive Manufacturing.
CO2	Apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.
CO3	Define the various process used in Additive Manufacturing.
CO4	Identify and select suitable process used in Additive Manufacturing.
CO5	Understand the basic concept of quick tooling and additive manufacturing application.

Text Books	
1.	Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2.	Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3.	Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.

Reference Books	
1.	J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
2.	Dougles Bryden, “CAD and Prototyping for Product Design”, 2014.
3.	CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping - Principles and Applications”, World Scientific, 2017.

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B. TECH.	B19BTP701 - TISSUE CULTURE LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To develop skills of students in plant and animal Biotechnology techniques by performing simple experiments in the laboratory.
2.	To perform techniques like plant tissue culture, embryo culture, protoplast isolation, and primary and secondary cell cultures in animal tissue culture.

List of Experiments		
Expt. No.	**Description of the Experiments**	
	PLANT TISSUE CULTURE	
1.	Composition and preparation of media and sterilization	
	a.	White's medium
	b.	Murashige and Skoog's medium
	c.	Nitsch medium
2.	In vitro seed germination	
3.	Micropropagation - Nodal and apical meristems	
4.	Callus induction and regeneration and acclimatization	
5.	Somatic embryogenesis and synthetic seeds	
6.	Suspension cultures and somatic embryogenesis	
7.	Anther culture	
8.	Embryo culture	
9.	Protoplast isolation and viability testing	
10.	Extraction of plant genomic DNA	

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	ANIMAL TISSUE CULTURE
11.	Preparation of animal cell culture media
12.	Primary cell culture (chicken fibroblasts)
13.	Secondary cell culture
14.	Determination of live cells from spleen cells
15.	Cytotoxic studies / MTT assay.
	Total Instructional hours : 60

Course Outcomes : At the end of the course student will be able to	
CO1	Utilize the knowledge for developing plant tissue culture and animal tissue culture.
CO2	Apply the skills of plant and animal cell culture techniques to understand the basics and to develop established cell lines.

Reference Books	
1.	Trigiano RN and DJ Gray, "Plant Tissue Culture Concepts and Laboratory Exercise", 2nd Ed., CRC Press, 1999.
2.	Razdan, MK, "Introduction to Plant Tissue Culture", 2nd Ed., Science Publishers, 2003.
3.	Freshney, RI, "Animal Cell Culture: A Practical Approach", IRL Press, 1986.
4.	Masters JRW, "Animal Cell Culture: A Practical Approach", 3rd Ed., Oxford University Press, 2000.

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B. TECH.	B19BTP702 – PROJECT WORK PHASE – I	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To identify a techno-scientific problem which requires Biotechnology intervention.
2.	To equip students with the skills to apply theoretical knowledge in practical Biotechnology projects.

Students in a group of 3 or 4 shall work on a topic approved by the Head of the Department under the guidance of a faculty member and submit a comprehensive project report duly approved by the project supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner. Students may publish their review of literature in a peer reviewed journal / conference proceeding.

Total Hours - 60

Course Outcomes : Students will be able to	
CO1	Identify and propose a Biotechnology project addressing a specific research problem.
CO2	Design and implement experiments to reduce the technological gaps.
CO3	Demonstrate effective teamwork and collaboration skills in Biotechnology projects.
CO4	Develop scientific writing and presentation skills.

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Semester - VIII

Professional Elective - VI

B. TECH.	B19BTE801 - BIOENTREPRENEURSHIP	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To know the scope, importance of Biotechnology and allied fields.
2.	To understand role of entrepreneurship in economic development of industry..
3.	To understand and market survey and assessment.
4.	To prepare business Plan; learn forms of business organization/ownership.
5.	To do case study of any top three Biotechnology Companies (start up, various stages in establishment, etc.,)

UNIT - I	INTRODUTION TO BIOTECHNOLOGY AND APPLICATIONS	9

Biotechnology – definition, history, thrust areas of Biotechnology; Elements of Bio process engineering; Biotech industries; Basic concepts of GLP, GMP and FDA; scope and importance of Biotechnology and allied fields.

UNIT - II	INTRODUCTION TO BIO- ENTREPRENEURSHIP	9

Definition of Bio-entrepreneurship, traits of entrepreneurship; copy rights, patents, trade mark, plant breeders and farmers' rights, biodiversity related issues; Biopiracy, International and Indian business policies with the focus on bio and pharmaceutical products.

