



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

*Regulations 2021  
Curriculum and Syllabi  
(Amendments updated upto February 2022)*

---

*B.Tech.  
(Biotechnology)*



**REGULATIONS 2021**

**CURRICULUM AND SYLLABI  
(Amendments updated upto February 2022)**

**B.TECH. BIOTECHNOLOGY**



## **VISION AND MISSION OF THE INSTITUTION**

### **VISION**

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

### **MISSION**

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



## **SCHOOL OF LIFE SCIENCES**

### **VISION AND MISSION**

#### **VISION**

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

#### **MISSION**

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



## **PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES**

### **B.Tech. (Biotechnology)**

#### **PROGRAMME EDUCATIONAL OBJECTIVES:**

- This course will facilitate the graduates to be professionally competent in Biotechnology to solve the problems in environmental, food, biochemical and biomedical sciences.
- This course will offer students with a solid foundation in Biological Sciences, to enable them to work on applications in biotechnology as per the requirement of the industries, and also will enable the students to pursue higher studies and research.
- This course will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology to enable them to understand basic concept in modern biology and help them to build their carrier in this field.
- This course will facilitate the students to acquire knowledge in skill-based courses such as Biofertilizer Technology, Agricultural Biotechnology, Medical Biotechnology, Herbal Technology, Disease Management and Mushroom Culture Technology enabling their skills and give confidence to them for business opportunities.
- This programme will teach students the importance of Bioethics, entrepreneurship, communication, and management skills.
- This course will also offer the graduates to demonstrate their proficiency in theory and practice of bio-techniques through life-long learning and provide confidence to perform as an individual and / or member of a team with professional and ethical behavior.



**PROGRAMME OUTCOMES:**

1. Having an ability to apply mathematics and science in engineering applications.
2. Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.
3. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment
4. Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information
5. Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice
6. Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems
7. Having adaptive thinking and adaptability in relation to environmental context and sustainable development
8. Having a clear understanding of professional and ethical responsibility
9. Having cross cultural competency exhibited by working as a member or in teams
10. Having a good working knowledge of communicating in English and communicate effectively on complex science activities with the science community and with the society at large.
11. Having a good cognitive load management skills related to project management and finance
12. Having interest and ability to engage in independent and life-long learning in the broadest context of technological change.

**PROGRAMME SPECIFIC OUTCOMES:**

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

1. Apply knowledge to find innovative solutions for biotechnological problems
2. Explore problems related to biotechnology and provide valid conclusions through industry academia interface
3. Infer the potentials and impact of biotechnological innovations for finding sustainable ethical solutions to issues pertaining to health, environment and agriculture

**REGULATIONS - 2021**  
**B.TECH. DEGREE PROGRAMMES**  
**(Under Choice Based Credit System)**

**1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE**

In these Regulations, unless the context otherwise requires:

- i) "**Programme**" means B.Tech. Degree Programme.
- ii) "**Branch**" means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,
- iii) "**Course**" means theory / practical / laboratory integrated theory / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,
- iv) "**Institution**" means B.S. Abdur Rahman Crescent Institute of Science and Technology.
- v) "**Academic Council**" means the Academic Council, which is the apex body on all academic matters of this Institute.
- vi) "**Dean (Academic Affairs)**" means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.
- vii) "**Dean (Student Affairs)**" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare and discipline in the campus.
- viii) "**Controller of Examinations**" means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.
- ix) "**Dean of the School**" means the Dean of the School of the department concerned.
- x) "**Head of the Department**" means the Head of the Department concerned.

**2.0 ADMISSION**

**2.1a)** Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have passed the Higher Secondary Examination of the 10+2 curriculum

(Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

- 2.1b)** The student shall have studied at least any three of the following courses: Physics, Mathematics, Chemistry, Computer Science, Electronics, Information Technology, Biology, Informatics Practices, Biotechnology, Technical Vocational Subjects, Agriculture, Engineering Graphics, Business Studies, Entrepreneurship at 10+2 level. In case if the student has not studied any or all the courses viz., mathematics, physics and chemistry, he / she shall undergo bridge course(s) in the concerned course(s) at 10+2 level knowledge.
- 2.2** Notwithstanding the qualifying examination, the candidate might have passed at 10+2, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.
- 2.3** Candidates for admission to the third semester of the eight semester B.Tech.programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.
- 2.4** The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.
- 2.5** The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.

### **3.0 BRANCHES OF STUDY**

- 3.1** Regulations are applicable to the following B.Tech. Degree

programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

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

#### **4.0 STRUCTURE OF THE PROGRAMME**

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

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

##### **4.1.1 Mandatory Induction Programme for First year Students**

The first year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local

areas, familiarization with departments / schools and centres, etc.,

#### **4.1.2 Personality and Character Development**

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

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

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

#### **4.1.3 Online Courses for Credit Transfer**

Students are permitted to undergo department approved online courses under SWAYAM up to 20% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean (Academic Affairs) during his / her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

#### **4.1.4 Value Added Courses**

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

The details of the value added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Dean (Academic Affairs) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course.

These value added courses shall be specified in the consolidated

mark sheet as additional courses pursued by the student over and above the curriculum during the period of study.

#### **4.1.5 Industry Internship**

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

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

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

#### **4.1.6 Industrial Visit**

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

#### **4.2 Each course is normally assigned certain number of credits:**

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

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

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

### **5.0 DURATION OF THE PROGRAMME**

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

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

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

## **6.0 REGISTRATION AND ENROLLMENT**

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

### **6.2 Change of a Course**

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

### **6.3 Withdrawal from a Course**

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

## **7.0 BREAK OF STUDY FROM PROGRAMME**

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

7.1.1 Medical or other valid grounds

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

7.1.3 Debarred due to any act of indiscipline

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

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



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

## **8.0 CLASS ADVISOR AND FACULTY ADVISOR**

### **8.1 Class Advisor**

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

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

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

### **8.2 Faculty Advisor**

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

## **9.0 COURSE COMMITTEE**

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

## **10.0 CLASS COMMITTEE**

A class committee is constituted branch wise and semester wise

by the Head of the Department / Dean of the School shall normally comprise of faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman.

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

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

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

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

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

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

**10.5** The third meeting of the class committee, excluding the student

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

### **11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER**

**11.1** A student can enroll for a maximum of 32 credits during a semester including Redo / Predo courses.

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

### **12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS**

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

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

### **12.2 Theory Course**

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

### **12.3 Laboratory Course**

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

### **12.4 Laboratory Integrated Theory Courses**

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

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

#### **12.6 Industry Internship**

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

#### **12.7 Project Work**

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

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

**12.9** For the first attempt of the arrear theory examination, the internal

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

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

### **13.0 SUBSTITUTE EXAMINATIONS**

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

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

### **14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION**

**14.1** A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded "1" grade in that course.

**14.2** The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned

course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

- 14.3** If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.
- 14.4** A student who has obtained an “I” grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall repeat all the courses of the semester in the subsequent academic year.
- 14.5** The student awarded “I” grade, shall enroll and repeat the course when it is offered next. In case of “I” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the Department / Dean of the School.
- 14.6** A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further

appearance of arrear examination.

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

### **15.0 REDO COURSES**

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

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

### **16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET**

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

<b>Letter Grade</b>	<b>Grade Points</b>
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-

**"W"** - denotes withdrawal from the course

“I” - denotes inadequate attendance in the course and prevention from appearance of semester end examination

“U” - denotes unsuccessful performance in the course.

**16.2** A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

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

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

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

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

If  $C_i$  is the number of credits assigned for the  $i^{\text{th}}$  course and  $GP_i$  is the Grade Point in the  $i^{\text{th}}$  course,



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

Where n = number of courses

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

"I" and "W" grades are excluded for calculating GPA.

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

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

Percentage equivalent of marks = CGPA X 10

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

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

#### 16.6.1 Eligibility for First Class with Distinction

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

#### 16.6.2 Eligibility for First Class

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

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

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

### **17.0 SUPPLEMENTARY EXAMINATION**

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

### **18.0 DISCIPLINE**

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

**18.2** Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the Head of the Department / Dean of the School concerned shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action. This committee shall also address the grievances related to the conduct of online classes.

### **19.0 ELIGIBILITY FOR THE AWARD OF DEGREE**

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

- i) Successfully earned the required number of total credits as specified in the curriculum of the programme of study within a maximum period of 14 semesters (12 semesters for lateral entry) from the date of admission, including break of study.
- ii) Successfully completed the requirements of the enrolled professional development activity.
- iii) No dues to the Institution, Library, Hostel, etc.
- iv) No disciplinary action pending against him/her.

**19.2** The award of the degree must have been approved by the

Institution.

## 20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

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

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation Engineering	• Computer Science and Engineering
• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering(Cyber Security)

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

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

		Electronics and Instrumentation Engineering Electronics and Communication Engineering
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering
8.	Robotics	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
9.	3D Printing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering

		(Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electronics and Communication Engineering
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering(Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics and Communication Engineering
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science and Engineering(Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering

		Electronics and Communication Engineering
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering

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

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

**21.0 POWER TO MODIFY**

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

\*\*\*\*\*

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

**B.TECH. BIOTECHNOLOGY**

**CURRICULUM & SYLLABIS, REGULATIONS 2021**

*(Choice Based Credit System)*

**SEMESTER I**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BSC	PHD 1181	Applied Physics *	3	0	2	4
2.	BSC	CHD 1181	Engineering Materials and Applications *	3	0	2	4
3.	BSC	MAD 1182	Biomathematics	3	1	0	4
4.	ESC	GED 1101	Engineering Graphics	2	0	2	3
5.	ESC	GED 1102	Engineering Design	2	0	0	2
6.	ESC	GED 1103	Manufacturing Practices Laboratory	0	0	2	1
7.	ESC	GED 1104	Programming for Problem Solving **	1	0	2	2
<b>Credits</b>							<b>20<sup>#</sup></b>

**SEMESTER II**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	HSC	END 1281	English for Engineers	3	0	0	3
2.	PCC	BTD 1201	Basics of Genetics	3	0	0	3
3.	PCC	BTD 1202	Cell and Molecular Biology	3	0	2	4
4.	PCC	BTD 1203	Microbiology	3	0	2	4
5.	PCC	BTD 1204	Yoga and alternative medicine **	0	0	2	1
6.	ESC	GED 1203	Basic Electrical Engineering *	3	0	2	4
7.	MC	GED 1206	Environmental Sciences	2	0	0	2
<b>Credits</b>							<b>21</b>

**SEMESTER III**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective I	3	0	0	3
2.	PCC	BTD 2101	Biophysics	3	0	0	3
3.	PCC	BTD 2102	Biochemistry *	3	0	2	4
4.	PCC	BTD 2103	Fundamentals of Chemical Engineering *	3	0	2	4
5.	PCC	BTD 2104	Analytical Techniques *	3	0	2	4
6.	PCC	BTD 2105	Technical Seminar **	0	0	2	2
7.	HSC	GED 2101	Essential Skills and Aptitude for Engineers**	0	0	2	1
<b>Credits</b>							<b>21</b>

**SEMESTER IV**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	BTD 2201	Plant and Animal Biotechnology *	3	0	2	4
2.	PCC	BTD 2202	Green Biotechnology and Pollution Abatement	2	0	0	2
3.	PCC	BTD 2203	Immunotechnology *	3	0	2	4
4.	PCC	BTD 2204	Recombinant DNA Technology	3	0	0	3
5.	PCC	BTD 2205	Bioinformatics and Chemoinformatics *	3	0	2	4
6.	PEC		Professional Elective-I	3	0	0	3
7.	PCC	BTD 2205	Project Based Learning and Comprehensive viva voice **	0	0	2	1
8.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers**	0	0	2	1
9.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0
<b>Credits</b>							<b>22</b>



**SEMESTER V**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	BTD 3101	Good Manufacturing and Laboratory Practice	2	1	0	3
2.	PCC	BTD 3102	Bioprocess Engineering *	3	0	2	4
3.	PCC	BTD 3103	Enzyme Technology *	3	0	2	4
4.	PCC		Professional Elective-II	3	0	0	3
5.	PCC		Professional Elective-III	3	0	0	3
6.	BSC	MAD 3182	Biostatistics	3	1	0	4
8.	HSC	GED 3101	Communication Skills for Career Success**	0	0	2	1
9.	PROJ	BTD 3105	Internship I ##	0	0	0	1
<b>Credits</b>							<b>23</b>

**SEMESTER VI**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3281	Entrepreneurship	3	0	0	3
2.	HSC		Humanities Elective II	2	0	0	2
3.	OEC		Open Elective I	3	0	0	3
4.	PCC	BTD 3201	Nanobiotechnology	3	0	0	3
5.	PCC	BTD 3202	Food Biotechnology	3	0	2	4
6.	PCC	BTD 3203	Fermentation Technology and Bioreactor Design	3	0	2	4
7.	PEC		Professional Elective-IV	3	0	0	3
8.	PEC		Professional Elective-V	3	0	0	3
9.	HSC	GED 3201	Reasoning and Aptitude for Engineers**	0	0	2	1
<b>Credits</b>							<b>26</b>

**SEMESTER VII**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective II				3
2.	OEC		Open Elective III				3
3.	PCC	BTD 4101	Data Analysis and Simulations	2	1	0	3
4.	PEC		Professional Elective-VI				3
5.	PEC		Professional Elective-VII				3
6.	PEC		Professional Elective-VIII				3
7.	PEC		Professional Elective-IX				3
8.	PROJ	BTD 4102	Internship II ###				1
9.	PROJ	BTD 4103	Project Phase - I***				1
10.	HSC	GED 3202	Employability Skills \$	0	0	2	1
<b>Credits</b>							<b>24</b>

**SEMESTER VIII**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	BTD 4201	Project work Phase - II				9
<b>Credits</b>							<b>9</b>

**Overall Total Credits – 165**

\* Laboratory Integrated Theory course

\*\* Laboratory Course

\*\*\* Project Phase I, evaluation and grades will be given in the same semester

# Three Week Orientation Programme – Mandatory Non-Credit Course

## 15 days of Industrial training during the summer vacation of second year. The credit will be awarded in the 5<sup>th</sup> Semester.

### 15 days of Industrial training during the summer vacation of third year. The credit will be awarded in the 7<sup>th</sup> Semester.

\$ Not a Mandatory Course - The student will take up this course during the Summer Holidays of III year as a comprehension of Soft Skills courses offered from semester III to VI. Upon successful completion, the course will be mentioned in grade sheet of VII semester.

**LIST OF PROFESSIONAL ELECTIVE COURSES**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
<b>Semester IV</b>							
1.	PE	BTDX 01	Structural Biology	3	0	0	3
2.	PE	BTDX 02	Bio-Organic Chemistry	3	0	0	3
3.	PE	BTDX 03	Big Data Analytics for Biotechnology	2	1	0	3
4.	PE	BTDX 04	Medical Biotechnology	3	0	0	3
<b>Semester V</b>							
1.	PE	BTDX 11	Cancer Biology	2	1	0	3
2.	PE	BTDX 12	Genome Editing	1	1	2	3
3.	PE	BTDX 13	Biosimilars Technology	1	1	2	3
4.	PE	BTDX 14	Machine Learning	1	1	2	3
5.	PE	BTDX 15	Developmental Biology	3	0	0	3
6.	PE	BTDX 16	Tissue Engineering	1	1	2	3
7.	PE	BTDX 17	Drug Design and Development	2	1	0	3
8.	PE	BTDX 18	Biosafety and Bioethics	2	1	0	3
<b>Semester VI</b>							
1.	PE	BTDX 31	Intellectual Property Rights	2	1	0	3
2.	PE	BTDX 32	Pharmaceutical Biotechnology	2	1	0	3
3.	PE	BTDX 33	Molecular and Cellular Diagnostics	2	1	0	3
4.	PE	BTDX 34	Molecular Pathology	2	1	0	3
5.	PE	BTDX 35	Artificial Intelligence for Biotechnology	3	0	0	3
6.	PE	BTDX 36	Waste Management and Upcycling	2	1	0	3
7.	PE	BTDX 37	Stem-Cell Technology	2	1	0	3
8.	PE	BTDX 38	Gene Expression and Transgenics	2	1	0	3

**Semester VII**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	PE	BTDX 60	Rational Drug Discovery	2	1	0	3
2.	PE	BTDX 61	State-of-the-art Imaging	2	1	0	3
3.	PE	BTDX 62	Precision Medicine and Wellness	2	1	0	3
4.	PE	BTDX 63	Industrial Biotechnology	2	1	0	3
5.	PE	BTDX 64	Bio separation Technology	2	1	0	3
6.	PE	BTDX 65	Proteomics and Genomics	2	1	0	3
7.	PE	BTDX 66	Biomedical Instrumentation	2	1	0	3
8.	PE	BTDX 67	Medical Biotechnology	2	1	0	3
9.	PE	BTDX 68	Material science	2	1	0	3
10.	PE	BTDX 69	Biomedical Engineering	2	1	0	3
11.	PE	BTDX 70	Healthcare Biotechnology	2	1	0	3
12.	PE	BTDX 71	Molecular Farming	2	1	0	3
13.	PE	BTDX 72	Transport Phenomena in Bioprocess	2	1	0	3
14.	PE	BTDX 73	Vaccine Technology	3	0	0	3
15.	PE	BTDX 74	Drug Formulation and Drug Delivery	3	0	0	3
16.	PE	BTDX 75	Regulatory Affairs for Biotechnology	3	0	0	3

**HUMANITIES ELECTIVES – III Semester**

Sl. No.	Course Code	Course Title	L	T	P	C
1	SSDX 01	Engineering Economics and Management	3	0	0	3
2	SSDX 02	Sociology of Science and Technology	3	0	0	3
3	SSDX 03	Industrial Economics and Management	3	0	0	3
4	SSDX 04	Dynamics of Indian Social Structure	3	0	0	3

**HUMANITIES ELECTIVES – VI Semester**

Sl. No.	Course Code	Course Title	L	T	P	C
1	SSDX 11	Economics of Sustainable Development	2	0	0	2
2	SSDX 12	Sociology of Industrial Relations.	2	0	0	2
3	SSDX 13	Professional Ethics and Human Values	2	0	0	2
4	SSDX 14	Gender, Technology and Development	2	0	0	2

**OPEN / GENERAL ELECTIVE COURSES FOR  
B.TECH. PROGRAMMES R 2021 - VI SEMESTER**

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX201	Application of Fluid Mechanics in Everyday Life	3	0	0	3	Aero
2	GEDX 202	Basics of Management and Organizational Behaviour	3	0	0	3	CSB
3	GEDX 203	Big data Analytics	3	0	0	3	CA
4	GEDX 204	Biology for Engineers	3	0	0	3	SLS
5	GEDX 205	Consumer Electronics	3	0	0	3	ECE
6	GEDX 206	Creative Writing	2	1	0	3	English