UNIT - III	ENTREPRENEUR AND ENTREPRENEURSHIP	9

Entrepreneur and Entrepreneurship: definition; role of entrepreneurship in economic development; entrepreneurial competencies and motivation; institutional interface for small scale industry enterprises.

UNIT - IV	PLANNING A SMALL SCALE ENTREPRISE	9

Opportunity scanning and identification; creativity and product development process; market survey and assessment; choice of technology and selection of site. Financing new/small enterprises; techno economic feasibility assessment; preparation of business plan; forms of business organization / ownership.

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UNIT - V	CASE STUDY	9
Case study of : 1). Serum Institute of India, 2). Biocon, 3). Panacea Biotech Limited, 4). Novozymes and 5). Wockhardt (start up, various stages in establishment, etc.).		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to:	
CO1	Understand the scope, importance of Biotechnology and allied fields
CO2	Understand the role of entrepreneurship in economic development of industry.
CO3	Learnt to do Market survey and assessment
CO4	Prepare business plan; learn forms of business organization/ownership
CO5	Case study of any top three Biotechnology Companies (start up, various stages in establishment, etc.,)

Text Books	
1.	Meredith GG, RE Nelson and PA Neek, “The Practice of Entrepreneurship”, ILO, 1982.
2.	Desai V, “Management of Small Scale Enterprises”, Himalaya Publishing House, 2004.

Reference Books	
1.	Holger P and B Thomas (Eds.), “Handbook of Bioentrepreneurship”. Springer, 2008.
2.	“A Handbook for New Entrepreneurs”, Entrepreneurship Development Institute of India, Ahmedabad, 1988.

BoS Chairman

B.TECH.	B19BTE802 - CLINICAL RESEARCH AND DATA MANAGEMENT	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To know the basics in clinical trials and clinical research
2.	To understand the requirements for carrying out contract research
3.	To get familiarize with clinical research and data management in clinical research
4.	To understand the ethics to be followed for carrying out human trials
5.	To understand the roles of investigator, sponsors and others involved in clinical trial and to describe the process of clinical trials

UNIT - I	CLINICAL TRIALS	9

Clinical Trials & Clinical Research; Clinical Trials : Terminology, Features of Clinical Trials; Good Clinical Trial Practices; Patient Recruitment, Statistics Bioavailability, Studies Research Methodology Design of Experiments, Informatics, Trial Team, Delivery Model; Business Environment, Regulatory Affairs, Bioethics; Audit of Clinical Trials / Case studies.

UNIT - II	CONTRACT RESEARCH	9

Contract research organization; Academic research organization contract research areas; Contract research: Delivery model, Business environment, information sources IT; Regulatory affairs and Contract research case studies.

UNIT - III	CONTRACT RESEARCH AND CLINICAL TRIAL ENVIRONMENT	9

Contract research need of organizations description; features and benefits of contract research; Contract research organizations in India; complementary and alternative medicine; Contract research and clinical trial environment in India; Non-clinical safety studies for the conduct of human clinical trials for pharmaceuticals; Choice of control group and related issues in clinical trials purposes of clinical trials and related issues detailed consideration of types of control external control; Research database demonstrations “Clinical Data Management” for pharma trials.

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UNIT - IV	GUIDELINES ON BIOMEDICAL RESEARCH ON HUMAN SUBJECTS	9
Statement of general principles on ethical Considerations involving human subjects. Ethical review procedures. General ethical issues. Statement of specific principles for clinical. Evaluation of drugs / devices / diagnostics / vaccines / herbal remedies. Statement of specific principles for epidemiological studies, human genetics research, research in transplantation, including fetal tissue transplantation, assisted reproductive technologies.		

UNIT - V	SCHEDULE - Y	9
Approval for clinical trial; Responsibilities of: Sponsor, investigator(s), informed Consent, the Ethics Committee. Human Pharmacology: (Phase I); Therapeutic exploratory trials (Phase II); Therapeutic confirmatory trials (Phase III); Post Marketing Trials (Phase IV); Studies in special populations. Post marketing surveillance. Special studies: Bioavailability / Bioequivalence studies.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the concepts of clinical trial and experimental design.
CO2	Explain the contract research and regulatory affairs.
CO3	Understand the principles of clinical data management.
CO4	Understand the guidelines on clinical trials involving human subjects.
CO5	Understand the concept of schedule Y in clinical trials.

Text Books	
1.	Furberg BD and DC Furberg, “Evaluating Clinical Research: All That Glitters is Not Gold”, 2nd Ed., Springer Publications, 2007.
2.	Hulley SB, SR Cummings, WS Browner, DG Grady and TB Newman, “Designing Clinical Research, 2nd Ed., Lippincott Williams & Wilkins Publishers, 2008.

Reference Books	
1.	Gallin JI and FP Ognibene, “Principles and Practice of Clinical Research”, 2nd Ed. Academic Press, 2007.
2.	Bacchieri A and GD Cioppa, “Fundamentals of Clinical Research” 1st Ed. Springer, 2007.

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B.TECH.	B19BTE803 - MARINE BIOTECHNOLOGY	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To know the economical significance of marine resources
2.	To understand the toxins from marine organisms.
3.	To get familiarize with the potential bioactive compounds from marine origin.
4.	To understand the management of waste discharged into coastal waters.
5.	To understand the diseases associated with marine organisms.

UNIT - I	ECONOMICAL IMPORTANCE OF MARINE RESOURCES	9

History of marine biology, economically important marine animals, commercially important finfishes, Penaeid and non-penaeid shrimps, Marine crabs, Edible oysters, economically important pearl oysters, marine micro and macro algae.

UNIT - II	TOXINS AND THEIR ACTION	9

Marine toxins from animals, Sources of toxins, Pharmacological potential of toxins, Tetrodotoxins, Conotoxins, Ciguateratoxins and algal toxins.

UNIT - III	POTENTIAL BIOACTIVE COMPOUNDS	9

Bioactive compounds from the sea, Source and benefits of bioactive compounds, Antioxidants, Collagen, gelatine, Heparin, chitosan, Omega 3 fatty acids and carotenoids, algal nutraceuticals.

UNIT - IV	OIL AND SOLID WASTE DEGRADATION	9

Oil spillage – methods of degradation in coastal waters, Algal blooms, Biodegradation of pesticides, Heavy metals discharged in coastal waters, Solid wastes disposed into coastal waters, Management of solid waste disposal.

UNIT - V	DISEASES AND WATER QUALITY MANAGEMENT	9

Diseases associated with cultured shrimps and management, Fin fish diseases and management, Antibiotics used in culture, Immunostimulants, Diagnostic kits, Water quality management in hatcheries and grow out ponds.

Total Instructional hours : 45

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Course Outcomes : At the end of the course student will be able to:	
CO1	Understand the economically important marine resources and their wealth.
CO2	Understand the potency of natural toxins and drugs.
CO3	Understand the potential bioactive compounds from marine origin.
CO4	Explain the degradation process for discharged wastes.
CO5	Understand the diseases of cultivable animals and its controlling measures.

Text Books	
1.	Fingerman M and R Nagabhushanam, “Recent Advances in Marine Biotechnology (Series) Biomaterials and Bioprocessing”, Science Publishers, 2009.
2.	Proksch and WEG Muller, “Frontiers in Marine Biotechnology”, Horizon Bioscience, 2006.
3.	Le Gal Y and R Ulber, “Marine Biotechnology I: Advances in Biochemical Engineering/ Biotechnology”, (Series Editor: T. Scheper) Springer-Verlag Berlin Heidelberg. Vol. 96, 2005.
4.	Le Gal Y and R Ulber, “Marine Biotechnology II : Advances in Biochemical engineering/ Biotechnology”, (Series editor: T. Scheper), Springer - Verlag Berlin Heidelberg, Vol. 97, 2005.

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B.TECH.	B19BTE804 - HUMAN RIGHTS	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To know the basics of Human Rights.
2.	To understand about various classes of Human Rights.
3.	To understand the Rights of Women and Children.
4.	To understand the multi- dimensional aspects of Human Rights.
5.	To extend the knowledge on National and State level Human Rights commission

UNIT - I	INTRODUCTION TO HUMAN RIGHTS	9

Human Rights : Meaning - definitions - Origin and Growth of human rights in the world - Need and types of Human Rights - UNHRC (United Nations Human Rights Commission) - collective and solidarity rights - Human Rights in India.

UNIT - II	CLASSIFICATION OF HUMAN RIGHTS	9

Right to liberty - Right to Life - Right to Equality - Right to dignity - Right against Exploitation - Educational Rights - Cultural Rights - Educational Rights - Economic Rights - Political Rights - Social Rights.

UNIT - III	RIGHTS OF WOMEN AND CHILDREN	9

Rights of Women - Gender Equity - Female feticide and Infanticide and selective abortion - Physical assault and sexual harassment - Domestic Violence - Violence at work place - Right for Equal Pay - Remedial Measures.