B.Tech.	Biotechnology				Regulations 2021		
7	GEDX 207	Cyber Forensics	3	0	0	3	CSE
8	GEDX 208	Cyber Security	3	0	0	3	IT
9	GEDX 209	Disaster Management	3	0	0	3	Civil
10	GEDX 210	English for Competitive Examination	2	1	0	3	English
11	GEDX 211	Enterprise Risk Management	3	0	0	3	CSB
12	GEDX 212	Fundamentals of Project Management	3	0	0	3	CSB
13	GEDX 213	Industrial Robotics	2	0	2	3	Mech.
14	GEDX 214	Internet of Things and its Applications	3	0	0	3	ECE
15	GEDX 215	Introduction to Health Care Analytics	3	0	0	3	CA
16	GEDX 216	IPR and Patent Laws	3	0	0	3	CSB
17	GEDX 217	Logistics and Supply Chain Management	3	0	0	3	CSB
18	GEDX 218	Nano Materials and Technology	2	0	2	3	Physics / Chemistry
19	GEDX 219	Numerical Computational Tools for Engineers	2	0	2	3	EIE
20	GEDX 220	Optimization Techniques	3	0	0	3	EEE
21	GEDX 221	Polymers for Emerging Technologies	3	0	0	3	Polymer
22	GEDX 222	Programming Language Principles	3	0	0	3	CSE
23	GEDX 223	Public Speaking and Rhetoric	2	1	0	3	English
24	GEDX 224	Python Programming	2	0	2	3	IT
25	GEDX 225	R Programming	3	0	0	3	CA
26	GEDX 226	Smart Sensors for Healthcare Applications	3	0	0	3	EIE
27	GEDX 227	Total Quality Management	3	0	0	3	Mech.
28	GEDX 228	Value Education	3	0	0	3	Commerce
29	GEDX 229	Waste Water Management	3	0	0	3	Civil
30	GEDX 230	Web Application Development	3	0	0	3	CA

**OPEN / GENERAL ELECTIVE COURSES FOR  
B.TECH. PROGRAMMES R 2021 - VII SEMESTER**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Offering Department</b>
1	GEDX 101	Advanced Entrepreneurship	3	0	0	3	CSB
2	GEDX 102	Artificial Intelligence and Machine Learning Applications	3	0	0	3	CSE
3	GEDX 103	Automotive Technology	3	0	0	3	Automobile
4	GEDX 104	Behavioural Psychology	3	0	0	3	SSSH
5	GEDX 105	Building Repair Solutions	3	0	0	3	Civil
6	GEDX 106	Cloud Services and Management	3	0	0	3	CA
7	GEDX 107	Cost Management for Engineers	3	0	0	3	Commerce
8	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
9	GEDX 109	Data Analytics and Visualization	3	0	0	3	CA
10	GEDX 110	Deep learning Essentials	3	0	0	3	CSE
11	GEDX 111	Drone Technologies	2	0	2	3	Aero
12	GEDX 112	Electric Vehicle	3	0	0	3	EEE
13	GEDX 113	Emerging Technologies in mobile networks	3	0	0	3	ECE
14	GEDX 114	Fundamentals of Data Science and Machine Learning	3	0	0	3	IT
15	GEDX 115	Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
17	GEDX 117	Image Processing and its Applications	3	0	0	3	ECE
18	GEDX 118	Industrial Automation and control	3	0	0	3	EIE
19	GEDX 119	Industrial Safety	3	0	0	3	Mech.
20	GEDX 120	Industry 4.0	3	0	0	3	Mech.
21	GEDX 121	Introduction to Artificial Intelligence	3	0	0	3	IT

B.Tech.	Biotechnology				Regulations 2021		
22	GEDX 122	Introduction to Artificial Intelligence and Evolutionary Computing	3	0	0	3	EEE
23	GEDX 123	Motor Vehicle Act and Loss Assessment	3	0	0	3	Automobile
24	GEDX 124	National Service Scheme	3	0	0	3	SSSH
25	GEDX 125	National Cadet Corps	3	0	0	3	SSSH
26	GEDX 126	Personal Finance and Investment	3	0	0	3	Commerce
27	GEDX 127	Soft Computing Techniques	3	0	0	3	CSE
28	GEDX 128	Value Analysis and Engineering	3	0	0	3	Mech.
29	GEDX 129	Vehicle Maintenance	3	0	0	3	Automobile



**SEMESTER I**

<b>PHD 1181</b>	<b>APPLIED PHYSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To make the students in understanding the importance of mechanics and properties of matter.

**COB2:** To classify the different types of crystal structures and study their defects.

**COB3:** To correlate the quantum mechanics principles and its impact in its application.

**COB4:** To introduce the basics of oscillations, optics and lasers.

**COB5:** To analyze the acoustics of buildings and applications of ultrasonics

**MODULE I                      MECHANICS AND PROPERTIES OF MATTER                      9**

Moment of inertia (M.I.) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - Elasticity – Stress-strain diagram – Factors affecting elasticity – Poisson’s ratio - Twisting couple on a wire – Shaft – Torsion pendulum – Bending moment - Depression on a cantilever – Young’s modulus by cantilever – Uniform and non-uniform bending – I Shape Girders-Viscosity.

**MODULE II                      CRYSTAL PHYSICS                      9**

Miller Indices-Interplanar distance-closely packed crystal structures and Diamond structures –Reciprocal Lattice -Defects in crystals: voids – Line defects - Edge and screw dislocations - Surface Defects - Crystal Growth Techniques - Bridgman method – Czochralski method (qualitative)- Polymorphism and allotropy in crystals.

**MODULE III                      QUANTUM MECHANICS                      9**

Black body radiation – Planck’s theory of radiation – Deduction of Wien’s displacement law and Rayleigh – Jean’s law from Planck’s theory — Dual nature of matter – de-Broglie wavelength - Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Quantum computing.

**MODULE IV                      OSCILLATIONS, OPTICS AND LASERS                      9**

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - Anti-reflection coating - Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet-Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: Nd:YAG laser –CO<sub>2</sub> laser and semiconductor laser - Applications : Laser Materials Processing - Holography.

**MODULE V                      ACOUSTICS & ULTRASONICS                      9**

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

**PRACTICALS**

List of Experiments

1. Determination of rigidity modulus of the given wire using Torsional pendulum.
2. Determination of young's modulus of the beam by uniform / non-uniform bending method.
3. Determination of young's modulus of the beam by cantilever method.
4. Determination of coefficient of viscosity of low viscous liquid by Poiseuille's flow.
5. Determination of coefficient of viscosity of high viscous liquid by Stoke's method.
6. To determine the frequency of an electrically maintained tuning fork using a vibration generator. (Melde's experiment)
7. Determination of thickness of a thin wire / sheet using Air Wedge method.
8. Determination of wavelength of laser light using semiconductor laser diffraction.
9. Determination of angle of divergence of a laser beam using

semiconductor diode laser and He-Ne laser.

10. Determination of particle size of lycopodium powder using semiconductor laser.
11. Determination of velocity of sound in solids using Kundt's tube method.
12. Determination of velocity of ultrasonic waves in the liquid using ultrasonic interferometer.

**L – 45; P – 30; Total Hours – 75**

**TEXTBOOKS:**

1. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.
2. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.

**REFERENCES:**

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. Brij Lal and N. Subramanyam, Properties of Matter, S.Chand& Co, 2003.
3. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.
4. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
5. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.
6. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.

**COURSE OUTCOMES:**

- CO1:** Grasp the importance of mechanics and the principles of elastic behaviour of materials & apply them to analyze the various substances based on elasticity.
- CO2:** Get acquainted with the topics concerning types, defects in crystal structures, methods of preparation and apply the same to categorize different crystal systems in real time
- CO3:** Comprehend the importance & principles of quantum mechanics and utilize ideas to understand working of modern devices and its variants.

**CO4:** Know the basics of oscillations, optics and lasers and their applications.

**CO5:** Assimilate the ideas of acoustical requirements of buildings, understand principles of ultrasonics and add values to their usefulness in acoustical design of halls and their applications.

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

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

<b>CHD1181</b>	<b>ENGINEERING MATERIALS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>APPLICATIONS</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

To make the students conversant with

**COB1:**preparation, properties and applications of various polymers and composites

**COB2:** synthesis, properties, and applications of nanomaterials

**COB3:** the basic concepts and different types of catalysts involved in catalytic processes.

**COB4:**basic principles and its applications of certain spectroscopic techniques towards characterization of chemical compounds and concepts of photochemical processes involved in photochemical reactions.

**COB5:**different types of sensors and its applications.

**MODULE I POLYMER AND COMPOSITES 9**

Introduction – classification: source, heat, composition and structure- glass transition temperature – synthesis, properties and applications of polycarbonate, polyurethane, teflon, ABS, kevlar, bakelite, epoxy resin, acrylic polymers (PAN) - biopolymers : importance and applications of biodegradable polymers (PLA, PHBV).

Composites- Introduction - properties and applications: fibre-reinforced plastics (glass, carbon, and aramid), ceramic matrix composites (CMC) – bio-composites.

**MODULE II NANOCHEMISTRY 9**

Introduction – classification based on dimension with examples – properties of nanomaterials (surface to volume ratio and size quantisation effect) - synthesis of nanomaterials (Top-down and Bottom-up)– role of capping & reducing agents - CVD (CNT), laser ablation (Ag, Ag<sub>2</sub>O), electrodeposition (semiconductor materials), precipitation (Ag, Au), thermolysis: solvothermal (CuO, CeO<sub>2</sub>) and hydrothermal (TiO<sub>2</sub>, ZnO, carbon dots), microwave method (metal oxide), bio-nanomaterials - biogenic method (synthesis of Ag, Au by plants extracts, bacteria, fungi)

**MODULE III CATALYSIS 9**

Types of catalysis – Criteria for catalysts - catalysis by transition metal ions and their complexes- solid catalyst - metal oxides and zeolites - shape

selective catalysts- mechanism of catalytic action- CO oxidation, NO<sub>x</sub> and SO<sub>x</sub> reduction– Enzyme catalysis-Mechanism of enzyme action-electrocatalysis -green catalyst.

#### **MODULE IV PHOTOCHEMISTRY AND SPECTROSCOPY 9**

Laws of photochemistry – Quantum yield -- Jablonski diagram - photophysical processes - photosensitisation – Quenching– chemiluminescence – bioluminescence

Atomic and molecular spectrum – absorption and emission spectrum - Beer Lambert's law – problems and applications – principles and applications: colorimetry, UV -vis spectroscopy (Chromophore- auxochrome, red and blue shift), atomic absorption spectroscopy, IR spectroscopy (fingerprint region, functional group interpretation)

#### **MODULE V SENSORS 9**

Sensors – types: bio and toxic chemicals sensors- principle, working and applications of Electrochemical sensors: MEMS and NEMS, - Biosensors- construction, working and classification, Advantages - Biochips - touch sensor (oxi and gluco meter) - Advanced sensors: Smoke and gas sensors, humidity sensors, temperature sensor and alcohol sensor.

#### **PRACTICALS**

List of Experiments

1. Preparation of polymers – phenol-HCHO, urea-HCHO, polylactic acid, epoxy resin
2. Determination of molecular weight and degree of polymerization using Oswald's viscometer.
3. Synthesis of nano-ZnO and CuO by precipitation
4. Demonstration of Laser ablation techniques for nanomaterials.
5. Electrochemical synthesis of graphene oxide
6. One-pot synthesis using green catalyst.
7. Green synthesis: Photocatalytic reactions, solvent - free organic reaction - Aldol; green oxidation, green reduction.
8. Diels - Alder reaction in eucalyptus oil (green process).
9. Spectrophotometer iron estimation.(Beer Lambert's law) determination of Fe<sup>3+</sup>
10. FT-IR spectral characterisation (functional group interpretation)

**L –45; P –30; Total Hours –75**

**TEXT BOOKS:**

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2016.
2. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, Thomas Graham House, Cambridge, 2012.
3. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis: Principles and Applications, Narosa Publishing House, 2002.
4. Gadi Rothenberg, Catalysis: Concepts and Green Applications, WILEY-VCH
5. Nicholas J. Turro, V. Ramamurthy and Juan C. Scaiano, Principles of molecular photochemistry: An introduction, University Science Books, Sausalito, CA, 2009.
6. John Vetelino, Aravind Reghu, Introduction to Sensors By - 2017.

**REFERENCES:**

1. Jhon S. Wilson, Sensor Technology Handbook, Elsevier 2005.

**COURSE OUTCOMES:**

The students will be able to

**CO1:** enumerate and compare the preparation, properties and applications of various types of polymers and composites.

**CO2:** synthesize different type of nanomaterials on a commercial scale based on its size and applications.

**CO3:** apply the concepts of spectroscopic techniques towards spectral interpretation for identification of compounds and explain various photochemical processes in photochemical reactions.

**CO4:** Impart types, characteristics, and applications of different types of catalyst.

**CO5:** categorize the sensors and its applications to real time situation.

**Board of Studies (BoS):**

11<sup>th</sup>BoS of Chemistry held on 17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	-	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 9: To support scientific & technology development and innovation of materials and electronic devices

Introduction of basics on various materials and electronic devices towards innovation on new technology.



<b>MAD1182</b>	<b>BIOMATHEMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To develop the skills in the areas of Biotechnology necessary to become a successful biologist

**COB2:** To serve as basic tools for specialized studies in biological fields

**COB3:** To facilitate the students to apply basic mathematical tools to solve biological problems

**COB4:** To familiarize problem solving techniques using Numerical methods

**COB5:** To demonstrate the students with mathematical modeling in biological models

**MODULE I MATRICES 9+3**

Characteristic Equation – Eigen values and Eigen vectors- Properties of Eigen values and Eigen vectors - Cayley -Hamilton Theorem (without proof) - Orthogonal transformation of a symmetric matrix to diagonal form.

**MODULE II CALCULUS 9+3**

Derivatives – Partial Derivatives – Optima of two variables – Multiple Integral – Cartesian and Polar Coordinates – Integration using Partial Fraction Method.

**MODULE III ORDINARY DIFFERENTIAL EQUATIONS 9+3**

Variable Separable – Homogeneous and Nonhomogeneous of first degree - Second order linear differential equation with constant coefficients, variable coefficients (Legendre and Cauchy).

**MODULE IV NUMERICAL METHODS 9+3**

Solution of Linear and Nonlinear Equations: Newton Raphson, Fixed Point Iteration Method - Solution of Simultaneous Equation: Gauss Jordan, Gauss Elimination Method –Numerical Integration: Trapezoidal, Simpson's Rule

**MODULE V APPLICATIONS IN BIOLOGY 9+3**

Role of Pattern in Biology - Reaction Differential Relation - Microbial Population Models – Mathematical Models.

**L – 45; T - 15; Total Hours – 75**

**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 43<sup>rd</sup> edition, New Delhi, 2012.
2. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2010.
3. John W. Cell, "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943
4. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers, 2007

**REFERENCES:**

1. Veerarajan.T., "Engineering Mathematics" (5<sup>th</sup> edition), Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011
3. Kreyszig,E., "Advanced Engineering Mathematics", 10<sup>th</sup> edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2001.
4. Kapur, J.N., "Mathematical Models in biology and medicine", New Age International Pvt. Ltd., Newyork 2008.

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:**understand the matrix techniques and compute Eigenvalues and Eigenvectors of a given matrix.

**CO2:**differentiate more than one variable and integrate multiple integrals

**CO3:**solve differential equations with constant and variable coefficients

**CO4:**find numerical Solution of transcendental and algebraic equations.

**CO5:** formulate mathematical models for biological problems and solve them

**Board of Studies (BoS):**

12<sup>th</sup> BOS of Mathematics and AS  
department held 23.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

Learning of various mathematical tools like Matrices, Calculus and Numerical methods will lead to knowledge of applications in biological fields

<b>GED 1101</b>	<b>ENGINEERING GRAPHICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To introduce the basic concepts of engineering drawing, and familiarize with conic sections, special curves and orthographic projection of points and straight lines

**COB2:** To get practical exposure on projection of planes and solids

**COB3:** To be familiar with sectioning of solids, and development of surfaces

**COB4:** To conversant with 3D isometric projection, and perspective projection of simple solids

**COB5:** To introduce computerized drafting using CADD for drawing the orthographic views of simple solids

<b>MODULE I</b>	<b>BASICS, ENGINEERING CURVES AND</b>	<b>L:7</b>
	<b>ORTHOGRAPHIC PROJECTION OF POINTS AND</b>	<b>P:7</b>
	<b>STRAIGHT LINES</b>	

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola. Special curves: cycloid, epicycloid, hypocycloid, and involutes.

Orthographic projection – first angle, second angle, third angle and fourth angle projections. Orthographic projection of points in all quadrants.

Projection of straight lines in first quadrant – true length and true inclinations – traces of straight line.

<b>MODULE II</b>	<b>PROJECTION OF PLANES AND SOLIDS</b>	<b>L:7</b>
		<b>P:7</b>

Projection of plane lamina in first quadrant and its traces

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

<b>MODULE III</b>	<b>SECTION OF SOLIDS AND DEVELOPMENT OF</b>	<b>L:5</b>
	<b>SURFACES</b>	<b>P:5</b>

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

Development of surface of truncated solids: prism, pyramid, cone and cylinder

– frustum of cone, pyramid and simple sheet metal parts.

**MODULE IV THREE DIMENSIONAL PROJECTIONS L:4  
P:4**

Isometric projection: Isometric scale – isometric axes- Isometric projection and view of prism, pyramid, cylinder, cone and frustums.

Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid by Visual ray method.

**MODULE V ORTHOGRAPHIC PROJECTION USING CADD L:7  
P:7**

Introduction to CADD - Basic commands for sketching - Editing sketches - creating texts and tables - Basic dimensioning and editing dimensions - Sketching orthographic views of simple solids and machine parts as per first angle projection - Plotting drawings.

**L – 30; P – 30; Total Hours – 60**

**TEXT BOOKS:**

1. N.D. Bhatt, “Engineering Drawing”, Charotar Publishing house, 53<sup>rd</sup> Edition, 2014.
2. Venugopal. K, and V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Ltd., Publication, Chennai, Edition 15, 2017.

**REFERENCES:**

1. K.V. Natarajan, “A text book of Engineering Graphics”, Dhanalakshmi publishers, Chennai, 31<sup>st</sup> Edition, 2018.
2. Agrawal B. & Agrawal C. M., “Engineering Graphics”, TMH Publication, 2012.
3. Jeyapoovan, T., “Engineering Graphics using AutoCAD”, Vikas Publishing House Pvt. Ltd., New Delhi, 2015.
4. AutoCAD Software Theory and User Manuals
5. Engineering graphics You tube Lecture videos link:  
<https://www.youtube.com/user/BSAUNIV/videos>

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** identify the specifications and standards of technical drawing and draw conic sections, special curves and orthographic projection of points and straight lines

**CO2:** apply the concept of orthographic projection to draw the orthographic views of plane figures and simple solids

**CO3:** draw the sections of solids and development of solid surfaces

**CO4:** apply the concept of isometric and perspective projection to draw the 3-D views of simple solids

**CO5:** draw the orthographic views of simple objects using drafting software

**Board of Studies (BoS):**

18<sup>th</sup>BoS of MECH held on 21.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

The various industrial standards of technical drawing and the application of orthographic projections to draw simple solids helps to innovate a new design for sustainable industrialization

<b>GED 1102</b>	<b>ENGINEERING DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG:9</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the basic concepts of design in engineering

**COB2:** To study the basic design thinking principles in problem solving

**COB3:** To encourage the students to develop a prototype using design concepts

**COB4:** To introduce the role of innovation in engineering

**MODULE I INTRODUCTION TO DESIGN 08**

Introduction to Engineering design – Design thinking – Problem identification - Design of Product, Process, System and Software – Case studies on Product, Process, Systems and Software design.

**MODULE II DESIGN THINKING PROCESS 08**

Empathy – Ideate - Need analysis - Voice of customers - product specification - concept generation - Bench marking - Quality function deployment - Concept evaluation - Case studies

**MODULE III PROTOTYPE DESIGN 07**

Product form and function – High level design – Design detailing - Sketch models – Prototypes - 3D printing - Case studies.