Rights of Children - Protection rights, survival rights - Emancipation rights - Development rights - Role of UN on convention on rights of children

UNIT - IV	MULTI-DIMENSIONAL ASPECTS OF HUMAN RIGHTS	9

Labour rights- Bonded labour- Child labour - Contract labour - Migrant Labour - Domestic Women labour - Gender Equity - Rights of Ethnic refugees- Problems and remedies - Role of trade union in protecting the unorganized labourers.

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UNIT - V	GRIEVANCE AND REDRESSAL MECHANISM	9
Redressal mechanisms at national and international levels - Structure and functions of National and State level Human Rights commission – constitutional remedies and directive principles of state policy.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Develop basic knowledge in atoms Human Rights.
CO2	Learn the various classifications of Human Rights.
CO3	Obtain knowledge in Rights of Women and Children.
CO4	Obtain knowledge on the multi – dimensional aspects of Human Rights.
CO5	Develop knowledge on National and State level Human Rights commission

Text Books	
1.	Sergio B and S Ghosh, “Teaching of Human Rights”, Dominant Publishers and Distributors, New Delhi, 2009.
2.	Roy AN, “Human Rights Achievements and Challenges”, Vista International Publishing House, New Delhi, 2005.

Reference Books	
1.	Das AK and PK Mohanty, “Human Rights in India: Sarup and Sons. New Delhi, 2007.
2.	Borgohain B, “Human Rights Social Justice and Political Challenge”, Kaniska Publishers and Distributors, New Delhi, 2007.

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B.TECH.	B19BTE805 - HAZARD MANAGEMENT	T	P	TU	C
		3	0	3	3

Course Objectives	
1.	To know the basics of industrial processes and hazards.
2.	To understand the importance of relief systems.
3.	To extend knowledge on toxicology and hazard analysis.
4.	To know the importance of leaks and leakages.
5.	To do case study of various industrial hazards.

UNIT - I	INTRODUTION TO INDUSTRIAL HAZARDS	9

Introduction-Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof. Shock wave propagation, vapour cloud and boiling liquid expanding vapours explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

UNIT - II	RELIEF SYSTEMS	9

Preventive and protective management from fires and explosion - inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems – relief valves, flares, scrubbers.

UNIT - III	TOXICOLOGY	9

Hazards identification - toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices - Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).

UNIT - IV	LEAKS AND LEAKAGES	9

Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.

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UNIT - V	CASE STUDY	9
Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.		
		Total Instructional hours : 45

Course Outcomes : At the end of the course student will be able to	
CO1	Understand the basics of industrial processes and hazards.
CO2	Understand the role of relief systems.
CO3	Learn the basics of toxicology and perform hazard analysis
CO4	Estimate and mitigate problems related to leaks and leakages
CO5	Learn the significance of hazard management.

Text Books	
1.	Crowl DA and JF Louvar, "Chemical Process Safety: Fundamentals with Applications", 2nd Ed., Prentice Hall, 2001.
2.	Mannan S, "Lee's Loss Prevention in the Process Industries", Vol. I, 3rd Ed., Butterworth Heinemann, 2004.

Reference Books	
1.	Colonna GR, "Fire Protection Guide to Hazardous Material", 14th Ed., NFPA.
2.	Varela J, "Hazardous Material Handbook for Emergency Responders", Onguard.

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Open Elective - IV

B.E. / B. TECH.	B19AEO801 - VEHICLE AERODYNAMICS (Common to all Except AERO)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of vehicle and its internal design.
2.	To know the principles of process, planning, and ventilation system.
3.	To know the different type of noises and acoustics.
4.	To learn about the ergonomics and occupant accommodation.
5.	To create knowledge on various control systems.

UNIT - I	INTRODUCTION TO VEHICLE DESIGN	9

Timeline developments in design - Mass production – Streamlining for style and low drag - Commercial vehicles - Engine developments - Transmission system development – Steering – Suspension – Brakes - Interior refinement - Safety design.

UNIT - II	VEHICLE BODY DESIGN	9

The styling process - Working environment and structure - Product planning - Concept sketching and package related sketching - Full sized tape drawing – Clay modelling - Aerodynamics - Aerodynamic forces – Drag & Drag reduction - Stability during cross – winds – Wind Noise - Under-hood ventilation - Cabin ventilation - Introduction to Computational fluid dynamics - Wind tunnel testing of scale models.

UNIT - III	NOISE AND VIBRATION	9

Vibration – fundamentals & control – Acoustics – fundamentals - Human response to sound - Sound measurement - Automotive noise criteria - Drive-by noise tests, Noise from stationary vehicles, Interior noise in vehicles, Automotive noise sources and control techniques - Engine noise, Transmission noise, Intake & exhaust noise, Aerodynamic noise, Tyre noise, Brake noise.