**MODULE IV INNOVATION 07**

Creativity and innovation – Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – Intellectual property rights - case studies on innovative products.

**L – 30; Total Hours – 30**

**TEXT BOOKS:**

1. Clive L. Dym, Patrick Little, and Elizabeth J. Orwin, "Engineering Design: A Project Based Introduction", 4<sup>th</sup> Edition, Wiley, 2014.
2. Eppinger, S. and Ulrich, K., "Product design and development", McGraw-Hill Higher Education, 2015.

**REFERENCES:**

1. Nigel Cross, "Design Thinking", Berg Publishers, 2011.
2. Tom Kelley, "The Art of Innovation", Profile Books Ltd, London, 2016.
3. Tim Brown, "Change by Design", HarperCollins e-books, 2009.
4. Cliff Matthews, "Case Studies in Engineering Design", John Wiley & Sons Pvt. Ltd, New York, 1998.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** explain the basic concepts of design in engineering products / process / Service

**CO2:** analyse the problems and perform design thinking process

**CO3:** correlate the basic principles of design thinking to solve engineering problems and develop prototypes

**CO4:** apply innovative approaches to engineering problems and provide design solutions

**Board of Studies (BoS):**

18<sup>th</sup>BoS of MECH held on 21.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

The holistic understanding of basic knowledge in Engineering design and its process in the development of prototypes results in satisfying industrial challenges.



<b>GED 1103</b>	<b>MANUFACTURING PRACTICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### **COURSE OBJECTIVES:**

**COB1:** To learn the basics of pipe connections used in household and industrial systems

**COB2:** To educate the usage of welding equipment's and machining methods

**COB3:** To impart knowledge on sand mould preparation for simple components

**COB4:** To explore various tools, instruments and methods used in electrical wiring

**COB5:** To impart knowledge on Design, assembly and testing of electronic circuits

### **PRACTICALS**

List of Experiments:

#### **CIVIL ENGINEERING PRACTICE:**

1. Study of plumbing in general household and industrial systems: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
2. Making a small window frame with Lap and Mortise & Tenon Joints by sawing planing and cutting.
3. Introduction to power tools

#### **MECHANICAL ENGINEERING PRACTICE:**

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints using Arc Welding - Gas cutting (Demo)
2. Machining of a component using simple turning and drilling practices.
3. Foundry operations such as sand mold preparation for simple component.
4. Plastic Component Manufacturing (Demo on Injection / Blow moulding)

#### **ELECTRICAL ENGINEERING PRACTICE:**

1. Comparison of incandescent, fluorescent, CFL and LED lamps.
2. Domestic, staircase and go down wiring.
3. Measurement of earth resistance.
4. Study of protection devices (small relay, fuse, MCB, HRC, MCCB,

ECCB).

5. Familiarization of household electrical gadgets (Iron Box, Wet Grinder).
6. Study of inverter fed UPS/Emergency lamp

#### **ELECTRONICS ENGINEERING PRACTICE:**

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

**P –30; Total Hours –30**

#### **TEXT BOOK:**

1. S.Gowri and T.Jeyapoovan, "Engineering Practices Lab Manual – Civil, Mechanical, Electrical, Electronics included", Vikas Publishing, 5<sup>th</sup> Edition, 2019.

#### **REFERENCES:**

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

#### **COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** demonstrate Plumbing requirements of domestic buildings.

**CO2:** use welding equipment's to join the structures and to carry out machining operations

**CO3:** perform the task of making sand mould for simple components

**CO4:** execute simple electrical wiring and comprehend the construction and working of household appliances.

**CO5:** assemble and test simple electronic circuits used in day-to-day life

#### **Board of Studies (BoS):**

18<sup>th</sup>BoS of MECH held on 21.06.2021

#### **Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

The holistic understanding of welding, moulding, machining, wiring, and electronic circuit increases the access of small-scale industrial and other enterprises in developing countries.

<b>GED 1104</b>	<b>PROGRAMMING FOR PROBLEM SOLVING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To explore the hardware and software components of the computer

**COB2:** To learn the structured and procedural programming concepts using C.

**COB3:** To study the constructs of decision making in branching and iteration statements

**COB4:** To learn Functions for effective reusability and readability of the code.

**COB5:** To understand pointer and file operation concepts.

**MODULE I INTRODUCTION TO C PROGRAMMING 05**

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, system software, compilers, creating, compiling and executing a program, Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming - Structure of C - C Tokens – Data Types – Declaration of Variables and Storage class – Operators – Expressions - Type Conversion.

**MODULE II DECISION MAKING AND ARRAY 05**

Decision Making and Branching: Simple if Statements, The if..else statements, Nesting of if..else statements, else...if Ladder, switch Statements, goto Statements, Looping: while, do...while, for Statements, Array: One-Dimensional, Two-Dimensional and Multi-Dimensional operations.

**MODULE III USER-DEFINED FUNCTIONS AND FILE OPERATIONS 05**

Definition of Functions - Function Types – Nesting of Functions – Recursion – Structures and Unions – Pointers - File handling operations.

**L – 15; P – 30; Total Hours – 45**

**PRACTICALS****LIST OF PROGRAMS IN C:**

1. Computer organization –Hardware in a typical computer Identification – Booting error messages and what it means
2. Structure of a basic program - Hello world program
3. Data types and Type conversions
4. Input / Output: Formatted functions – Unformatted functions – Library functions

5. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
6. Conditional Statements: If – if else- nested if else- goto- switch case – nested switch case
7. Iteration Statements: for loops – nested for loops – while loop – do-while loop – break and continue statement
8. I/O operations of one- and two-dimensional arrays
9. Bubble Sort and Linear Search using arrays.
10. Functions and its types, Recursion Function
11. Pointers File Operations

**TEXT BOOKS:**

1. Richard L. Stegman, “Focus on Fundamentals of Programming with C”, Ninth Edition, ISBN -170077395X, 9781700773951, 2019.
2. E. Balagurusamy, “Programming in ANSI C”, McGraw Hill Education, Eighth Edition, ISBN-13: 978-93-5316-513-0, ISBN-10: 93-5316-513-X, 2019.

**REFERENCES:**

1. Brian W. Kernighan and Dennis M. Ritchie, “ The C Programming Language”, Prentice Hall, ISBN 0-13-110362-8, 2015.
2. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012.
3. Paul J. Deitel, Deitel& Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** identify the hardware components and describe the software components of computer.

**CO2:** bring out the importance of structural and procedural programming

**CO3:** write C coding using conditional and iteration statements

**CO4:** develop programs using Functions, Pointers and Files

**CO5:** implement program to build a real time application.

**Board of Studies (BoS):**

18<sup>th</sup>BoS of CSE held on  
26.07.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	M	L	H	-	L	-	-	M	-	-	-	-	-
CO2	H	M	M	-	-	H	M	-	M	-	-	-	-	-
CO3	H	M	H	-	-	H	-	-	H	-	-	-	-	-
CO4	H	H	H	H	M	H	-	-	H	-	-	-	-	-
CO5	H	H	H	H	H	H	H	H	H	L	H	H	-	-

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

Statement: The students can have productive employment and decent work by learning this computer fundamentals and programming course.

**SEMESTER II**

<b>END 1281</b>	<b>ENGLISH FOR ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To train students to use appropriate vocabulary in academic and technical contexts

**COB2:** To facilitate students to speak effectively while exchanging ideas and making presentations

**COB3:** To develop students' listening skill for comprehending and analysing information

**COB4:** To develop their reading skill through sub skills like skimming, scanning and critical reading of a text

**COB5:** To sharpen their academic writing skills

**COB6:** To expose them to the correct usage of language and help them to apply that knowledge appropriately

**MODULE I HUMAN RESOURCES 10**

L: Listening to short texts – short formal & informal conversations.

S: Introducing one self – exchanging personal info.

R: Process of reading purposes, Reading comprehension, improving comprehension skills, Reading activities – short comprehension passages, practice in skimming & scanning.

W: Scientific & Technical Writing, Editing skills, Activities – completing sentences, developing hints - Paragraph Writing

Voc. development: Prefixes, Suffixes

Lang. development: Articles, Countable and Uncountable nouns, Present tense, Wh– Questions, Yes or No questions.

**MODULE II TRANSPORT 10**

L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

R: Comprehension passages with multiple choice questions / Wh–questions/ openended questions - Reading longer technical texts & completing exercises based on them.

W: Use of reference words & discourse markers on a text, jumbled sentences, describing a process – flow chart, use of sequence words.

Voc. development: Guessing meanings of words in context, vocabulary used in formal letters, e-mails & reports.

Lang. development: Preposition of Time, Place & Date, Past tense, Conjunctions, Impersonal passive voice, Question tags, Numerical Adjectives.

**MODULE III ENERGY 9**

L: Listening to talk on the topic & completing tasks.

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

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

Voc. development: Sequence words, misspelt words.

Lang. development: Adverbs, Degrees of comparison, Future tense, Homophones

**MODULE IV OUR LIVING ENVIRONMENT 8**

L: Listening to scientific texts & making notes – Effective ways of making notes.

S: Speaking about one's friend.

R: Reading texts & magazines for detailed comprehension. (Students can be asked to read any book of their choice to encourage reading habit)

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

**MODULE V TECHNOLOGY 8**

L: Listening to talks (General & Scientific).

S: Short group conversations.

R: Reading and understanding technical articles, Short narratives & articles from Newspaper including conversations.

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

**L - 45; Total Hours- 45**

**TEXT BOOKS:**

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP,



2015.

**REFERENCES:**

1. Perry, Carol Rosenblum(2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan G. andPrakash, C.L.N. (2007). A course in Communication Skills, Cambridge Univesity Press, India.
3. Sen, Leena(2004). Communication Skills, Prentice Hall, New Delhi.
4. Matt Firth, Chris Sowton et.al (2012). Academic English An Integrated Skills Course for EAP, Cambridge University Press, Cambridge.
5. Bailey,Stephen2011. Academic Writing: A practical guide for students, New York, Rutledge.
6. Redston, Chris&Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book&Workbook) Cambridge University Press, New Delhi.
7. Dutt P. Kiranmai and RajeevanGeeta (2013). Basic Communication Skills, Foundation Books.

**COURSE OUTCOMES:****CO1:**Read articles of a general kind in magazines and newspapers**CO2:**Participate effectively in conversations, introduce themselves and their friends and express opinions in English**CO3:**Comprehend conversations and short talks delivered in English**CO4:**Write short essays of a general kind and letters and emails in English**CO5:**Express through speaking and writing using appropriate vocabulary and grammar**Board of Studies (BoS):**13<sup>th</sup>BoS of Department of English held on 17.6.2021**Academic Council:**17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	-	-	-	-	-	-	H	-	-
CO3	-	-	-	-	-	-	-	-	-	M	-	-
CO4	-	-	-	-	-	-	-	-	-	H	-	-
CO5	-	-	-	-	-	-	-	-	-	M	-	-

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 4: Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship.

<b>BTD 1201</b>	<b>BASICS OF GENETICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3</b>		3	0	0	3

**COURSE OBJECTIVES:**

**COB1:** Introduction to the subject and few fundamental works on genetics

**COB2:** Interactions and structural organization of genes and chromosome

**COB3:** Significance of mutation and repetitive sequences

**COB4:** Genetic linkage analysis, sex determination and mapping techniques

**COB5:** Population genetics and evolutionary genetics

**MODULE I INTRODUCTION TO GENETICS 9**

Historical developments in the field of genetics; various organisms suitable for genetic experimentation and their genetic significance; Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid crosses, Law of segregation & Principle of independent assortment; test cross and back cross, chromosomal theory of inheritance.

**MODULE II ALLELIC INTERACTIONS 9**

Concept of dominance, recessive, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

**MODULE III CHROMOSOME AND GENOMIC ORGANIZATION 9**

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. Packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

**MODULE IV SEX DETERMINATION AND SEX LINKAGE 9**

Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance. Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing-over Genetic



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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

### SDG 3: Good Health and Well Being

Statement: Understanding of the fundamentals of Genetics of different live organisms can help in maintain systems to promote good health and well being.

<b>BTD 1202</b>	<b>CELL AND MOLECULAR BIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge about different cell structures

**COB2:** To understand the concept of fertilization and embryogenesis

**COB3:** To understand the concept of organogenesis and morphogenesis

**COB4:** To study fertilization process in detail

**COB5:** To understand the different process using different model organisms

**MODULE I MICROSCOPY 09**

Visualizing cells and tissues; Integrating cells into tissues (animals and plants); Structure of cell and cell organelles, Details of the cell cycle, cell division and regulation; Cell-Cell junctions; Mitosis and Meiosis.

**MODULE II GAMETOGENESIS-I 09**

fertilization and embryogenesis, morphogen gradients, differentiation, asymmetric cell division, cell fate and lineage determination; Developmental embryonic stages, zygotic division, incomplete division and consequences; Ecto, meso and endodermal development, neural plate and tube formation; Early asymmetric division and generation of symmetry in developing embryo in animals and plants.

**MODULE III GAMETOGENESIS-II 09**

organogenesis and morphogenesis, metamorphosis, animal life cycle, sex determination and role of apoptosis in organ development; Role of morphogens and their gradient in axis patterning and determination. Concept of anteroposterior, dorso-ventral, and medio-lateral axis formation. Stem cells, pluripotency, and iPS cells.

**MODULE IV FERTILIZATION 09**

Introduction to plant fertilization, ovule and egg, and support cells; Root and shoot development, seed formation (monocot/dicot) and germination; flowering and nonflowering plants; Cellular differentiation and senescence; Meristematic tissue, development of root and leaf and floral tissues.

**MODULE V MODEL ORGANISMS 09**

Model organisms like *Drosophila melanogaster*, *C. elegans*, *G. gallus*, *Xenopus*, *Arabidopsis*, etc.

**PRACTICALS 30**

1. Understanding components of different kinds of microscopes.
2. Visualization of mitochondria, plastids, and other intracellular structures.
3. Study of the life cycle of *Drosophila melanogaster*.
4. Study of different stages of chick embryos.
5. In situ hybridization of *Drosophila* embryos to study the cellularization process.
6. Observation of developmental mutants in *Drosophila* and *C. elegans*
7. Study of mitosis in onion root tips
8. Totipotency: Analysis of Growth and Subculture

**L – 45; P – 30; Total Hours – 75**

**TEXT BOOKS:**

1. Molecular Biology of the Cell: Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walte; 6th edition New York: Garland Science; 2008.
2. Cell and Molecular Biology-Concepts and Experiments; Gerald Karp et al. John Wiley; 8th edition; 2015.
3. Plant Development: The Cellular Basis (1990 edition) by R. F. Lyndon (Publisher Springer)
4. Topics in Plant Physiology 3. Series editors M. Black and J. Chapman; Unwin Hyman Ltd, 1990.
5. Plant growth and Development: a molecular approach: DE. Fosket; Academic Press 1994.
6. Developmental Biology (12th Edition) by Michael J.F. Barresi and Scott F. Gilbert (Publisher- Sinauer Associates Inc; 2019)

**COURSE OUTCOMES:**

**CO1:** Define components of a cell

**CO2:** Understand cellular structure and functions

**CO3:** Understand the mechanisms of Cell cycle control and cell division

**CO4:** Understand the concept of fertilization in plants and relate with cell biology

**CO5:** Acquire the concept of model organisms and usage in experiments

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3: Good Health and Well Being

Statement: Understanding of the fundamentals of cell biology live organisms can help in maintain systems to promote good health and well being.



<b>BTD 1203</b>	<b>MICROBIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** Describe how microorganisms are used as model systems to study basic biology, genetics, metabolism, and ecology.

**COB2:** Identify ways microorganisms play an integral role in disease, and microbial and immunological methodologies are used in disease treatment and prevention.

**COB3:** To provide an introduction to the science of microbiology, particularly medical microbiology, to the student with both limited background in the biological sciences and limited interest in pursuing this field further.

**COB4:** To provide concepts of microbial metabolism, growth and control of microbes.

**COB5:** Describe the opportunity available in applied & industrial microbiology through the different application.

**MODULE I                      MICROBES AND FUNCTIONAL ANATOMY                      09**

Types of microorganisms. Brief history of microbiology. Microbes & human warfare. Microbes & human disease, Classification of microorganism and methods of classifying and identification of microorganism. Size, shape, and arrangement of bacterial cells. Structures external to cell wall, structures internal to cell wall.

**MODULE II                      OBSERVING MICROORGANISMS THROUGH A                      09**  
**MICROSCOPE**

Types of Microscopies -Light Microscopy, Two-Photon Microscopy, Scanning Acoustic Microscopy, Electron Microscopy, Confocal Microscopy, Scanned-Probe Microscopy; Preparation of Specimens for Light Microscopy- Preparing Smears for Staining, Simple Stains, Differential Stains, Special Stains.

**MODULE III                      VIRUSES, VIROIDS AND PRIONS                      09**

General Characteristics of Viruses -Host Range, Viral Size; Viral Structure - Nucleic Acid, Capsid and Envelope, General Morphology, Isolation, Cultivation, and Identification of Viruses - Growing Bacteriophages in the Laboratory, Growing Animal Viruses in the Laboratory, Viral Identification; Viral Multiplication- Multiplication of Bacteriophages, Multiplication of Animal Viruses; Prions- Plant Viruses and Viroid.



4. General Microbiology: Stainier, Adelberg and Ingraham, 4<sup>th</sup> Edition, 1979
5. Laboratory Exercises in Microbiology, Fifth Edition by Harley–Prescott, The McGraw–Hill Companies, 2002
6. Lab manual

#### **COURSE OUTCOMES:**

**CO1:** Demonstrate a broad understanding of the diversity and range of microorganisms, the interactions between humans and microorganisms, the role of microorganisms in industrial and environmental processes, and their role in the development of the techniques that underpin modern molecular biology

**CO2:** Demonstrate proficiency in a set of core microbiological and molecular biological technical methods, including both an understanding of the principles of the methods and their utilization in laboratory settings

**CO3:** Demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment

**CO4:** Collect, organize, analyze, evaluate and interpret experimental data using appropriate quantitative, technological and critical thinking skills

**CO5:** Critically evaluate relevant scientific data and literature and comprehend the nature and scope of the scientific literature in microbiology and related areas

#### **Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### **Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3: Good Health and Well Being

Statement: Understanding of the fundamentals of Microbiology live organisms can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: Microbiology course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTD 1204</b>	<b>YOGA AND ALTERNATIVE MEDICINE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 16</b>		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:**To make the students understand the importance of sound health and fitness principles as they relate to better health.

**COB2:**To expose the students to a variety of yogic activities aimed at stimulating their continued inquiry about Yoga, health and fitness.

**COB3:**To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize mental pressure.

**COB4:**To develop among students an appreciation of yoga activity as a lifetime pursuit and a means to better health.

**COB5:**To make the students understand the importance of sound health and fitness principles as they relate to better health.

**PRACTICALS**

1. Introduction to Meaning & Importance of Yoga, of Elements of Yoga
2. Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
3. Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
4. Relaxation Techniques for improving concentration - Yog-nidra
5. Asanas as preventive measures.
6. Hypertension: Tadasana, Vajrasana, Pawanuktasana, ArdhaChakrasana, Bhujangasana, Shavasana.
7. Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, ArdhMatsyendrasana.
8. Back Pain: Tadasana, ArdhMatsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
9. Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pawanuktasana, ArdhMatsyendrasana.
10. Asthma: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

**P – 30; Total Hours –30****TEXT BOOKS:**

Light on Yoga by B.K.S. Iyengar.Thorsons; 2/18/06 edition

**COURSE OUTCOMES:**

On successful completion of the course the students will be able to:

**CO1:**Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.**CO2:**Learn breathing exercises and healthy fitness activities**CO3:**Understand basic skills associated with yoga including strength and flexibility, balance and coordination.**CO4:**Perform yoga movements in various combination and forms, Identify opportunities for participation in yoga activities.**CO5:**Improve personal fitness through participation in yogic activities and assess yoga activities in terms of fitness value.**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	-	-	-	-	-	H	L	-	-	-	-	-
CO2	-	-	-	-	-	H	L	-	-	-	-	-
CO3	-	-	-	-	-	H	L	-	-	-	-	-
CO4	-	-	-	-	-	H	L	-	-	-	-	-
CO5	-	-	-	-	-	H	L	-	-	-	-	-

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation**SDG 3: Good Health and Well Being**

Statement: Understanding of the fundamentals of cell biology live organisms can help in maintain systems to promote good health and well being.

**SDG16: Peace, Justice and Strong Institutions**

Statement: This course provides information for maintenance peace in self, body, surrounding, society and environment.

<b>GED 1203</b>	<b>BASIC ELECTRICAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**SDG: 3, 5,  
8, 11, 12**

**COURSE OBJECTIVES:**

**COB1:**To make the students understand the basic calculations and measurements in DC circuits.

**COB2:**To provide the basic knowledge on AC circuit calculations and measurements.

**COB3:**To familiarize with working and characteristics of different DC machines.

**COB4:**To impart knowledge on the fundamentals of transformer and AC rotating machines.

**COB5:**To acquaint the students with different methods of electric power generation.

**MODULE I DC CIRCUITS & MEASUREMENTS 12**

The concept of voltage and current-Electric circuit elements: R, L, C –Independent and dependent sources - Ohm’s law- Kirchhoff’s law- series and parallel resistive circuits – Voltage and current division – Star-delta transformation - Mesh and nodal analysis of resistive circuits – simple problems - Measurement of voltage, current and power in DC circuits.

**MODULE II AC CIRCUITS & MEASUREMENTS 18**

Sinusoidal voltage - RMS, average, peak value, peak factor and form factor - single phase RL, RC and RLC circuits –phasor representation - complex power – power factor - simple problems - Resonance in RLC circuits – 3 phase balanced circuit calculations– star and delta connections - Principles of measurement of AC voltage, current, power and energy - Measurement of three phase power – Protection of AC circuits: Fuse and Miniature Circuit Breaker(MCB)

**MODULE III ELECTROMAGNETISM & DC MACHINES 16**

Construction, principle of operation, basic equations, characteristics and applications of DC generators, DC motors, single phase transformers and three phase induction motors. Working principle of BLDC Motor and its applications in home appliances. (Qualitative treatment only).

**MODULE IV AC MACHINES 16**

Transformers: Principle of operation and construction of single-phase transformers (core and shell types) - EMF equation, efficiency and voltage

regulation.

Synchronous Generators: Principle of operation; Types and constructional features - EMF equation.

Three Phase Induction Motors: Concept of rotating magnetic field - Principle of operation, types and constructional features - Slip and its significance - Applications of squirrel cage and slip ring motors - Necessity of a starter - star-delta starter. (Qualitative treatment only)

**Practical:** Load Characteristics of single-phase transformer and three-phase induction motor.

## **MODULE V ELECTRICAL POWER SOURCES**

**13**

Introduction to Wind, Solar, Fuel cell, Tidal, Geo-thermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation.

### **PRACTICALS**

List of Experiments

1. Verification of KCL and KVL (ii) Measurement of voltage, current and power in DC circuits.
2. (i) Resonance of RLC series circuit  
(ii) Measurement of voltage, current, power and power factor in single phase & three phase AC circuits.
3. (i) Magnetization characteristics of DC generator  
(ii) Load Characteristics of DC shunt motor,
4. Load characteristics of single-phase transformer and three-phase induction motor.
5. Site visit to any thermal / hydro / wind / solar power generating station.

**L – 45 ; P – 30 ; TOTAL HOURS – 75**

### **REFERENCES:**

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

8. SahdevRitu, "Basic Electrical Engineering", Khanna Book Publishing Co., 2018.

### COURSE OUTCOMES:

At the end of this course, the student will be able to:

- CO1:** Perform the basic calculations in DC circuits and measure the various quantities associated with DC circuits.
- CO2:** Measure and compute the rms current and voltage, power, power factor and energy in AC circuits.
- CO3:** Choose appropriate DC motor for specific applications based on the motor characteristics.
- CO4:** Interpret the specifications of different AC machines used in industries.
- CO5:** Explain the methods by which electrical energy can be generated.

### Board of Studies (BoS) :

15th meeting of BoS of EEE held on  
25.06.2021

### Academic Council:

15<sup>th</sup> AC held on 14.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		H	L	M		M		L	L	M	L			
CO2	H		H	L	M		M		L	L	M	L			
CO3	H		H	L			M		L	L	M	L			
CO4	H		H	L			M		L	L	M	L			
CO5	H		H	L			M		L	L	M	L			

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3: Good health and well being.

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

SDG 5: Gender equality

Statement: Acquiring the interdisciplinary knowledge help overcome the gender barriers in workplace.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.



SDG 11: Sustainable cities and communities

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

SDG 12: Responsible consumption and production.

Statement: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production.

<b>GED 1206</b>	<b>ENVIRONMENTAL SCIENCES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: All</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

To make the student conversant with the

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

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

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

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

**MODULE I NATURAL RESOURCES 8**

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems - (a) Land resources: Land degradation soil erosion and desertification - (b) Forest resources: Use and over-exploitation, deforestation (c) Water resources: Use and over-utilisation of surface and ground water, conflicts over water, dams: benefits and problems, effects on forest and tribal people - (d) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, mining (e) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture (f) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources.

**MODULE II ECOSYSTEMS AND BIODIVERSITY 8**

Concept of an ecosystem - Food chains, food webs, Energy flow in the ecosystem - ecological pyramids - Ecological succession - Characteristic features, structure and function of (a) Terrestrial Ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem (b) Aquatic fresh water ecosystems: Ponds and lakes, rivers and streams (c) Aquatic salt water ecosystems: oceans and estuaries

Biodiversity and its conservation - Types: genetic, species and ecosystem diversity - Values of biodiversity - India as a mega-diversity nation - Invasive, endangered, endemic and extinct species - Hot spots of biodiversity and Red Data book - Threats to biodiversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**MODULE III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8**

Sources, cause, 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 pollution (h) ill-effects of fireworks and upkeep of clean environment, types of fire and fire extinguishers- Solid waste Management: types, collection, processing and disposal of urban waste, industrial waste, e-waste and biomedical wastes - Disaster management: flood, drought, cyclone, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

**MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6**

Human Population - Population growth, Population explosion, population pyramid among nations - Family Welfare Programme - Human Rights - Value Education - Environment and human health: air-borne, water borne, infectious diseases, contagious diseases and immunisation (all types of vaccines from birth), risks due to chemicals in food and water, endocrine disrupting chemicals, cancer and environment - Sustainable development - Resettlement and rehabilitation of people - Environment Legislative laws- Women and Child Welfare, Public awareness.

**Case studies related to current situation.**

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. ErachBharucha, "Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education for University Grants Commission", Orient Blackswan Pvt. Ltd., Hyderabad, India, 2013.
2. Benny Joseph, "Environmental Studies", Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, "Environmental Science and Engineering", Sri Krishna Publications, Tamil Nadu, India, 2018.
4. Raman Sivakumar, "Introduction to Environmental Science and Engineering", McGraw Hill Education, India, 2009.
5. Venugopala Rao P, "Principles of Environmental Science and Engineering", Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., "Environmental Science and Engineering", New Age International Pvt. Ltd., New Delhi, India, 2009.

**REFERENCES:**

1. Masters G.M., "Introduction to Environmental Engineering and Science", Prentice Hall, New Delhi, 1997.

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

#### COURSE OUTCOMES:

The student will be able to

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

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

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

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

**Board of Studies (BoS) :**

11<sup>th</sup> BoS of Chem held on  
17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	-	L	M	-	-	L	M	-	-	-	-	-	-	-	-
CO2	-	-	-	M	H	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	M	-	-	L	-	-	-	-
CO4	-	-	-	-	-	M	M	M	-	-	-	L	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG All: No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable & Clean Energy, Decent Work and Economic Growth, Industry, Innovation & Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships for the Goals.

Statement: This course discuss about the environment, all the natural resources available, sharing of resources, effective utilisation, effects of over utilisation, health and environmental issues pertained to that, global warming and related issues, climates, disasters, impact assessments, population, human rights, societal welfare, laws to conserve the environment and sustainability.

**SEMESTER III**

<b>BTD 2101</b>	<b>BIOPHYSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Students will learn the detailed structure of biomolecules.

**COB2:** They will understand the importance of structures in the field of biotechnology.

**COB3:** They will learn some techniques which help to elucidate the structures.

**COB4:** They will be able to design strategies for treatment of various diseases.

**COB5:** They will learn to correlate the structure and function of macromolecules

**MODULE I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 9**

Interaction of Biomolecules – Covalent and Ionic bond, co-ordinate-covalent bond, non-covalent bond, hydrophobic interaction, hydrogen bonds, water structure, examples of bonds present in biomolecules, stereochemistry, chirality and isomerism.

**MODULE II CONFORMATION OF NUCLEIC ACIDS 9**

Primary structure –Bases, sugars, phosphodiester bonds – Double helical structure, A, B and Z forms of DNA, properties of circular DNA – Topology – Polymorphism and flexibility of DNA, Structure of ribonucleic acids, Thermodynamics of DNA denaturation and T<sub>m</sub> values.

**MODULE III CONFORMATION OF PROTEINS 9**

Conformation of the peptide bond – Secondary structures, – Ramachandran's plots, alpha-helices and factors stabilizing the alpha helix, beta turns, random coils, torsion angles, dihedral angles, hydration of proteins, Tertiary structure-types of interaction present in tertiary structure, hydropathy plots.

**MODULE IV STRUCTURE DETERMINATION OF MACROMOLECULES 9**

Ultraviolet/Visible Absorption Spectroscopy, Applications of Absorption Spectroscopy, Fluorescence Spectroscopy, Applications of Fluorescence, Spectroscopic Techniques Using Plane-Polarized Light, CD of Biopolymers, Crystallization of biomacromolecules, X-ray diffraction by crystals, structure determination by NMR

**MODULE V MEMBRANE BIOLOGY 9**

Phospholipids-major class of membrane lipids, lipid bilayer-noncovalent and cooperative structures, liposome- its significance, molecular structure of membranes-fluid mosaic model, carbohydrate and proteins molecules associated with membrane, lipid movement in membranes, membrane channels and their motifs, hydrophobicity plots.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. Cantor, C.R. and Schimmel, P.R., Biophysical Chemistry, W.H Freeman and Company, Press, New York, 4th Edition, 1999.
2. Sheehan. D. Physical biochemistry, principles and Applications, Second Edition, 2006
3. Crieghton, T.E, Biophysical Chemistry, 1<sup>st</sup> Edition, 1994

**COURSE OUTCOMES:**

The student will be able to

**CO1:**understand the chemistry of the structures of biomolecules.

**CO2:** have the all-basic information related to the biological structure.

**CO3:**know about the detail structure elucidation by using the basic techniques.

**CO4:**design strategies for combating diseases.

**CO5:**understand structure-function correlation.

**Board of Studies (BoS) :**

11<sup>th</sup> BoS of Chem held on  
17.06.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	-	L	M	-	-	L	M	-	-	-	-	-	-	-	-
CO2	-	-	-	M	H	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	M	-	-	L	-	-	-	-
CO4	-	-	-	-	-	M	M	M	-	-	-	L	-	-	-
CO5	-	-	-	L	-	-	-	-	-	-	-	L	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals of biological macromolecular systems can help in designing systems to promote good health and well being.

SDG15: Life on Earth

Statement: Biophysics course gives knowledge about the interaction of macromolecules that constitute living beings and relation with all the levels of life in the earth.



<b>BTD 2102</b>	<b>BIOCHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG:3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** Provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis

**COB2:** Enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.

**COB3:** Help students to understand concepts related to metabolism

**COB4:** Provide knowledge to the defects related to metabolic disorders

**COB5:** Able to understand biological membranes

**MODULE I AMINO ACIDS, CARBOHYDRATES AND LIPIDS 09**

Structure, Function, Methods of Characterization, Separation Techniques based on the structure and properties of amino acids, Classification, Structure, Function, Separation and Characterization Techniques of mono and polysaccharides and lipids.

**MODULE II NUCLEIC ACIDS AND VITAMINS 09**

Nucleic Acids and Polynucleotides, Classification, Structure, Function, Separation and Characterization Techniques, Clinical Significance. Vitamins: classification, Structure, Function, Separation and Characterization Techniques, Clinical Significance.

**MODULE III METABOLISM OF AMINO ACIDS 09**

Nitrogen metabolism and urea cycle – Biosynthesis of amino acids (Gly, Ser, Cys, Met, Thr, Lys, Ile, Val and Leu) – Regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feedback) from oxaloacetate and pyruvate – Biosynthesis of aromatic amino acids – Metabolic disorders associated with branched chain and aromatic amino acid degradation – Important molecules derived from amino acids (auxins, DOPA, Serotonian, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines).

**MODULE IV METABOLISM – NUCLEIC ACIDS, POLYSACCHARIDES AND LIPIDS 09**

Biosynthesis of nucleotides – *de novo* and salvage pathways for purines and pyrimidines – Regulatory mechanisms – Degradation of nucleic acid by exo and

endo nucleases – Biosynthesis and degradation of starch and glycogen – Biosynthesis and degradation of Lipids –Fatty acid synthesis and oxidative degradation – Triacylglycerol and phospholipid biosynthesis and degradation – Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs.

#### **MODULE V BIOMEMBRANE, TRANSPORT AND ELECTRICAL CONDUCTIVITY 09**

Micelles – Lipid bi-layer structure of membranes – Membrane proteins – Passive – Carrier mediated and active transport – Ion-selective channels – Trans-membrane potential coupled ATP generation – Receptors – Acetylcholine receptor as a ligand gated ion-channel – Neuronal sodium channel as voltage-gated ion channel – Neurotransmitters and their mechanism of action – Action potential – Depolarization and nerve conduction – Ion-channel agonists and antagonists as drugs – Ion channel defects (Cystic Fibrosis)

#### **PRACTICALS 30**

1. Preparation of solutions: 1) percentage solutions, 2) molar solutions, 3) normal solutions
2. pH measurements and preparation of buffers.
3. Determination of Wavelength maximum and concentration of a given solution.
2. Qualitative tests for Carbohydrates.
3. Quantitative estimation of reducing sugars.
4. Estimation of proteins by Lowry's method.
5. Estimation of cholesterol by Zak's method.
6. Estimation of Urea by DAM Method.
7. Determination of saponification number of lipids.
8. Estimation of Amino acids.
9. Separation of amino acids - Thin layer chromatography.
10. Separation of sugars - Paper chromatography
11. Biochemical estimation of DNA /RNA using Spectrophotometer

**L – 45; P – 30 ; TOTAL HOURS – 75**

#### **TEXT BOOKS:**

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY, 9<sup>th</sup> Edition, 2019
2. Biochemistry by Lehninger. McMillan publishers, 7<sup>th</sup> Edition, 2017
3. Biochemistry by Zubey. Wm. C. Brown publishers, 3<sup>rd</sup> Edition, 1993

**COURSE OUTCOMES:**

**CO1:** demonstrate broad knowledge of the biomolecules, machinery and information flow within living cells, and an appreciation of how these underpin all biological processes, in both normal and diseased states

**CO2:** demonstrate knowledge of key facets of modern biochemistry including: proteins and structural biology, bioinformatics, advanced molecular biology, cell organization, signal transduction and its role in diseases such as cancer; and the identification of drug targets

**CO3:** demonstrate proficiency in core biochemical laboratory techniques, understanding both the principles and applications of these methods within the molecular biosciences

**CO4:** demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment

**CO5:** collect, organize, analyze, evaluate and interpret biochemical data using appropriate quantitative, technological and critical thinking skills

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**18<sup>th</sup> AC held on 24.02.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation M - Medium Correlation H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of biochemistry of live organisms can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

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

<b>BTD 2103</b>	<b>FUNDAMENTALS OF CHEMICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>ENGINEERING</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To refresh and strengthen the concept of units used in chemical engineering and conversion from one system of units to another.

**COB2:** To provide insight on the behavior of ideal gas behavior and applications of gas laws

**COB3:** To introduce the concept of material flow in an industry

**COB4:** To emphasize the significance of energy, energy flow and its significance in industries

**COB5:** To highlight the types of fluid and its behavior

**MODULE I BASIC CHEMICAL CALCULATIONS 10**

Units and dimensions, Systems of Unit, Conversion from one unit system to another, basic/fundamental units, multiple units, derived units, Dimensional Homogeneity, Significant figures, concept of mass, volume and concentration, composition of mixtures and solutions- solids, liquids and gases - mass fraction, mole fraction, mass %, mole %, density, specific gravity, ppm, molarity, molarity and normality, flow rate –mass, volumetric and molal, Determination of molecular mass of a mixture, Pressure measurements- atmospheric pressure, absolute pressure, gauge pressure, temperature scale- conversion from one temperature scale to another scale.

**MODULE II BASIC CONCEPTS OF GASES AND GASEOUS MIXTURE 10**

Ideal gas, Ideal gas equation, mixture of ideal gases- partial pressure- Dalton's law, Amagat's law, average molecular weight of gaseous mixtures, real gases, van der Waals equation, compressibility factor, vapour pressure, Vapour liquid equilibria, Humidity, Humidity chart, Psychrometer.

**MODULE III MATERIAL BALANCE 9**

Unit operations and process, Classification and Types of system, Conservation of mass/material, Concept of Degree of freedom, Concept of material balance in different systems, Chemical reactions, Stoichiometry, material balance with chemical reactions, yield, selectivity, percent conversion, specificity, recycle, bypass and purge operations.

**MODULE IV ENERGY BALANCE 8**

Law of conservation of energy, components of energy balance equation- Heat, work, kinetic, potential energy, enthalpy, internal energy, heat capacity, steam tables and its application, concept of heat associated with physical Process - Hess's law, heat associated with chemical reactions, applications of energy balance in bioprocess.

**MODULE V FLUID AND ITS PROPERTIES 8**

Fluids, fluid flow, concept of viscosity, Newtonian and non-Newtonian fluid, Fluid flow in pipes- laminar, transient and turbulent, flow measurement- applications and devices, Transport of fluids- pumps and its types.