UNIT - IV	CRASHWORTHINESS AND ERGONOMIC APPROACH	9

Accident and injury analysis - Vehicle impacts: general dynamics & crush characteristics - Structural collapse and its influence upon safety - Occupant accommodation – Ergonomics in the automotive industry - Ergonomics methods and tools - Case studies of Fiat Punto - Strategies for improving occupant accommodation and comfort.

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UNIT - V	VEHICLE CONTROL SYSTEMS	9
Automotive application of sensors - Chassis control systems - Anti-lock braking systems, Traction control systems, Electronically controlled power - assisted steering - Vehicle safety and security systems - Air-bag and seat belt pre-tensioner systems, Remote keyless entry and vehicle immobilization, Introduction to On-board navigation systems.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the periodical developments in design, production and various components of vehicle bodies.
CO2	Make use of sketching concept like tape drawing and clay modelling to reduce the aerodynamics drag on vehicle body.
CO3	Analyze the various automotive noise sources and its control techniques.
CO4	Evaluate the vehicle crash worthiness requirements for improving passengers and comfort.
CO5	List the different control system and sensors used in controlling the vehicle.

Text Books	
1.	Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Butterworth- Heinemann Ltd., 2002.

Reference Books	
1.	Wolf-Heinrich Hucho (Eds.), “Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering”, Butterworth-Heinemann Ltd., 1987.
2.	Ian R Sinclair, Sensors and Transducers, Butterworth - Heinemann Ltd., 2001.
3.	T.K. Garrett, K. Newton & W. Steeds, “the Motor Vehicle”, Butterworth- Heinemann Ltd., 2001

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B.E. / B. TECH.	B19AGO801 – AGRICULTURE FINANCE, BANKING AND COOPERATIVES (Common to all Except AGRI)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on principles basic agriculture finance system.
2.	To understand the different farm financial analysis
3.	To acquire the knowledge on different functions of financial institutions
4.	To understand banking and cooperation for agricultural and agro based industries and financial system
5.	To know the functions of various institutions involved in farm financing crop insurance products.

UNIT - I	AGRICULTURAL FINANCE - NATURE AND SCOPE	9

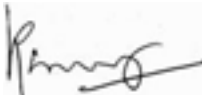
Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural Credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - Institutional agencies: Advantages and Disadvantages - Rural indebtedness: consequences of rural indebtedness - History and Development of rural credit in India.

UNIT - II	FARM FINANCIAL ANALYSIS	9

Principles of Credit - 5C's, 5R's and & 7P's of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow statement - Financial Ratio Analysis.

UNIT - III	FINANCIAL INSTITUTIONS	9

Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches - Area Approach - Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and its role in poverty alleviation - Self-Help Groups - Non -Governmental Organizations - Rural credit policies followed by State and Central Government - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).



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UNIT - IV	CO-OPERATION	9

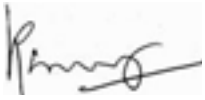
Co-operation: Philosophy and Principles - History of Indian Cooperative Credit Movement: Pre and Post-Independence periods and Cooperation in different plan periods - Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyananthan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, - Special cooperatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd., (NAFSCOB) - Objectives and Functions.

UNIT - V	BANKING AND INSURANCE	9

Negotiable Instruments: Meaning, Importance and Types - Central Bank: RBI - functions - credit control - objectives and methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non - Banking Financial Institutions (NBFI) – Preparation of Bankable Projects - Assessment of crop losses, Determination of compensation - Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation - Estimation of crop yields - Livestock, insurance schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Acquiring the knowledge on sources of Agricultural Micro-Macro financing and credit systems.
CO2	Understanding the history of financing agriculture in India.
CO3	Learning the significance and limitations of crop insurance.
CO4	Developing the knowledge on cooperative systems.
CO5	Creating the knowledge on insurance policies and financial system.



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Text Books	
1.	Muniraj, R., “Farm Finance for Development”, Oxford & IBH, New Delhi, 1987.
2.	Subba Reddy S. and P. Raghu Ram, “Agricultural Finance and Management”, Oxford & IBH, New Delhi, 2011.
3.	Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray, “Agricultural Finance”, Kalyani Publishers, New Delhi, 1998.
4.	Mammoria, C.B. and R.D. Saxena, “Cooperation in India”, Kitab Mahal, Allahabad, 1973.
5.	Patnaik, V.E. and A.K. Roy, “Cooperation and Cooperative Management”, Kalyani Publishers, Ludhiana, 1988.