**PRACTICALS 30**

1. Iodometric estimation of  $\text{Cu}^{2+}$ .
2. Estimation of mixed alkalies:  $\text{NaOH}$  and  $\text{Na}_2\text{CO}_3$ .
3. Estimation of available chlorine in bleaching powder.
4. Paper chromatography/TLC for separation of amino acid/sugar.
5. Iodometric estimation of vitamin C.
6. Determination of surface tension of a liquid by drop weight method.
7. Estimation of saponification value of oil.
8. Estimation of iodine value of oil
9. Estimation of available oxygen in pyrolusite.
10. Estimation of amino acid by formol titration

**L – 45; P – 30; Total Hours – 75**

**TEXT BOOKS:**

1. Stoichiometry and process calculations by KV Narayanan and B. Lakshmikutty, PHI Learning Pvt Ltd., 5<sup>th</sup> Edition, 2016
2. Basic principles & Calculations in Chemical engineering by David Himmelblau, 6<sup>th</sup> edition, PHI Learning Pvt Ltd, 2012
3. Elementary Principles of Chemical Processes by Richard Felder, 3<sup>rd</sup> Edition, John Wiley & Sons, Inc., 2005

**COURSE OUTCOMES:**

**CO1:** To perform simple calculations using different unit systems, concentration, humidity, pressure and temperature

**CO2:** To differentiate ideal gas and non-ideal gas behavior.

**CO3:** To apply material balance calculations on simple systems

**CO4:** To apply energy balance and can demonstrate the direction of flow of

energy

**CO5:** To identify and categorize the different types of fluid

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of chemical engineering of live organisms can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the chemical reactions in biological systems and their relation with all the levels of life in the earth.

<b>BTD 2104</b>	<b>ANALYTICAL TECHNIQUES</b>	<b>L T P C</b>
<b>SDG: 3, 15</b>		<b>3 0 2 4</b>

**COURSE OBJECTIVES:**

**COB1:** To learn basic techniques in different instruments.

**COB2:** To learn the concept of different techniques

**COB3:** To learn and perform different types of chromatography

**COB4:** To learn the techniques of protein purification

**COB5:** To learn protein folding and unfolding

**MODULE I ELECTROANALYTICAL TECHNIQUES 10**

Principle and applications: conductometric titrations – potentiometric titrations, ion-selective electrodes and pH-metry – coulometry – voltammetry – polarography, amperometric titrations.

**MODULE II CHROMATOGRAPHY 10**

Basic concepts of chromatography – paper chromatography – column chromatography – thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

**MODULE III SPECTROSCOPY 8**

Absorption spectroscopy (principle, instrumentation and applications): Colorimetric analysis – UV-Visible spectroscopy – FTIR spectroscopy – Emission Spectroscopy (principle, instrumentation and applications): fluorescence, phosphorescence and chemiluminescence – Atomic absorption spectroscopy – flame emission spectroscopy.

**MODULE IV THERMAL ANALYSIS 8**

Principle, instrumentation and applications: Thermogravimetric analysis – Differential thermal analysis – Differential scanning calorimetry

**MODULE V MICROSCOPY AND RADIOISOTOPES TECHNIQUES 9**

Simple theory of microscopy, parts of microscope, adjusting a microscope, dark-field microscopy, phase contrast microscopy, fluorescence microscopy, electron microscopy, methods of preparing samples. Study of radioisotopes in biological samples, proportional and GM counter, scintillation counters, autoradiography, radio-immunoassay

**PRACTICALS****30**

1. Preparation of buffers (acetate and PBS buffer).
2. To check the purity of proteins using SDS PAGE.
3. To find out the concentration of unknown protein using absorption techniques.
4. To see the effect of different denaturant in protein by absorption spectroscopy.
5. Purification of proteins using affinity chromatography.
6. Purification of carbohydrates by paper chromatography.
7. Purification of amino acids using thin layer chromatography.

**L – 45; P – 30; Total Hours – 75****TEXT BOOKS:**

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8<sup>th</sup> Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7<sup>th</sup> Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5<sup>th</sup> Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6<sup>th</sup> Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5<sup>th</sup> Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

**REFERENCES:**

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI, Press (G70.212 .G584 2005)
2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California

**COURSE OUTCOMES:****CO1:** Students will be able to learn the handling of instruments.**CO2:** They can learn different techniques to be applied according to the requirement of purification.**CO3:** Have an understanding of protein folding**CO4:** Have knowledge of purifying proteins.



**CO5:** Will become thorough with chromatographic techniques.

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course will help to, purify and isolate biologically important compounds needed to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTD 2105</b>	<b>TECHNICAL SEMINAR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: ALL</b>		<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>

**COURSE OBJECTIVES:****COB1:**Develop habit of reading research articles**COB2:**Learn to gather information from research articles**COB3:**Develop critical thinking capability**COB4:**Will develop ability to design experiments**COB5:**Beneficial to carry out research**PRACTICALS**

List of seminar topics:

- Plant Biotechnology for crop improvement
- Enzyme technology in the beverage industry
- Stem cell technology to cure diseases
- Gene silencing in human embryonic stem cells by RNA interference
- Biocatalyst biosensors
- Cancer treatment using nanotechnology
- Bridging Polymer Science to Biotechnology Application
- Signaling pathways in Stem Cell differentiation
- Disease Detection Using Bio robotics
- Antisense technology for crop improvement.
- Antibody inks replace ELISA in biomedical research
- Cell Banking
- Human genome project
- Bioprocess Economics and Plant Design
- Bio-fluid Mechanics and Heat Transfer
- Computer Application in Bio processes
- Challenge of Biotechnology
- Tuberculosis One in All the Threatening Diseases
- Biotechnology innovation in biological control of plant diseases
- Current scenario of transgenic crops in India
- Health Care Biotech Industry
- Applied genomic research in rice genetic improvement
- Biotechnology in Defence Sector
- Defending Against Biological attack : Importance of Biotechnology in Preparedness
- Biotechnology in India – Current Scene

- Removal of metals from water
- Post-transcriptional gene silencing in plants
- Enhancement of biogas production
- Challenges to the central dogma
- Banding of chromosomes
- Chemiluminescence biosensors
- Primary tissue explanation technique
- Mushrooms role as bio-remediation agent
- Venom proteins drug design: scorpion
- Evolution of human being
- Xenobiotic transformation
- Mushroom Culture: biotechnology topics for assignment

**P – 30 ; TOTAL HOURS – 30**

#### **TEXT BOOKS:**

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8<sup>th</sup> Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7<sup>th</sup> Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5<sup>th</sup> Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6<sup>th</sup> Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5<sup>th</sup> Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

#### **REFERENCES:**

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI, Press (G70.212 .G584 2005)
2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California.

#### **COURSE OUTCOMES:**

**CO1:**The students will be able to summarize research

**CO2:**The students will be able to design their own experiments

**CO3:**The students will be benefitted with project related research

**CO4:**The students will develop critical thinking ability

**CO5:**The students will develop confidence to present their work in scientific

community

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG All: No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable & Clean Energy, Decent Work and Economic Growth, Industry, Innovation & Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships for the Goals.

Statement: This course discusses about the environment, all the natural resources available, sharing of resources, effective utilisation, effects of over utilisation, health and environmental issues pertained to that, global warming and related issues, climates, disasters, impact assessments, population, human rights, societal welfare, laws to conserve the environment and sustainability.

<b>GED 2101</b>	<b>ESSENTIAL SKILLS AND APTITUDE FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 17</b>	<b>ENGINEERS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:**To enable them to make effective business presentations

**COB2:**To train them to participate in group discussions

**COB3:**To enhance the problem-solving skills

**COB4:**To train students in solving analytical problems

**MODULE I ORAL DISCOURSE 07**

Importance of oral communication-verbal and non-verbal communication, Presentation Strategies- one minute presentation (using Audacity/vocaro) - Effective listening skills, listening for specific information

**MODULE II VERBAL COMMUNICATION 08**

Understanding negotiation, persuasion & marketing skills - Listening to short conversations & monologues - Group Discussion techniques - Role plays - Interview techniques

**MODULE III BASIC NUMERACY 08**

Simplification and Approximation – Competitive Examination Shortcut Techniques - Number Systems - Simple and Compound Interest-Progression

**MODULE IV ANALYTICAL COMPETENCY 07**

Blood Relations – Clocks and Calendars – Coding and Decoding – Analytical Reasoning(Linear Arrangement, Circular Arrangement, Cross Variable Relationship and Linear Relationship)– Directions .

**P – 30; Total Hours - 30**

**REFERENCES:**

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
2. Swan, Michael (2005). Practical English Usage, Oxford University Press
3. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi.
4. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
5. R. S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

6. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
7. Khattar Dinesh, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
8. Rajesh Verma, Fast Track Objective Arithmetic Paperback, Arihant Publications (India) Limited , 2018
9. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

### COURSE OUTCOMES:

**CO1:** Make effective business presentations

**CO2:** Speak English intelligibly, fluently and accurately in group discussions

**CO3:** To apply the various problem-solving techniques

**CO4:** Understand and solve aptitude problem

### Board of Studies (BoS):

13<sup>th</sup>BoS of the Department of  
English held on 17.6.2021

### Academic Council:

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Statement: This course ensures capacity building and skills development requisite for implementing global partnership.

**SEMESTER IV**

<b>BTD 2201</b>	<b>PLANT AND ANIMAL BIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3,15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To provide training in the science behind plant biotechnology,

**COB2:** Knowledge of the current scope and limits to its industrial application,

**COB3:** Understanding implications of modern methods of genetic modification for plant industries.

**COB4:** Knowledge of main mechanism of cell, tissues, organs and apparatus functionality and the current methods of animal cell culture and its application in research

**COB5:** Ability to apply the knowledge for basic research

**MODULE I INTRODUCTION TO PLANT TISSUE CULTURE 09**

Introduction, History, Applications of Plant tissue culture, Laboratory facilities and operations, Nutrition medium composition and preparation, Sterilization Techniques and Types of culture.

**MODULE II MICROPROPAGATION, INVITRO PRODUCTION OF HAPLOIDS AND SOMATIC HYBRIDIZATION 09**

Micro propagation techniques- different methods, advantages and disadvantages. Haploid plants -generation, significance, method, advantage disadvantage. Protoplast preparation, isolation, purification, viability and culturing, somatic hybridization- techniques, methods to screen, methods of verification/ characterization. Advantage and disadvantage; Somatic hybridization Applications.

**MODULE III TRANSGENICS FOR CROP IMPROVEMENT AND METABOLITE PRODUCTION 09**

Transgenic plant generation, Agrobacterium infection-Ti and Ri plasmid, plant vectors, methods of gene transfer, selection and screening, transgenics in crop improvement, terminator seed technology, transgenics in molecular farming, Cell suspension culture, secondary metabolite production, selection of high yielding line, Molecular farming.

**MODULE IV INTRODUCTION TO ANIMAL TISSUE CULTURE, MEDIA AND CRYOPRESERVATION OF ANIMAL CELLS 09**

Background, Advantages, Limitations, Application, Culture Environment, Cell

Adhesion, Cell Proliferation, Differentiation. Planning, Construction, Layout, Essential Equipment's, Aseptic Technique, Objectives, Elements, Sterile Handling. Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Serum-Free Media, Disadvantages of Serum, Advantages of Serum Free media, Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell line designations, Routine maintenance. Need of Cryopreservation, Preservation, Cell banks, In Vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involved in IVF

#### **MODULE V TRANSGENIC ANIMALS AND GENE THERAPY 09**

Methodology, Embryonic Stem Cell method, Microinjection method, Retroviral vector method, Applications of transgenic animals'-vivo gene therapy, In vivo gene therapy, Viral gene delivery system, Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vector system, Herpes simplex virus vector system, non-viral gene delivery system, Prodrug activation therapy, Nucleic acid therapeutic agents.

#### **PRACTICALS 30**

1. Introduction to animal cell culture lab
2. Animal cell culture media preparation
3. Subculturing of animal cells
4. Cell counting by hemocytometer
5. Cell viability study (trypan blue)
6. Cell viability study (mtt assay)
7. Plant tissue culture lab introduction
8. Tissue culture media preparation (liquid and solid)
9. Effect of sugar on the growth of root explant
10. Callus culture
11. Establishment of suspension culture

**L – 45; P – 30; Total Hours – 75**

#### **TEXT BOOKS:**

1. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH Animal Cell Culture by John R.W. Masters Oxford University Press, 2002
2. Lab Manual

#### **COURSE OUTCOMES:**

**CO1:** An understanding of the theoretical background knowledge in molecular, biochemical and plant sciences needed for an understanding of plant biotechnology.



**CO2:** A working knowledge of laboratory techniques used in plant biotechnology.

**CO3:** An appreciation of the issues associated with growing and using transgenic plants as food crops.

**CO4:** An understanding of the aims and needs of industrial enterprises using plant biotechnology techniques to develop new products.

**CO5:** Apply biotechnological methods for basic research;

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of plant and animal biotechnology can help in the development of better crops and livestock that can contribute to good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the ways to create better plant, crop varieties and livestock that can contribute all the levels of life in the earth.

<b>BTD 2202</b>	<b>GREEN BIOTECHNOLOGY AND POLLUTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>ABETMENT</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the principles of waste treatment

**COB2:** To understand the principle of biodegradation

**COB3:** To understand the process of biotransformation

**COB4:** To understand the principle of bioremediation

**COB5:** To be able to identify eco-friendly products

**MODULE I BIOLOGICAL WASTE TREATMENT 6**

Principles and design aspects of various waste treatment methods with advanced bioreactor configuration: Solid waste management: landfills, recycling and processing of organic residues, minimal national standards for waste disposal.

**MODULE II BIODEGRADATION OF XENOBIOTIC COMPOUNDS 6**

Xenobiotic compounds–Definition, examples and sources. Biodegradation-Introduction, effect of chemical structure on biodegradation, recalcitrance, co metabolism and biotransformation. Factors affecting biodegradation, microbial degradation of hydrocarbons.

**MODULE III BIOTRANSFORMATIONS AND BIOCATALYSTS 6**

Basic organic reaction mechanism- Common prejudices against enzymes, advantages & disadvantages of biocatalysts, isolated enzymes versus whole cell systems, biocatalytic application, catalytic antibodies; stoichiometry.

**MODULE IV BIOREMEDIATION AND BIORESTORATION 6**

Introduction and types of bioremediations, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, phytoremediation- restoration of coal mines a case study.

bioremediation: reforestation through micropropagation, use of mycorrhizae in reforestation, use of microbes for improving soil fertility, reforestation of soils contaminated with heavy metals.

**MODULE V ECO-FRIENDLY BIOPRODUCTS FROM RENEWABLE SOURCES 6**

Fundamentals of composting process: scientific aspects and prospects of biofuel production: bioethanol, biohydrogen and biodiesel; biofertilizers and biopesticides.

**L – 30; Total Hours – 30****TEXT BOOKS:**

1. Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications
2. Introduction to Wastewater Treatment- R. S. Ramalho, Academic Press.
3. Elements of Water Pollution Control Engineering – O.P. Gupta, Khannabooks.
4. Energy Technology – O.P. Gupta, Khannabooks, 2018.
5. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.
6. Environmental Biotechnology, B.C. Bhattacharya &Ritu Banerjee, Oxford Press,2007.
7. Environmental Biotech, PradiptaKrimar, I.K. International Pvt. Ltd., 2006.
8. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New AgeInternational Publishers, 2004.
9. Biodegradation and Bioremediation 1999 (2nd edition). Martin Alexander, ElsevierScience& Technology.
10. Environmental Biotechnology by Bruce Rittmann and Perry McCarty.

**COURSE OUTCOMES:****CO1:** To understand the principles of waste treatment**CO2:** To understand the principle of biodegradation**CO3:** To understand the process of biotransformation**CO4:** To understand the principle of bioremediation**CO5:** To be able to identify eco-friendly products**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of bioremediation, waste water treatment, biodegradation of xenobiotics will help in good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the ways to create better environment that can contribute all the levels of life in the earth.

<b>BTD 2203</b>	<b>IMMUNOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** An understanding of immunity, history of immunology, cells and organ involved in immune system

**COB2:** An understanding of Antigen-Antibody interaction

**COB3:** An understanding of cytokines and complement system involved in immune system.

**COB4:** An understanding of receptors, MHC class of molecules and regulation of immune response

**COB5:** An understanding of relation between diseases and immune system impairment

**MODULE I INTRODUCTION TO IMMUNE SYSTEM 10**

General concepts of the immune system, Innate and acquired immunity, active and passive immunity, humoral and cell mediated immunity, Inflammation-basic concept, components, functions and properties. Complement System.

**MODULE II CELLS & TISSUES OF IMMUNE SYSTEM 10**

Hematopoiesis, T and B-lymphocytes, antigen presenting cells, Natural killer cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils, Mast Cells, Dendritic Cell, Organs of the Immune System, Bone marrow, Thymus, Lymph node, Spleen, CALT, MALT.

**MODULE III ANTIGEN AND ANTIBODY 9**

Antigens: Different characteristics of antigens (foreignness, molecular size, heterogeneity), epitope, Hapten, immunogen, adjuvants. Antibody: Molecular structure of antibody, Classification, Isotypes, Synthesis assembly and expression of immunoglobulin molecules, Antigen-antibody interaction.

**MODULE IV INTRODUCTION TO ANTIBODY ENGINEERING 8**

Definitions of chimeric and hybrid monoclonal antibodies, Hybridoma technology: - Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application.

**MODULE V IMMUNE SYSTEM IN HEALTH AND DISEASE 8**

Autoimmunity, hypersensitivity, Transplantation immunology: Types of grafts, immunologic basis of graft rejection, properties and types of rejection, immunosuppressive therapy and transplants to immunologically privileged sites, Tumor immunity- tumor antigens (TSTA and TAA), immune response to tumors. Tumor evasion of the immune system. Immunotherapy for tumors. Synthetic vaccines.

**PRACTICALS****30**

1. Blood grouping
2. Immunodiffusion, Immunoelectrophoresis.
3. Antigen-antibody reaction-Haemagglutination, precipitation-Widal and VDRL
4. Affinity chromatography for antibody purification.
5. ELISA-DOT and plate ELISA
6. Western blotting

**L – 45; P – 30; Total Hours – 75****TEXT BOOKS:**

1. Immunology – an Introduction by Tizard, Thomson., 2<sup>nd</sup> Edition, 1988
2. Immunology by J Kuby, WH Freeman, 7<sup>th</sup> Edition, 2011
3. Immunology & Immunotechnology by Ashim K Chakravarty, Oxford University Press, 7<sup>th</sup> Edition 2006.
4. Immundiagnosics by S C Rastogi, New Age International, 1<sup>st</sup> Edition, 1996
5. Rose et al., Manual of Clinical laboratory Immunology, 6th Ed ASM Publications, 2002.
6. Lefkovic and Pernis. Immunological methods. Academic Press, 1978.
7. Hudson L. and Hay F.C. Practical Immunology. Black Well publishers, 1989

**COURSE OUTCOMES:****CO1:** Describe and explain the fundamental principles of modern immunology**CO2:** Understand and apply related immunological techniques in medical laboratory profession**CO3:** Relate and apply medical laboratory science**CO4:** Correlate human diseases with immune response malfunction**CO5:** Identify strategies to prevent diseases**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of immune system of live organisms can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTD 2204</b>	<b>RECOMBINANT DNATECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To establish an understanding of DNA manipulation strategies

**COB2:** To establish an appreciation of the advantages and disadvantages of novel methods for DNA purification, sequencing and mutagenesis

**COB3:** To be aware of ethical issues associated with DNA engineering and cloning

**COB4:** To get knowledge of gene libraries

**COB5:** To get knowledge of modifying genes

**MODULE I TOOLS OF GENETIC ENGINEERING 9**

Cloning vehicles, Restriction enzymes, modifying enzymes, DNA ligase, Polymerase etc, Cloning Vectors: Plasmids, Lambda phage, Phagemids, Cosmids, Artificial chromosomes (BACs, YACs), Shuttle vectors, and virus-based vector

**MODULE II METHODS OF GENE TRANSFER 9**

Transformation, transduction, Particle gun, Electroporation, liposome mediated, microinjection, Agrobacterium mediated gene transfer, Preparation and application of molecular probes: DNA probes, RNA probes, Radioactive labeling, non-radioactive labeling, use of molecular probes, DNA fingerprinting

**MODULE III ANALYSIS AND EXPRESSION OF CLONED GENE IN HOST CELLS 9**

Expression vectors, Restriction enzyme analysis, Southern blotting, Northern blotting, Western blotting, In-situ hybridization. Colony and plaque hybridization, Factors affecting expression of cloned genes, Reporter genes, Fusion proteins

**MODULE IV GENE LIBRARIES 9**

cDNA synthesis, Genomic DNA libraries, Amplification of gene libraries, Identifying the products of cDNA clones, Isolation, Sequencing and synthesis of gene: Different methods of gene isolation, Techniques of DNA sequencing, Artificial DNA synthesis.