Reference Books	
1.	Ghosal, S N., “Agricultural Financing in India”, Asia Publishing House, Bombay, 1966.
2.	John, J.Hamptron., “Financial Decision Making: Concepts, Problems and Cases”, Prentice-Hall of India, New Delhi, 1983
3.	https://www.nabard.org/

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B.E. / B. TECH.	B19BMO801 – HOSPITAL MANAGEMENT (Common to all Except BME)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of hospital administration
2.	Learn human resource management in hospital
3.	Know the market-related research process
4.	Explore various information management systems and relative supportive services.
5.	Learn the quality and safety aspects of the hospital.

UNIT - I	OVERVIEW OF HOSPITAL ADMINISTRATION	9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning - Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.

UNIT - II	HUMAN RESOURCE MANAGEMENT IN HOSPITAL	9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT - III	MARKETING RESEARCH PROCESS	9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behavior - Model of consumer behavior - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT - IV	HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES	9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.

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UNIT - V	QUALITY AND SAFETY ASPECTS IN HOSPITAL	9
Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the principles of Hospital administration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and its uses.
CO5	Summarize the quality and safety procedures followed in hospitals.

Text Books	
1.	R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI, 4th Edition, 2006.
2.	G.D.Kunders, “Hospitals – Facilities Planning and Management”, TMH, 5th Reprint, New Delhi, 2007.

Reference Books	
1.	Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering”, Academic Press, New York, 1977.
2.	Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd Edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3.	Peter Berman “Health Sector Reform in Developing Countries”, Harvard University Press, 1995.

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4.	William A. Reinke “Health Planning For Effective Management”, Oxford University Press, 1988.
5.	Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press, 2002.
6.	Arnold D. Kalcizony & Stephen M. Shortell, “Health Care Management”, 6th Edition, Cengage Learning, 2011.

BoS Chairman

B. E. / B. TECH.	B19CSO801 – FUNDAMENTAL OF IOT (Common to all Except CSE, AI & DS, CSBS)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand and gain complete knowledge about internet of things.
2.	To study about network protocols.
3.	To learn basic programming and IoT tools.
4.	To understand the basics of embedded systems in IoT.
5.	To explore various IoT applications

UNIT - I	INTRODUCTION	9
Basics of IoT, Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, Functional Blocks of IoT, Communication Models & APIs, Machine to Machine, Difference between IoT and M2M.		

UNIT - II	NETWORK AND COMMUNICATION ASPECTS	9
Wireless Medium Access Issues, MAC Protocol Survey, Survey Routing protocols, Sensor Deployment & Node Discovery, Data Aggregation & Dissemination.		

UNIT - III	ISSUES AND CHALLENGES IN IOT	9
Design Challenges, Development Challenges, Security Challenges, Issues related to Privacy, Standards and Regulation.		

UNIT - IV	DEVELOPING INTERNET OF THINGS	9
Introduction to different IoT Tools, Developing Applications through IoT Tools, Developing Sensor based Application through Embedded System Platform, Implementing IoT concepts with examples.		

UNIT - V	DOMAIN SPECIFIC APPLICATIONS	9
IoT applications - Home Automation-Agriculture- Health care - Surveillance Applications - Smart Grid - Introduction to Industrial IoT (IIoT).		
Total Instructional hours : 45		

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Course Outcomes : Students will be able to	
CO1	Explain the concepts of Internet of Things.
CO2	Analyze basic protocols in Wireless Sensor Network.
CO3	Outline the issues of IoT application design in different domains.
CO4	Illustrate the use of IoT tools and its performance.
CO5	Identify the IoT concepts and applications.

Text Books	
1.	Perry Lea, “Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security”, Packt, 2018.
2.	David Hanes, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco press, 2017.

Reference Books	
1.	Samuel Greengard, “The Internet of Things”, MIT Press, 2015.
2.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley, 2012.
3.	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice”, 2010.

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B.E./ B.TECH.	B19ECO801 – WIRELESS TECHNOLOGIES (Common to all Except ECE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To provide basic understanding about wired and wireless communication.
2.	To have an exposure to Internet of Things and applications.
3.	To know the basic wireless network security.
4.	To get exposed to antenna systems.
5.	To understand various satellite communication.