**MODULE V MODIFYING GENES 9**

Site-directed mutagenesis, Insertion & Deletion Mutagenesis, Polymerase, Chain reaction (PCR): Basic principles, modifications, applications.

**L – 45; Total Hours – 45**



**TEXT BOOKS:**

1. From genes to clones Introduction to gene technology. Author: Ernst-L Winnacker. Publisher: New Delhi Panima Publishing Corporation, 2003. Edition
2. "Molecular biotechnology: principles and applications of recombinant DNA". APA (6th ed.) Glick, B. R., & Pasternak, J. J. (1998).
3. From Genes to Genomes: Concepts & Applications of DNA Technology by J.W. Dale & M.V. Scharz (2011)
4. Brown, T. A. (2010). Gene cloning and DNA analysis: An introduction. Hoboken: Wiley-Blackwell.

**COURSE OUTCOMES:**

**CO1:** Define recombinant DNA technology and explain how it is used to clone genes

**CO2:** Compare and contrast different types of vectors and describe practical features of vectors and their applications in molecular biology.

**CO3:** Discuss how DNA libraries are created and screened to clone a gene of interest.

**CO4:** Be familiar with RNA interference (RNAi) as a powerful new technique for silencing gene expression

**CO5:** Understand potential scientific and medical consequences of the Human Genome Project, and discuss its ethical, legal, and social issues

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	L	-	L
CO2	H	L	-	L	-	-	L	L	-	L	-	L
CO3	H	L	-	L	-	-	L	L	-	L	-	L
CO4	H	L	-	M	-	-	M	L	-	M	-	L
CO5	H	L	-	H	-	-	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of rDNA technology we can modify the live organisms that can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTD 2205</b>	<b>BIOINFORMATICS AND CHEMINFORMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** an experimental and computational knowledge to embrace a systems biology approach and

**COB2:** experience authentic systems genetics research by designing and conducting independent research projects.

**COB3:** Understanding of alignment tools and techniques

**COB4:** Phylogenetic analysis methods

**COB5:** Predictive models and methods

**MODULE I INTRODUCTION TO BIOINFORMATICS AND RESOURCES - I 9**

History and Scope of Bioinformatics, Central Dogma-biological information, Biological Databases, Primary and Secondary, Nucleotide-Protein Sequence and Structure databases, Data- formats, Accession, Submission, Retrieval, NCBI Data Model, GenBank, PDB

**MODULE II SEQUENCE ALIGNMENT AND DATABASE SEARCHING - II 8**

Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements, Multiple Sequence Alignment: Progressive alignment methods, Motifs and patterns

**MODULE III PHYLOGENETIC ANALYSIS 8**

Elements of phylogenetic models, data analysis: Alignment, substitution model building, tree building and tree evaluation, building methods, searching for trees, rooting trees, Evaluating trees and data, phylogenetic software Some simple practical consideration

**MODULE IV PREDICTIVE METHODS 10**

Gene structure Genome-types, Gene Prediction tools, Genome Browsers, Genome Annotation pipeline Codon Bias Detection, Protein identity based on composition, Propsearch, Physical properties based on sequences, secondary structure features prediction, Tertiary structure, homology modeling, ab initio methods threading

**MODULE V ADVANCED BIOINFORMATICS 10**

Drug Discovery overview, Computational Drug Designing- Structure Based, Protein target identification, Molecular Docking, Scoring, MD Simulations, Ligand Based,

ligand databases, virtual HTS, Molecular Similarity, QSAR, Pharmacophore. Machine Learning-Supervised vs Unsupervised, Genomics, Proteomics Analysis, Data Classification-Bioinformatics Pipelines, R, Python- Basics and Applications

**PRACTICALS****30**

1. Study of internet resources in Bioinformatics
2. Similarity search using BLAST
3. Similarity search using FASTA
4. Algorithm used in bioinformatics
5. Multiple sequence alignment
6. DNA Prediction Methods
7. Protein Prediction Methods
8. Phylogenetic analysis
9. Python basic syntax
10. Python programming

**L – 45; P – 30; TOTAL HOURS – 75****TEXT BOOKS:**

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). John Wiley and Sons, 2002.
2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, Cold Spring Harbor Laboratory Press, 2001.

**COURSE OUTCOMES:**

**CO1:** Familiar with principles used in modelling dynamic phenomena in cells and methods that are used to analyze computational models

**CO2:** Able to understand basic research methods in bioinformatics

**CO3:** Able to understand the data structure (databases) used in bioinformatics and interpret the information (especially: find genes; determine their functions), understand and be aware of current research and problems relating to the area of their research project, to be able to critically evaluate the literature and identify the most important body of work

**CO4:** Aware of the range of technologies available to computer scientists in bioinformatics

**CO5:** Able to carry out data mining gene and protein expression patterns and modelling cellular interactions and processes.

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

### SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of bioinformatics we can carry out data mining gene and protein expression patterns and modelling cellular interactions and processes, that will help in good health and well being.

### SDG15: Life on Earth

Statement: This course makes aware of the range of technologies available to computer scientists in bioinformatics gives knowledge about relation with all the levels of life in the earth.

<b>GED 2201</b>	<b>WORKPLACE SKILLS AND APTITUDE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>FOR ENGINEERS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To expose them to reading for specific purposes, especially in professional contexts

**COB2:** To expose them to the process of different kinds of formal writing

**COB3:** To prepare the students to be successful in their career

**COB4:** To familiarize various problem-solving techniques in aptitude and puzzles.

**MODULE I EXTENSIVE READING & WRITING 07**

Reading for comprehension - inferring and note-making – Process of writing- paragraph development - elements of business writing: Email, memos.

**MODULE II INTENSIVE READING & WRITING 08**

Intensive reading and reviewing - Interpretation of charts, graphs - Résumé - Letter of enquiry, thanksgiving letters.

**MODULE III QUANTITATIVE APTITUDE 08**

Percentage - Ratio and Proportion - Profit and Loss – Averages, Allegations and Mixtures.

**MODULE IV LOGICAL COMPETENCY 07**

Syllogism – Blood Relations- Number, Alpha and Alpha numeric series - Puzzles – Cubes and Dice - Odd One Out-Coding and Decoding

**P – 30; Total Hours- 30**

**REFERENCES:**

1. Sharma, R.C. and Mohan, Krishna (2010). Business Correspondence and Report Writing. 4th edition. Tata McGraw Hill Education Private Limited, New Delhi
2. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

### COURSE OUTCOMES:

**CO1:**Demonstrate reading skills with reference to business related texts

**CO2:**Draft professional documents by using the three stages of writing

**CO3:**Apply various short cut techniques for solving complicated aptitude problems

**CO4:**To understand various problems and patterns of different ways to solve it

### Board of Studies (BoS) :

13<sup>th</sup>BoS of the Department of English  
held on 17.6.2021

### Academic Council:

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PSO2	PS O3
CO1		L		H						H					
CO2			L							H					
CO3			L				M								
CO4		H		M											
CO5															

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

Statement: Demonstrating, Drafting and applying various techniques for sustainable growth to employment.

<b>GED 2202</b>	<b>INDIAN CONSTITUTION AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 16</b>	<b>HUMAN RIGHTS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To explicate the emergence and evolution of Indian Constitution.

**COB2:** To have an insight into the philosophy of fundamental rights and duties, and Directive Principles.

**COB3:** To differentiate the structure of executive, legislature and judiciary.

**COB4:** To understand human rights and its implication - local and international and redressal mechanism.

**MODULE I INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION 8**

Meaning of the constitution law and constitutionalism - Historical Background of the Constituent Assembly - Government of India Act of 1935 and Indian Independence Act of 1947 - The Constituent Assembly of India - Enforcement of the Constitution - Indian Constitution and its Salient Features - The Preamble of the Constitution. Citizenship.

**MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES 7**

Fundamental Rights and its Restriction and limitations in different complex situations - Directive Principles of State Policy (DPSP) & its present relevance in our society with examples- Fundamental Duties and its Scope and significance in nation building - Right to Information Act 2005.

**MODULE III GOVERNANCE IN INDIA 8**

The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions. The Union legislature – The Parliament – The Lok Sabha and the Rajya Sabha, Composition, powers and functions – Government of the State - The Governor – the Council of Ministers and the Chief Minister – Powers and Functions-Elections-Electoral Process and Election Commission of India - Indian judicial system.

**MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION 7**

Human rights – meaning and significance - Covenant on civil and political rights - Covenant on Economic, Social and Cultural rights - UN mechanism



and agencies - The Protection of Human Rights Act, 1993 – watch on human rights and enforcement - Roles of National Human Rights Commission of India - Special Constitutional Provisions for SC & ST, OBC - Special Provision for Women, Children & Backward Classes.

**L – 30; Total Hours–30**

**TEXT BOOKS:**

1. B.K. Sharma, Introduction to the Constitution of India, 6th ed., PHI Learning Private Limited, New Delhi 2011
2. Durga Das Basu “Introduction to the Constitution on India”, (Students Edition.) Prentice –Hall EEE, 19th / 20th Edn. 2008
3. M.P. Jain, Indian Constitutional Law, 7th ed., LexisNexis, Gurgaon. 2014.

**REFERENCES:**

1. Fadia B.L “Indian Government and Politics”, Sahitya Bhavan Publications. 2010
2. Kashyap Subhash C “Our Constitution: An Introduction to India’s Constitution and constitutional Law, NBT. 2017
3. M.V.Pylee “An Introduction to Constitution of India”, Vikas Publishing. 2002
4. Sharma Brij Kishore “Introduction to the Indian Constitution”, 8th Edition, PHI Learning Pvt. Ltd. 2015
5. Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

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

**CO1:** describe the emergence and evolution of Indian Constitution.

**CO2:** realize the status and importance of fundamental rights, fundamental duties and directive principles of state policy and relation among them by understanding the articulation of its basic values under the Constitution of India.

**CO3:** compare the various structure of Indian government.

**CO4:** recognize the human rights, cultural, social and political rights and its relationship with Indian constitution. .

**Board of Studies (BoS) :**

4<sup>th</sup>BoS of SSSH held on 28.06.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L- Low Correlation    M - Medium Correlation    H -High Correlation

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Application of human, legal and political rights leading to empowerment in real-life situations for protection of fundamental freedoms and freedom from violence, abuse, trafficking and exploitation are at the core of human rights.

**SEMESTER V**

<b>BTD 3101</b>	<b>GOOD MANUFACTURING AND LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>PRACTICE</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** to promote the quality of test data;

**COB2:** to avoid duplication of research;

**COB3:** to improve the protection of human health and environment;

**COB4:** to facilitate international acceptance of test data;

**COB5:** to prevent the creation of technical trade barriers.

**MODULE I INTRODUCTION TO GMP 9**

Definition, Importance, General requirements of GM, GMP Categories, Key quality terms, Good documentation practice, GMP and validation for pharmaceuticals, Schedule M (M-1, M2, M3), Schedule T.

**MODULE II QUALITY CONTROL LABORATORY 9**

Responsibilities, Good Laboratory Practices, Routine controls, Instruments, Protocols, Non-clinical testing, Controls on animal house, Application of Computers in Quality control laboratory.

**MODULE III ORGANIZATION AND PERSONNEL, RESPONSIBILITIES, TRAINING, HYGIENE. 9**

Location, Design, Plan Layout, Construction, Maintenance and Sanitations. Environmental control, Sterile areas, control of contamination. Equipments: Selection, purchase specifications, maintenance, sterilization of an area (TP & STP) Raw Materials: Purchase specifications, Maintenance of stores, Selection of vendors, Controls on Raw materials.

**MODULE IV MANUFACTURE OF AND CONTROLS ON DOSAGE FORMS 9**

Manufacturing Documents, Master Formula, Batch Formula Records, Quality audits of manufacturing processes and facilities, Site master file. Standard operating procedures for various operations like cleaning, filling, drying, compression, coating, disinfection, sterilization, and membrane filtration etc.,

**MODULE V FINISHED PRODUCT RELEASE 9**

Quality review, Quality audits, Batch release document. Complaints and Recalls : Evaluation of complaints, Recall procedures, Related records and documents. Waste disposal, Scrap disposal procedure and records. Regulatory aspects of Pharmaceuticals

and Bulk drug Manufacturing, Regulatory drug analysis. WHO Certification, Globalization of Drug Industry, Introduction to Export of Drugs and Import Policy Hours. Patent regime.

**L – 30; T – 15; Total Hours – 45**

**TEXT BOOKS:**

1. Quality Assurance & Quality Management in Pharmaceutical Industry, By Y. Anjaneyulu, R Marrayya (2017)
2. Good Laboratory Practice Regulations, Third Edition, Revised and Expanded (Drugs and the Pharmaceutical Sciences) ; Publisher: CRC Press, 2002.

**REFERENCES:**

1. Documentation Basics That Support Good Manufacturing Practices and Quality System Regulations Paperback – July 1, 2004 By Carol DeSain
2. Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference Paperback – September 17, 2009 by Mindy J. Allport-Settle
3. GMP Fundamentals – A Step-by-Step Guide Maas & Peither Good Quality Practice (GQP) in Pharmaceutical Manufacturing: A Handbook, Jordi Botet.

**COURSE OUTCOMES:**

**CO1:** To enable students to understand the basics of the Good Manufacturing Practices in India.

**CO2:** To enable students to understand the basics of the Good Laboratory Practices in India.

**CO3:** Definition and concept of Quality control, Quality assurance and GLP

**CO4:** Definition and concept of Quality control, Quality assurance and GMP

**CO5:** To achieve rules and regulation of GLP and GMP

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of Microbiology live organisms can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: Microbiology course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTD 3102</b>	<b>BIOPROCESS ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** Understanding the theoretical basis Bioprocess principles and

**COB2:** Knowledge of the integration of biochemistry, microbiology, cell biology and process engineering.

**COB3:** Ability to exploit the potential of microorganisms and cells by technical means.

**COB4:** Understand fluid flow and mixing

**COB5:** Understand heat and mass transfer

**MODULE I INTRODUCTION TO ENGINEERING CALCULATION, PRESENTATIONS AND ANALYSIS OF DATA 9**

Physical variables, dimensions, Modules, errors in data and calculations, testing mathematical models, process flow diagram

**MODULE II MATERIAL & ENERGY BALANCES 8**

Thermodynamics Law of conservation of mass, types of material balance products, electron balances, biomass yield, General Energy balance equations, Enthalpy calculations, Enthalpy changes in non-reactive processes, Types of heat reactions, problems

**MODULE III UNSTEADY STATE MATERIAL AND ENERGY BALANCES 8**

Material balance equation for CSTR, Energy balance equations, solving differential equations, solving mass balances, solving energy balances, problems.

**MODULE IV FLUID FLOW AND MIXING 10**

Classification of fluids, Reynolds number, Momentum transfer, Non – Newtonian fluids, Two-Parameter models, rheological properties of fermentation broths, mixing, power requirements for mixing, scale-up of mixing systems, role of shear in stirred fermentors, problems.

**MODULE V HEAT & MASS TRANSFER 10**

Equipments, mechanism of heat transfer, conduction, heat transfer between fluids, design equation for heat transfer systems, applications of design equations, problems, Mass transfer: Molecular diffusion, role of diffusion in bio-

processing, film theory, convective mass transfer, oxygen uptake and transfer in cell cultures, kLa determination, problems

**PRACTICALS****30**

1. Batch sterilization kinetics.
2. Medium optimization of growth conditions – Physical and Chemical parameters
  - a. Placket burman design.
  - b. Response surface methodology
3. Growth Kinetics study of Bacteria and Yeast (Estimation of biomass, calculation of specific growth rate and yield coefficient).
4. Residence time distribution.
5. Calculation of Oxygen Transfer Coefficient – Dynamic Gassing-out method and Sulphite Oxidation Method.
6. Enzyme Purification by Ammonium Sulfate Precipitation.
7. Enzyme kinetics – Michelis-Menton parameter, effect of temperature and pH and Enzyme inhibition kinetics.
8. Immobilized Enzyme Kinetics in batch reactor – matrix entrapment, ionic and cross linking.
  - a. Bioreactor (Fermentor lab scale)
  - b. Microbial shaker incubator
  - c. Cooling centrifuge
  - d. Refrigerator
  - e. Incubator

**L – 45; P – 30 ; TOTAL HOURS –75****TEXT BOOKS:**

1. Bioprocess Engineering Principles by Pauline M. Doran, Academic Press, 2<sup>nd</sup> Edition, 1995.
2. Bioprocess Engineering - Basic concepts by M. L. Schuler & F. Kargi, Entice Hall. 1<sup>st</sup> Edition, 1992
3. K.R. Aneja, Experiments in Microbiology, Plant Pathology and Biotechnology, 4th Edition, New Age International (P) Ltd. Publisher, New Delhi,2013.
4. Sadasivam S, Manickam A Biochemical method. 3rd Edition, New Age International (P) Ltd. Publisher, New Delhi, 2016.
5. Soylemez, Z. and Fadiloglu, S., 1996. Laboratory Manual on Enzyme Purification and Immobilization. 1996.

**COURSE OUTCOMES:****CO1:** Understand the basic role of engineering in bio-processing applications

**CO2:** Obtain a basic understanding of how cells work and become familiar with the environmental conditions (i.e., nutrients, pH, etc.) required for applications of biological components (cells or enzymes) to bio-processing systems

**CO3:** Understand and model enzyme kinetics and apply the models for analysis of immobilized enzymatic bioreactors.

**CO4:** Understand and model enzyme kinetics and apply the models for analysis of immobilized enzymatic bioreactors.

**CO5:** Become familiar with principles of recovery and purification techniques of bioprocesses

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of bioprocess will help to develop new products to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



<b>BTD 3103</b>	<b>ENZYME TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To learn basics of enzymatic reactions and its characteristics.

**COB2:** To understand the diverse nature of enzyme based on mechanism of catalysis.

**COB3:** To learn the strategies needed to purify enzymes for industrial use

**COB4:** To learn chemical nature of enzyme catalysis

**COB5:** To learn extraction of enzymes and assay

**MODULE I INTRODUCTION TO ENZYMES 9**

The Enzyme- Introduction-- Distinct features of Enzymes, Characteristics of Enzyme Catalysis, Specificity of Enzyme action- The active site - General features and regulation, Hypothesis and Models for Enzyme Substrate action. Enzyme classification and Nomenclature

**MODULE II ENZYME KINETICS 9**

Enzyme kinetics-Michaelis-Menten equation- Brigg's-Haldane steady state hypothesis & estimation of constants using graphical technique, Lineweaver Burk Plot-Kinetics for reversible reactions-basics of enzymatic reaction-collision theory and transition state theory and role of entropy in catalysis- Enzyme inhibition- Competitive, Uncompetitive and Mixed. Effect of pH and temperature on Enzyme action, Bisubstrate reactions

**MODULE III CHEMICAL NATURE OF ENZYME CATALYSIS 9**

Mechanisms of catalysis- Acid base catalysis- Electrostatic catalysis- Covalent catalysis- Proximity and Orientation effects, Enzyme catalysis- Mechanisms of reactions catalyzed by enzymes without cofactors- Metal activated enzymes and metalloenzymes. Mechanism of Reactions catalyzed by Ribonuclease, carbonic anhydrase, Lysozyme, Triose phosphate Isomerase and Lactate dehydrogenase, Involvement of Coenzymes in enzyme catalyzed reactions.

**MODULE IV EXTRACTION OF ENZYMES AND ASSAY 9**

The extraction of soluble enzymes, Membrane bound Enzymes, nature of extraction medium. Purification of Enzymes by analytical techniques, Criteria of Purity, Determination of Molecular Weight of Enzymes. Enzyme assay- Introduction, Enzyme assay by kinetic determination of catalytic activity,

Coupled kinetic assays, Radioimmunoassay (RIA) of enzymes, Investigation of sub-cellular compartmentation of enzyme, and enzyme histochemistry

#### **MODULE V APPLICATIONS OF ENZYMATIC CATALYSIS 9**

Applications in Medicine- Assay of Plasma Enzymes, Enzymes in Inborn errors in metabolism, Application of enzymes in food industry, Forensic Science and others Large-scale production and purification of enzymes, Synthesis of artificial enzymes, Immobilization of enzymes, its preparation, properties and applications.

#### **PRACTICALS 30**

1. Isolation and Screening of amylase producing microorganisms from soil and saliva
2. Construction of Protein standard curve by Folin's Lowry method and Determination of specific activity of enzyme.
3. Effect of substrate concentration on Enzyme kinetics and determination of  $K_m$  and  $V_{max}$
4. Effect of temperature on Enzyme kinetics
5. Effect of time on Enzyme kinetics
6. Effect of pH on Enzyme kinetics

**L – 45; P – 30; Total Hours – 75**

#### **TEXT BOOKS:**

1. Trevor Palmer, Enzymes IInd Horwood Publishing Ltd, 2<sup>nd</sup> Edition, 2008
2. Enzymes by Robert A. Copeland, 2nd edition, 2000\
3. Biocatalysis and Enzyme Technology by Klaus Buchholz, Volker Kasche, and Uwe T. Bornscheuer, 2005

#### **COURSE OUTCOMES:**

**CO1:** Understand the fundamentals of enzyme properties and distinguish based on reaction mechanism

**CO2:** Apply biochemical calculation and plot graphs for enzyme kinetics

**CO3:** Compare methods for production, purification, characterization and immobilization of enzymes

**CO4:** Understand various application of enzymes that can benefit human life

**CO5:** Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

#### **Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### **Academic Council:**

18th AC held on

24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

### SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of enzyme technology can help to improve the production of artificial enzymes that can help in maintaining living systems to promote good health and well being.

### SDG15: Life on Earth

Statement: This course gives knowledge about enzyme catalysis in the living and non living and relation with all the levels of life in the earth.

<b>MAD 3182</b>	<b>BIOSTATISTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG:4</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** make informed decisions based on data

**COB2:** correctly apply a variety of statistical procedures and tests.

**COB3:** know the uses, capabilities and limitations of various statistical procedures.

**COB4:** interpret the results of statistical procedures and tests.

**COB5:** understand sampling techniques

**MODULE I INTRODUCTION TO STATISTICS 12**

Exploratory Data Analysis - Motivation, Population vs Sample," Scientific Method" - Definitions, Examples, Medical Study Designs – Graphical Displays: Dot plots, Stem plots, Pie chart, Histograms - Summary Statistics: Measures of Central tendency.

**MODULE II MEASURES OF DISPERSION 12**

Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Coefficient of Dispersion: coefficient of variation, Moments: Relationship between raw and central moments, Effect of change of Origin and Scale, Pearson beta and gamma coefficients, Skewness: Measures of Skewness, Kurtosis.

**MODULE III CORRELATION AND REGRESSION 12**

Bi-variate data – Correlation and Regression coefficients and their relation, properties - Effect of change of origin and scale on correlation coefficient, Linear regression, Association and Independence of attributes.

**MODULE IV PROBABILITY AND ITS DISTRIBUTIONS 12**

Events - exhaustive, mutually exclusive and equally likely - Baye's theorem (without proof) - Binomial, Poisson, Exponential and Normal distributions - Simple properties of the above distributions (without derivation).

**MODULE V SAMPLING TECHNIQUES 12**

Concept of population and sample, Random sample, Methods of taking a simple random sample, Tests of Significance: Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.); small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, Paired and unpaired t-test for correlation and regression coefficients, t-test for

comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit.

**L – 45; T – 15; TOTAL HOURS –60**

**TEXT BOOKS:**

1. Norman T J Bailey, "Statistical Methods in Biology " (3<sup>rd</sup> Edition), Cambridge University Press 1995
2. Gerald van Belle, L.D.Fisher, P.J.Heagerty, and T.Lumney, "Introduction to Biostatistics" Second Edition, John Wiley & Sons, New Jersey 2004
3. Wong Limsoon, "Essence of biostatistics" , NUS Lecture Notes Series 2003.
4. Gupta.S.C and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons ,New Delhi 2002.
5. Gupta.S.C., "Fundamentals of Applied Statistics", Sultan Chand & Sons, NewDelhi 2014.
6. Ross,S.M., "Probabilty and Statistics for Engineers and Scientists" John Wiley & Sons, New Jersey 2007

**COURSE OUTCOMES:**

**CO1:** represent the data in pictorial form.

**CO2:** make decision based on statistical data.

**CO3:** correlate the real time data.

**CO4:** apply Baye's theorem and probability distributions

**CO5:** interpret the results of hypothesis tests

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

Statement: Learning of various mathematical tools like Matrices, Calculus and Numerical methods will lead to knowledge of applications in biological fields



5. Bill Mascull. 'Business Vocabulary in Use'. Advanced. Cambridge University Press, Cambridge, 2004

**COURSE OUTCOMES:**

**CO1:** Use the LSRW skills effectively in business and general situations

**CO2:** Demonstrate receptive skills effectively in various formal and informal communication situations.

**CO3:** Demonstrate productive skills effectively in various formal and informal communication situations

**CO4:** Use appropriate grammar and vocabulary in any context.

**Board of Studies (BoS) :**

13<sup>th</sup> BoS of the Department of  
English held on 17.6.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

**BTD 3105****INTERNSHIP - I****L T P C****0 0 2 1****SDG: 9, 4****COURSE OBJECTIVES:**

**COB1:** To offer the opportunity for the young students to acquire on job the skills, knowledge, attitudes, and perceptions along with the experience needed to constitute a professional identity

**COB2:** To provide means to immerse students in actual supervised professional experiences.

**COB3:** To give an insight into the working of the real organizations.

**COB4:** To appreciate the linkages among different functions and departments.

**COB5:** To develop perspective about business organizations in their totality.

**GENERAL GUIDELINES:**

- It is one credit for four weeks of internship.
- Internship shall be of not less than two weeks duration and shall be organized by the Dean of the Department.
- Students should choose preferably, government agencies/ Central Government research Institutes/DBT/ICAR/IISER/CSIR/ICMR /IIT's/ NIT's /major industries in their specialization to do their internship
- At the end of industrial internship, the student shall submit a certificate and feedback from the organization. Students should also submit a brief report.
- The evaluation will be made based on this report and a Viva-Voce
- Examination, conducted internally by a Departmental Committee constituted by the Dean of the School of Life Sciences.

**COURSE OUTCOMES:**

**CO 1:** After completion of this semester long course the student trained in his specialized area of operation

**CO 2:** Will be able to critically think, observe and communicate

**CO 3:** Will acquire the work experience through advance learning (in terms of



depth, complexity and engagement) in an industrial environment

**CO 4:** Will be able to apply, extend and test the knowledge gained from class room experience to understand and mitigate complex issues and address real industry challenges

**CO 5:** Will be able to assimilate technical and administrative or managerial skills from his interactions with a variety of individuals, systems and practices

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 4. Quality Education

Statement: This course will help in promoting better Industrial exposure and provide the quality education opportunity

SDG 9: Industry, Innovation, and Infrastructure

Statement: This course will help Industrial exposure for the students and provide an opportunity for Industry, Innovation, and Infrastructure developments.



**MODULE IV BRANDING AND CHANNEL STRATEGY 9**

**Branding and Channel Strategy**– Intro to Branding, draw your Venture's Golden Circle, Define Your Values, Positioning Statements, Selecting Brand Name, Social Media Handle, Logo and Mobile app names for Your Venture, Creating online public profiles, Bulls Eye Framework and other traditional channel types, Identify your Right Channel using Bulls Eye Framework.

**MODULE V LEVERAGING TECHNOLOGIES AND AVAILABLE PLATFORMS & MEASURING PROGRESS 9**

**Leveraging Technologies and Available Platforms** – Leaping Ahead with Technology, Digital Marketing for Your Startup, plan a Social Media Campaign, Digital Collaboration, Store Your Documents Online, Other Platforms, Make Your Tech Plan and Platform Wish List. Measuring Progress – Metrics for Customer Retention and Satisfaction, find your CAC, CLV, and ARPU, Key Financial Metrics, How to Communicate Your Metrics, Find New Revenue Streams based on Your Key Financial Metrics, Re-forecast your Financial Plan to Increase Margin.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. Robert Mellor- Entrepreneurship for Everyone: A Student Textbook, Publisher: SAGE Publications Ltd (2009).

**REFERENCES:**

1. Learn wise platform - Wadhvani Foundation, 2018.
2. All Lessons are delivered as Online videos accessible using Wadhvani Foundation's Learnwise Platform - <https://lms.learnwise.wfglobal.org/>

**COURSE OUTCOMES:**

**CO1:** Achieve sustainable growth by pivoting, refining business models, expand customer segments, and business planning for developing early customer traction into a repeatable business.

**CO2:** Develop strategies to grow revenues and markets.

**CO3:** Develop an A-Team, brand strategy and create digital presence.

**CO4:** Develop brand and channel strategy for customer outreach

**CO5:** Leverage social media to reach new customers cost effectively.

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

#### SDG 8. Decent Work and Economic Growth

Statement: This course will help in promoting better employment opportunities and promote stable, sustained economic growth

<b>BTD 3201</b>	<b>NANOBIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide an introduction to nanobiotechnology

**COB2:** To make the students understand about the functional principles of nanobiotechnology

**COB3:** Knowledge about applications of bionanotechnology

**COB4:** Knowledge about characterization of bionanomaterials

**COB5:** Understanding the role of nanomaterials in toxicity evaluation

**MODULE I FUNDAMENTALS OF NANOSCIENCE 9**

Introduction, the nanoscale dimension and paradigm, definitions and historical evolution (colloids etc.) and current practice, types of nanomaterials and their classifications (1D, 2D and 3D etc. nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc), Polymer, Carbon, Inorganic, Organic and Biomaterials –Structures and characteristics.

**MODULE II CHARACTERIZATIONS IN BIONANOTECHNOLOGY 9**

Optical (UV-Vis/Fluorescence), X-ray diffraction, Imaging and size (Electron microscopy, light scattering, Zeta potential), Surface and composition (ECSA, EDAX, AFM/STM etc), Vibration (FT-IR and RAMAN), SERS -3, Magnetic, Electrical and Electrochemical.

**MODULE III APPLICATIONS OF BIONANOTECHNOLOGY 9**

Materials in Biosystems: Proteins - Lipids - RNA and DNA, Protein Targeting – Small Molecule/Nanomaterial - Protein Interactions Nanomaterial-Cell interactions- Manifestations of Surface Modification (Polyvalency), Drugs-Photodynamic therapy, molecular motors, neuroelecronic interphases, development of nanoluminiscent tags.

**MODULE IV NANOMATERIALS AND DIAGNOSTICS 9**

Drug Delivery and Therapeutics, MRI, Imaging, Surface Modified Nanoparticles, MEMS/NEMS, based on Nanomaterials, Peptide/DNA Coupled Nanoparticles, Lipid Nanoparticles for Drug Delivery, Inorganic Nanoparticles For Drug Delivery, Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral), Anisotropic and Magnetic Particles (Hyperthermia).

**MODULE V NANOMATERIALS AND TOXICITY EVALUATION****9**

Designer biopolymers, Procollagen, DNA Polynode, RNA topoisomerase, Protein – magnetic materials, Cyto-toxicity, Geno-toxicity, In vivo tests/assays.

**L – 45; TOTAL HOURS –45****TEXT BOOKS:**

1. C. M. Niemeyer, C. A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspective, Wiley – VCH, 2004.
2. T. Pradeep, —Nano: The Essentials, McGraw – Hill education, 2007.
3. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures, CRC, 2006.
4. David S Goodsell, “Bio nanotechnology”, John Wiley & Sons, 2004.

**COURSE OUTCOMES:**

**CO1:** the basic knowledge of nanoparticles and the field of bio nanotechnology.

**CO2:** Understanding the techniques used for the characterization of nanoparticles

**CO3:** understanding the application of Nanomaterials in biotechnology and acquire the knowledge about the DNA, proteins, amino acids, drug delivery, biomedicine etc.

**CO4:** it will also impart correct scientific understanding of current environmental problems that can be solved using nanobiotechnology.

**CO5:** focus on advanced nanobiotechnology techniques to facilitate nanoparticles and toxicity evaluation

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of nanotechnology can help in maintaining systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: Microbiology course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTD 3202</b>	<b>FOOD BIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG:2, 3, 15</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:**provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of food biotechnology.

**COB2:**To update students' knowledge of new developments in biology of food industry

**COB3:**To give students a broad understanding and experience of technological processes involved in the food industry.

**COB4:**To give students a broad understanding of food quality and control

**COB5:**To give students a broad understanding of food preservation

**MODULE I INTRODUCTION 9**

History of Microorganisms in food, Historical Developments, Taxonomy, role and significance of microorganisms in foods. Intrinsic and Extrinsic Parameters of Foods that affect microbial growth, Microorganisms in fresh meats and poultry, processed meats, seafood's, fermented and fermented dairy products and miscellaneous food products, Starter cultures, cheeses, beer, wine and distilled spirits, SCP, medical foods, probiotics and health benefits of fermented milk and foods products.

**MODULE II PRIMARY & SECONDARY FERMENTATION 9**

Brewing malting, mashing, hops, primary & secondary fermentation: Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl. Beer, wine and distilled spirits.

**MODULE III FOOD QUALITY PARAMETERS 9**

Emerging processing and preservation technologies for milk and dairy product, Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms, Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods

**MODULE IV FOOD PRESERVATION 9**

Food Preservation Using Irradiation, Characteristics of Radiations of Interest, in Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Processing of Foods for Irradiation, Application of Radiation, Radappertization, Radicidation, and Radurization of Foods

Legal Status of Food Irradiation, Effect of Irradiation of Food constituents

**MODULE V FOOD QUALITY AND CONTROL 9**

Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination.

**PRACTICALS 30**

**List of Experiments**

1. Determination of microbiological quality of water by MPN method.
2. Presumptive and confirmatory tests for coliform bacteria in water.
3. Microbiological quality of processed milk.
4. Microbiological quality of dehydrated foods.
5. Microbiological examination of spoiled food.
6. Production of alcohol by fermentation.
7. Production of Dahi and examination of its microbiological study.

**L – 45; P – 30; TOTAL HOURS – 75**

**TEXT BOOKS:**

1. Modern Food Micro-Biology by James M. Jay, (2000), 6th edition, An Aspen Publication, Maryland, USA.
2. Food Microbiology: Fundamentals and frontiers by M.P. Doyle, L.R. Beuchat and Thoma J. Montville, (2001), 2nd edition, ASM press, USA.
3. Food Science and Food Biotechnology by G.F.G. Lopez & G.V.B. Canovas (2003), CRCPress, Florida, USA

**COURSE OUTCOMES:**

**CO1:** Decision-making

**CO2:** Working independently

**CO3:** Showing social, professional and ethical responsibility and sensitivity to gender issues

**CO4:** Criticism and self-criticism

**CO5:** Production of free, creative and inductive

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022



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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

### SDG 2: Zero Hunger

Statement: Understanding of the fundamentals of food biotechnology and its applications can eliminate the problems of food shortage in the world.

### SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this nutritious food can be procured to promote good health and well being.

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

<b>BTD 3203</b>	<b>FERMENTATION TECHNOLOGY AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>BIOREACTOR DESIGN</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To educate the students about microorganisms, development of media, and anaerobic digesters

**COB2:** To make the students understand the fermentation process using these tools and its combination of bioprocess engineering

**COB3:** To give students a broad understanding of fermentation design

**COB4:** To give students a broad understanding of microbial products

**COB5:** To give students a broad understanding of scale up study and product development

**MODULE I INTRODUCTION TO FERMENTATION TECHNOLOGY 9**

History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms – primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology

**MODULE II FERMENTATION MEDIA 9**

Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation.

**MODULE III FERMENTOR DESIGN 9**

Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter

**MODULE IV PRODUCTION OF MICROBIAL PRODUCTS 9**

Production of alcohol; Organic acid – Citric acid; Antibiotic – Penicillin, Amino acid – Glutamic acid; Vitamin – B1; Single Cell Protein (SCP).

**MODULE V SCALE UP STUDY AND PRODUCT DEVELOPMENT 9**

Down-stream processing and Product recovery; Regulation and safety

**PRACTICALS 30**

**List of Experiments**

1. Determine the growth patterns and specific growth rate of E. coli

2. Determine the effect of peptone concentration on E. coli growth
3. Fermentative production of Penicillin Antibiotics using *Penicilliumchrysogenum*.
4. To study the induction effect of  $\beta$ -galactosidase enzyme in E.coli.
5. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillusniger*
6. Citric acid production from whey with glucose as supplementary carbon source by *Aspergillusniger*
7. Microbial production of citric acid by solid state fermentation process
8. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
9. Fermentative production of Ethanol using *Saccharomyces cerevisiae*

**L – 45; P – 30; TOTAL HOURS – 75**

**TEXT BOOKS:**

1. Fermentation and biochemical engineering handbook by Henry C. Ogal, 2nd edition, Noyes Publications.
2. Advances in Biochemical Engineering Biotechnology by T. Sceper and J.J Zhong; Springer Publication.
3. The Microbiology of anaerobic Digesters by Michael H. Gerardi, A John Wiley & Sons, Inc., Publication, 2003.