UNIT - I	FUNDAMENTALS OF COMMUNICATION	9

Basics of Communication, Spectrum - FCC, Transceiver design and its Components, Wired and wireless communication. Modulation techniques, OSI Layers, TCP/IP Protocols 1G to 5G developments; 3G, 4G and 5G cell architecture.

UNIT - II	INTERNET OF THINGS	9

Introduction, IoT- Architecture, IEEE 802.15.4, M2M and IoT Protocols, SCADA and RFID Protocols, Architecture and Applications - Bluetooth, Zigbee, LORA, 6LOWPAN, Wi-Fi, WIMAX.

UNIT - III	WIRELESS NETWORK SECURITY	9

Cryptography, Integrity, Authentication and Key management, Wireless Threats – Hacking 802.11, Eavesdropping, Jamming, Cyber-crimes and awareness – countermeasures, Wireless Security.

UNIT - IV	ANTENNA SYSTEMS	9

Introduction, Types of Antennas, Radiation Mechanisms and Measurements, Dipole, Monopole, Mobile Phone Antenna, Smart Antennas, RFID antennas, Automotive Antenna, Reconfigurable Antennas, SAR measurements.

UNIT - V	SATELLITE COMMUNICATION	9

Basic principles, Kepler's law, Types of satellites – LEO, MEO and GEO. Launch Vehicles, Satellite Subsystems and Satellite links, Applications – GPS, Mobile communication and TV broadcast, Navigation systems, Modern Navigation systems.

Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Analyze the wired and wireless communication and networks.
CO2	Develop Internet of Things for various applications
CO3	Apply security protocols in Wireless Networks
CO4	Discover various antenna systems for Wireless Technologies
CO5	Explain the Satellite Communication technologies

Text Books	
1.	John G Proakis, MasoudSalehi, “Communication Systems Engineering” Prentice Hall, 1994.
2.	Oliver Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things- Key applications and Protocols”, Wiley 2012.

Reference Books	
1.	Dennis Roddy, “Satellite Communication”, 4th Edition, Tata McGraw-Hill, 2009.
2.	Behrou A. Forouan, “Data Communication and Networking”, 5th Edition, Tata McGraw Hill, 2013.
3.	Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.
4.	AfifOsseiran, Jose.F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.
5.	KasunMaduranga Silva Thotahewa(Author), Jean-Michel Redoute(Author), Mehmet RasitYuce, “Ultra Wideband Wireless Body Area Networks”, Springer, 2016.
6.	Timothy Pratt and Charles W.Bostain, “Satellite Communications”, John Wiley and Sons, 2nd Edition, 2012.
7.	M. Richharia, "Satellite Systems for Personal Applications", John Wiley, 2010.
8.	Balanis. A, “Antenna Theory Analysis and Design”, 3rd Edition, John Wiley and sons, New York, 1982.
9.	William Stallings, “Cryptography & Network Security - Principles and Practices”, Pearson Education, 4th Edition, 2006.

BoS Chairman

B.E. / B. TECH.	B19EEO801 – ENERGY CONSERVATION AND MANAGEMENT (Common to all Except EEE)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To acquire the knowledge about the current energy scenario and importance of energy conservation, audit and management.
2.	To understand about the economics associated with energy conservation.
3.	To understand about the different electrical systems and the methods of improving energy efficiency.
4.	To improve the thermal efficiency by designing suitable systems for heat recovery and co-generation.
5.	To understand how to conserve energy in Major utilities.

UNIT - I	INTRODUCTION	9

Energy - Power – Past and Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers- Instruments for energy auditing - energy security- Material and energy balance diagrams.

UNIT - II	ECONOMICS	9

Energy Economics – energy pricing - Fixed and variable costs, Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept.

UNIT - III	ELECTRICAL SYSTEMS	9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT - IV	THERMAL SYSTEMS	9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation – Steam Distribution and Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization and Insulators - Waste Heat Recovery- Cogeneration.

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UNIT - V	ENERGY CONSERVATION IN MAJOR UTILITIES	9
Energy conservation in Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Interpret the basic knowledge of current energy scenario and importance of energy Conservation and management
CO2	Summarize the knowledge of economics associated with energy conservation
CO3	Apply the methods of improving energy efficiency in different electrical systems
CO4	Make use of the heat utilization, saving and recovery in different thermal systems
CO5	Interpret the knowledge of energy conservation in Major utilities

Text Books	
1.	Murphy W.R. and G.Mckay Butter worth, “Energy Management”, Heinemann Publications, 2013.
2.	Guide books for National Certification Examination for Energy Managers and Energy Auditors, Book 1, 2, 3 & 4. Bureau Energy Efficiency, a statutory body under Ministry of Power, Government of India, New Delhi. 2005.
3.	W.C.Turner, “Energy Management Handbook”, John Wiley and Sons, Fifth edition, 2013.

Reference Books	
1.	Amlan Chakrabarti, Energy Engineering and Management, Prentice hall India 2011.
2.	John.C.Andreas, “Energy Efficient Electric Motors”, Marcel Dekker Inc Ltd – 2nd edition; 2015.
3.	Paul o’ Callaghan, “Energy Management”, Mc-Graw Hill Book Company – 1st edition; 2012.
4.	Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publications, Washington, 1988.
5.	www.em-ea.org/gbook1.asp

BoS Chairman

B.E. / B. TECH.	B19MEO801 – LEAN SIX SIGMA (Common to all Except MECH)	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To describe about introduction to Six Sigma.
2.	To discuss the importance of Set up time, TQM, 5S, VSM.
3.	To describe about introduction to lean manufacturing.
4.	To study the various tools for lean manufacturing.
5.	To describe about lean involvement and culture.

UNIT - I	INTRODUCTION TO SIX SIGMA	9
Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.		

UNIT - II	SET UP TIME REDUCTION, TQM, 5S, VSM	9
Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.		

UNIT - III	INTRODUCTION TO LEAN MANUFACTURING	9
Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.		

UNIT - IV	LEAN TOOLS AND METHODOLOGY	9
Primary tools – , Workplace organization – Stability - Just-In-Time – Takt time - One piece flow – Pull, Cellular systems, , Six Sigma. SMED: Single minute exchange of dies –theory and practice of the SMED system - TPM, Pillars of TPM, Conditions for TPM success,TPM implementation process - Overall Equipment Effectiveness - computation of OEE.		

UNIT - V	LEAN INVOLVEMENT AND CULTURE	9
Necessity of involvement – Waste of Humanity – Activities supporting involvement – Kaizen Circle Activity – Practical Kaizen Training – Key factors in Practical Kaizen Training – Lea Culture – Standardization – Standards and abnormality control – 'Five Why' analysis.		
Total Instructional hours : 45		

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Course Outcomes : Students will be able to	
CO1	Understand the fundamental principle of six sigma
CO2	Apply techniques, skills and modern engineering tools necessary for production design
CO3	Understand the principles of Lean Manufacturing
CO4	Identify the various lean tools and methodologies
CO5	Understand the implementation of lean and work culture in shop floor

Text Books	
1.	Dennis P, “Lean Production Simplified: A Plain Language Guide to the World's Most powerful Production System”, Productivity Press, New York, 2009.
2.	Liker J. and Meier D., “The Toyota Way”, Field book, McGraw-Hill, 2010.
3.	N.Gopalakrishnan, “Simplified Lean Manufacture”, PHI, 2010.

Reference Books	
1.	Devadasan S. R., Mohan Sivakumar V., Murugesh R. and Shalij P.R., “Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities”, Prentice Hall of India Learning Limited, New Delhi, 2012.
2.	Gopalakrishnan N., “Simplified Lean Manufacture: Elements, Rules, Tools and implementation”, Prentice Hall of India Learning Private Limited, India, 2010.
3.	Bill Carr ira, “Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Wastes and Maximizing Profits”, Prentice Hall of India Learning Private Limited, India, 2009.
4.	Don Tapping, Tom Lu ster and Tom Shuker, “Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements”, Productivity Press, New York, USA, 2007.

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B. TECH.	B19BTP801 – PROJECT WORK PHASE – II	T	P	TU	C
		0	16	0	8

Course Objectives	
1.	To enable students to develop problem solving skills in Biotechnology.
2.	To inculcate project management skills, including planning, organizing, and executing the project among the students

Students in a group of 3 or 4 shall work on a topic approved by the Head of the Department under the guidance of a faculty member and submit a comprehensive project report duly approved by the project supervisor. The progress of the project is evaluated based on three reviews by the review committee constituted by the Head of the Department. The project work is evaluated based on oral presentation and the final project report jointly by a team of examiners including one external examiner. The project outcome shall be a product / patent / publication.

Total Hours - 60

Course Outcomes : Students will be able to	
CO1	Identify and propose a Biotechnology project addressing a specific research problem.
CO2	Design and implement experiments to reduce the technological gaps.
CO3	Demonstrate effective teamwork and collaboration skills in Biotechnology projects.
CO4	Analyze experimental data and draw evidence-based conclusions.
CO5	Develop scientific writing and presentation skills.

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