**COURSE OUTCOMES:**

**CO1:** This course will give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.

**CO2:** This course is taught to give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.

**CO3:** The students will be able to design fermentors

**CO4:** The students will be able to scale up fermentation experiment

**CO5:** The students will be able to establish product development plan

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	H	L	-	-	-	-	L	L	-	-	-	L
CO2	H	L	-	-	-	-	L	L	-	-	-	L
CO3	H	L	-	-	-	-	L	L	-	-	-	L
CO4	H	L	-	-	-	-	M	L	-	-	-	L
CO5	H	L	-	-	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintaining systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>GED 3201</b>	<b>REASONING AND APTITUDE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>FOR ENGINEERS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To develop students' critical reading skills

**COB2:** To foster their writing skills

**COB3:** To enlighten the various methods of solving quantitative problems

**COB4:** To make students ready for clearing placement and competitive examination

**MODULE I Objective English 07**

Reading Comprehension - Sentence Rearrangement - Cloze Test – Error Spotting

**MODULE II Vocabulary Development 08**

Vocabulary (Synonyms and Antonyms, one word Substitutes, Spellings, Idioms and Phrases, etc) - Fill in the blanks - Paragraph Completion

**MODULE III General Mental Ability 08**

Time speed and Distance –Problems on Trains – Boats and Streams - Permutation and Combination - Probability

**MODULE IV Quantitative Ability 07**

Data Interpretation (charts, graphs, tables, data sufficiency, etc.) – Time and work-Pipes and Cisterns-Venn Diagrams-Mensuration

**P – 30; TOTAL HOURS 30**

**REFERENCES:**

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009  
R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
4. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal

Reasoning, S. Chand Limited, 2010

5. Khattar Dinesh, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India, 2016
6. Rajesh Verma, Fast Track Objective Arithmetic Paperback, Arihant Publications (India) Limited, 2018
7. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019

### **COURSE OUTCOMES:**

**CO1:**Demonstrate their reading ability

**CO2:**Exhibit their vocabulary and writing skills

**CO3:**Apply the problem-solving techniques

**CO4:**Gain confidence mentally and be successful in their career

**Board of Studies (BoS) :**

**Academic Council:**

13<sup>th</sup>BoS of the Department of English held on 17.6.2021

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG No. 4 : Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

**SEMESTER VII**

<b>BTD 4101</b>	<b>DATA ANALYSIS AND SIMULATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** : In this course, the students will learn the principles and methods of statistical analysis.

**COB2:** The objective of the course is to provide a basic understanding of data analysis using statistics and to use computational tools on problems of applied nature.

**COB3:** Applications of data science techniques such as machine learning, deep learning and their applications in biological data.

**COB4:** Learn and practice using a range of real-world data sets.

**COB5:** Learn realtime application Data analysis and stimulation.

**MODULE I DATA PREPROCESSING AND VISUALIZATION 6+3**

Types of data, dealing with missing data, data visualization: Scatter Plot, histogram, group plots, box plots etc., dimensionality reduction. Plotting graphs using MS Excel

**MODULE II DATA ANALYSIS 6+3**

: Statistical analysis, hypothesis testing, significance of p-value, chi-square, T-test, ANOVA, Bayesian Probability. . Statistical data analysis using PSPP

**MODULE III MINING FREQUENT PATTERNS 6+3**

Associations and Correlations, Classification,

**MODULE IV MACHINE LEARNING: 6+3**

Supervised, unsupervised, logistic regression, SVMs, decision trees, clustering and model evaluation. Implementing machine learning algorithms.

**MODULE V ARTIFICIAL NEURAL NETWORKS 6+3**

Types of ANN, case studies for the application of deep learning in biology and health care research. Deep learning using Deep Learning Studio Desktop.

**L – 30; T - 15; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Introduction to Machine Learning using Python, Jeeva Jose, Khanna Publishing House, 2019.
2. Data Mining: Concepts and Techniques by Jiawei Han, Jian Pei, Micheline Kamber, Elsevier; Third edition 2007.
3. Data Visualization – A Practical Introduction by Kieran Healy, Princeton University Press 2019.

**REFERENCES:**

1. Deep Learning – Rajiv Chopra, Khanna Publishing House, 2019
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, MIT Press 2017.

**COURSE OUTCOMES:**

**CO1:** On completion of this course, students will be able to gain insights such as correlation and basic analysis using data visualization.

**CO2:** Students can present their research results in probabilistic terms using statistical significance.

**CO3:** Students can build and train machine learning models and evaluate them; get accustomed with deep learning techniques and their applications in biological and healthcare data.

**CO4:** Students can work a range of real-world data sets.

**CO5:** Students can handle realtime application Data analysis and stimulation.

**Board of Studies (BoS) :**

Mention details of BoS

Ex: 8<sup>th</sup> BoS of CSE held on  
25.08.2020

**Academic Council:**

Mention Number and date

Ex: 15<sup>th</sup> AC held on 14.07.2021

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation



**SDG 9: Industry, Innovation, and Infrastructure**

Statement: Students can build and train data analytics and evaluate them; get accustomed with deep learning techniques and their applications in biological and healthcare industry.

**BTD 4102****INTERNSHIP - II****L T P C****0 0 2 1****SDG: 9, 4****COURSE OBJECTIVES:**

**COB1:** To offer the opportunity for the young students to acquire on job the skills, knowledge, attitudes, and perceptions along with the experience needed to constitute a professional identity

**COB2:** To provide means to immerse students in actual supervised professional experiences.

**COB3:** To give an insight into the working of the real organizations.

**COB4:** To appreciate the linkages among different functions and departments.

**COB5:** To develop perspective about business organizations in their totality.

**GENERAL GUIDELINES:**

- It is one credit for four weeks of internship.
- Internship shall be of not less than two weeks duration and shall be organized by the Dean of the Department.
- Students should choose preferably, government agencies/ Central Government research Institutes/DBT/ICAR/IISER/CSIR/ICMR /IIT's/ NIT's /major industries in their specialization to do their internship
- At the end of industrial internship, the student shall submit a certificate and feedback from the organization. Students should also submit a brief report.
- The evaluation will be made based on this report and a Viva-Voce
- Examination, conducted internally by a Departmental Committee constituted by the Dean of the School of Life Sciences.

**COURSE OUTCOMES:**

**CO 1:** After completion of this semester long course the student trained in his specialized area of operation

**CO 2:** Will be able to critically think, observe and communicate

**CO 3:** Will acquire the work experience through advance learning (in terms of

depth, complexity and engagement) in an industrial environment

**CO 4:** Will be able to apply, extend and test the knowledge gained from class room experience to understand and mitigate complex issues and address real industry challenges

**CO 5:** Will be able to assimilate technical and administrative or managerial skills from his interactions with a variety of individuals, systems and practices

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 4. Quality Education**

Statement: This course will help in promoting better Industrial exposure and provide the quality education opportunity

**SDG 9: Industry, Innovation, and Infrastructure**

Statement: This course will help Industrial exposure for the students and provide an opportunity for Industry, Innovation, and Infrastructure developments.

<b>BTD 4103</b>	<b>PROJECT WORK (PHASE I)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 4, 9</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>

**COURSE OBJECTIVES:**

To learn and experiments handled on their own by the students to exhibit their capacity in executing a project work and provide fruitful solution to a research problem or improving the health and wealth of human beings in the field of Biotechnology.

**GENERAL GUIDELINES:**

At post graduate level project work shall be carried out by the student individually

- Student shall select a project topic of his/her interest relevant to Biotechnology and approach any faculty member of the School of Life Sciences with expertise in that field and get his willingness to supervise the project.
- Students are permitted to carry out their project in an Industry / Research organization, with the approval of the Dean of School of Life Sciences. In such cases, the project work shall be jointly supervised by a faculty of the school and a professor/ Scientist from the organization. Proper permission and approvals should be obtained from the industry and documented.
- The information related to proposed topic and the faculty member willing to act as guide shall be informed to the project co-ordinator within 15 days from the commencement of the semester.
- Supervisor identified by the student shall be approved by the dean of School of Life Sciences considering the guidelines followed in the School of Life Sciences to allot supervisor for student projects.
- The project co-ordinator in consultation with Professor in-charge shall give initial approval to start the project work.
- A project review team comprising of minimum two senior faculty members of the department preferably doctorates shall be appointed by the Dean of the School of Life Sciences.
- Project review schedules, weightage for each review and rubrics for evaluation will be prepared by the project co-ordinator in line with the

academic calendar and informed to the students in advance. A minimum of three reviews shall be conducted to evaluate the progress of the students. All the members of the review committee shall evaluate the students individually and the mean value shall be taken for grading.

- Student should meet the supervisor periodically and attend the review committee meetings for evaluating the progress. Proper documents shall be maintained by the supervisor to ensure the attendance and progress of the students.
- In the project phase I, students are expected to identify a suitable topic, draw the need for present study and scope of the investigation, review at least 25 journal papers in the related field, formulate the experimental / analytical methodology and conduct preliminary studies.
- At the end of project work phase I, students should submit a report based on the preliminary studies and the future work to be carried out.

#### COURE OUTCOMES:

Students will be able to

- Apply their practical knowledge and skill in Biotechnology with specialization in to solve real time problems
- Prepare an appropriate documentation

#### Board of Studies (BoS):

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### Academic Council:

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	-	L	-	H	H	H	L	-	-	-	-	L
CO2	-	L	-	H	H	H	L	-	-	-	-	L
CO3	-	L	-	H	H	H	L	-	-	-	-	L
CO4	-	L	-	H	H	H	M	-	-	-	-	L
CO5	-	L	-	H	H	H	H	-	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

#### SDG 4. Quality Education

Statement: This project will help in promoting understating about expriements and Industrial uasability and provide the quality practical education.

#### SDG 9: Industry, Innovation, and Infrastructure

Statement: This project course will help employment opportunity for the students and provide an opportunity for new Innovation possibilities.

<b>BTD 4201</b>	<b>PROJECT WORK (PHASE II)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 4, 9</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>9</b>

**COURSE OBJECTIVES:**

To learn and experiments handled on their own by the students to exhibit their capacity in executing a project work and provide fruitful solution to a research problem or improving the health and wealth of human beings in the field of food Biotechnology.

**GENERAL GUIDELINES:**

- Project work phase II is a continuation of phase I following the same guidelines.
- The project co-ordinator shall arrange to conduct three reviews to ascertain the progress of the work and award the marks based on the performance.
- Detailed experimental investigation / in-depth analytical study / Preparation of specimens / testing has to be performed in-line with the scope of investigation.
- The students are expected to analyse the obtained results and discuss the same in an elaborate manner by preparing necessary Figures/Graphs/Tables/Illustrations/images to get an inference.
- The important conclusions need to be drawn and scope for further research also to be highlighted.
- The outcome of project work shall be published in journals / conference of National or International importance.
- At the end, students should submit a report covering the various aspects of Project work.
- The typical components of the project report are Introduction, Need for present study, Scope of the Investigation, Literature review, Methodology / Experimental investigation / development of software packages, Results & discussion of experimental and analytical work, Conclusions, References etc.

- The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last Instructional day of the semester.
- The project co-ordinator in consultation with head of the department and controller of examination shall arrange for an external expert member to conduct the final viva-voce examination to ascertain the overall performance of the students in Project work.

### COURE OUTCOMES:

Students will be able to

- Apply their practical knowledge and skill in Biotechnology with specialization in to solve real time problems
- Prepare an appropriate documentation

### Board of Studies (BoS):

8<sup>th</sup>BoS of SLS held on 5.07.2021

### Academic Council:

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	-	L	-	H	H	H	L	-	-	-	-	L
CO2	-	L	-	H	H	H	L	-	-	-	-	L
CO3	-	L	-	H	H	H	L	-	-	-	-	L
CO4	-	L	-	H	H	H	M	-	-	-	-	L
CO5	-	L	-	H	H	H	H	-	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

### SDG 4. Quality Education

Statement: This project will help in promoting understating about expriements and Industrial uasability and provide the quality practical education.

### SDG 9: Industry, Innovation, and Infrastructure

Statement: This project course will help employment opportunity for the students and provide an opportunity for new Innovation possibilities.

## PROFESSIONAL ELECTIVES COURSES

### SEMESTER IV

<b>BTDX 01</b>	<b>STRUCTURAL BIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

#### **COURSE OBJECTIVES:**

**COB1:** Understanding of the behavior of proteins in solution and

**COB2:** Knowledge of how their properties may be altered by changing the physical surroundings.

**COB3:** To provide an understanding of the theory and practical techniques involved in developing a purification process.

**COB4:** Get knowledge about different protein states

**COB5:** Get knowledge about protein conformational states in crystal

#### **MODULE I                    STRUCTURAL STATES OF PROTEINS-I                    9**

chemical nature of polypeptide chains, Secondary structure, beta structure, collagen triple helix, higher structure determination, prediction of secondary structure, Domains and super secondary structures.

#### **MODULE II                    STRUCTURAL STATES OF PROTEINS -II                    9**

Association of protein subunits, helical or continuous protein polymers. The quaternary structure of closed aggregates - oligomeric enzymes, biological implication of quaternary structure, surface accessibility.

#### **MODULE III                    CRYSTALLOGRAPHY                    9**

Diffraction methods, X-ray crystallography, crystallization, resolution, temperature factors, electron density maps, NMR methods for protein structure determination

#### **MODULE IV                    PROPERTIES OF MACROMOLECULES IN                    9** **CRYSTALLINE STATE**

Protein crystal, physical properties, chemistry of crystalline proteins, chemical reactivity, enzymatic and biological activities, crystal versus solution NMR studies, Crystallographic temperature factors, structural heterogeneity in protein crystals



**MODULE V CONFORMATIONAL STATES IN CRYSTAL AND NUCLEAR MAGNETIC RESONANCE STRUCTURES 9**

Comparison of two conformational states, Oxygenation of hemoglobin: two crystals conformation, Hydrogen Bonds and Water Molecules in Crystalline Proteins- hydrogen bonding positions in proteins, water molecules observed in crystalline proteins, the distribution of protein bound water, water network in crystalline proteins.

**L –45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.), 2<sup>nd</sup> Edition, 2002
2. Foundations of Structural Biology by Leonard J. Banaszak (2000) Academic Press, 1<sup>st</sup> Edition, 2000

**REFERENCES:**

1. Wolfgang P. Baumeister, Focus on Structural biology, Book Series, Springer Publisher

**COURSE OUTCOMES:**

**CO1:** Students will be able to understand methods to determine and study protein structures

**CO2:** students will be able to understand different protein states and their significance

**CO3:** students will be able to understand crystal structures

**CO4:** students will know properties of macromolecules in crystal state

**CO5:** students will be able to understand principles of crystallography

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation M - Medium Correlation H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of structural biology of living organisms can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 02</b>	<b>BIO-ORGANIC CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Understanding in the area of Organic Chemistry and its applications in Biology.

**COB2:** Knowledge of enzymes and kinetics of enzymes

**COB3:** Knowledge of concepts related to different enzyme models

**COB4:** Understanding protein folding problem

**COB5:** Understanding nucleic acid structure and function

**MODULE I INTRODUCTION TO BIOORGANIC 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 Adaptation; Molecular Recognition; Chemistry of the Living Cells; Analogy Between Biochemical and Organic Reaction

**MODULE II BIOORGANIC CHEMISTRY OF AMINO ACIDS AND POLYPEPTIDES 9**

Chemistry of the Living Cells; Analogy Between Organic Reactions and Biochemical; Chemistry of the Peptide Bond; Non ribosomal Peptide Bond Formation; Asymmetric Synthesis of  $\alpha$ -Amino Acids; Asymmetric Synthesis with Chiral Organometallic Catalysts; Transition State Analogs ; Antibodies as Enzymes ; Chemical Mutations; Molecular Recognition and Drug Design

**MODULE III ENZYME CHEMISTRY 9**

Introduction to Catalysis; Introduction to Enzymes; Multifunctional Catalysis and Simple Models;  $\alpha$ -Chymotrypsin; Other Hydrolytic Enzymes; Stereoelectronic Control in Hydrolytic Reactions ; Immobilized Enzymes and Enzyme Technology ; Enzymes in Synthetic Organic Chemistry ; Enzyme-Analog-Built Polymers ; Design of Molecular Clefs

**MODULE IV ENZYME MODELS 9**

Host-Guest Complexation: Chemistry New Developments in Crown Ether Chemistry; Membrane Chemistry and Micelles; Polymers; Cyclodextrins; Enzyme Design Using Steroid Template; Remote Functionalization Reactions; Biomimetic Polyene Cyclizations

**MODULE V BIOORGANIC CHEMISTRY OF NUCLEIC ACIDS 9**

History, Sugars and bases; Conformation of sugar-phosphate backbone; hydrogen bonding by bases; the double helix; A, B, and Z double helices; Stability of Double Helix; DNA intercalators; Chemical synthesis of DNA

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Structure and Mechanism In Protein Science: A Guide To Enzyme Catalysis and Protein Folding; A. R. Fersht, W.H. Freeman, 1999.
2. Bioorganic Chemistry; H. Dugas, Springer Verlag, 1999.

**REFERENCES:**

1. Introduction to Bioorganic Chemistry and Chemical Biology,. By David Van Vranken and Gregory Weiss. New York: Garland Science (Taylor & Francis Group).
2. Highlights in Bioorganic Chemistry: Methods and Applications, Carsten Schmuck, Helma Wennemers, Wiley, 2006

**COURSE OUTCOMES:**

**CO1:** Understand enzyme actions

**CO2:** Understand enzyme kinetics

**CO3:** Understand the mechanisms of protein folding

**CO4:** Understand protein folding

**CO5:** Understand nucleic acid structure and function

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation M - Medium Correlation H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintaining systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 03</b>	<b>BIG DATA ANALYTICS FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>BIOTECHNOLOGY</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To process used to extract meaningful insights, such as hidden patterns, unknown correlations, market trends, and customer preferences.

**COB2:** To provide various advantages—it can be used for better decision making, preventing fraudulent activities, among other things.

**COB3:** To provide information about Microarray analysis

**COB4:** To perform Whole Genome / Exome / Targeted Resequencing Analytics

**COB5:** To execute Denovo Whole Genome and Transcriptome Assembly analytics

### **MODULE I INTRODUCTION TO GENOME STRUCTURE AND ORGANIZATION 9**

Basics of Molecular Biology, Introduction to DNA & RNA, Structural and Functional aspects of DNA, Structural and Functional aspects of RNA, Types and variants of RNAs (Coding & Noncoding), Central Dogma, Genes and Proteins, Prokaryotic & Eukaryotic CELL structures, Genome size - sequence complexity -Introns and Exons, Genome sequences and database subscriptions. Genome organization: Mitochondrial and Chloroplast genome. Genomic regulatory elements and their role: Promoters, Enhancers & CpG Islands; Genomic Repetitive Elements & their role: Long Repeats, Short Repeats, SSRs, Transposons / Transposable elements, Miniature Inverted Repeat TE, etc.; DNA Modifications: Variations and Base modifications, Polymorphisms: types of polymorphism Single Nucleotide Polymorphisms (SNPs), mutations, other genetic variations, Introduction to Structural Variation and implications on genomes.

### **MODULE II INTRODUCTION TO GENOME INFORMATICS 9**

Microarray analysis definition, types of microarray, microarray analysis life cycle (sample preparation and labeling, hybridization, washing and image acquisition), microarray data analysis, tools, databases and software for microarray data analysis. Past, present and feature of sequencing technology. Platform overview: Illumina, Pacific Biosciences. Comparison of NGS Systems: Recent scientific breakthroughs using NGS technology. Major biological databases and its classification, sequence database - NCBI, GenBank, EMBL, DDBJ. NGS Database: SRA, DRA, ENA. File/Data formats

overview: FASTA, FASTQ, FNA, CSFASTA, GFF, SAM and BAM. Genome alignment and analysis tools- BWA (Burrows-Wheeler Aligner), SAMtools, GATK (The Genome Analysis Toolkit), IGV (Integrative Genomics Viewer), HISAT, StringTie, Cuffcompare, Velvet, Oases, Trinity. Advantage and disadvantage of NGS Technology.

### **MODULE III WHOLE GENOME / EXOME / TARGETED RESEQUENCING ANALYTICS 9**

Introduction to genome Re-Sequencing, Indexing the reference genome, Sequence Alignment Tools and its Parameters, Alignment quality Assessment, Exome Enrichment Analysis, Target /Non-Target Enrichment Analysis, Statistical Analysis and genome Visualization, Introduction to Variation Analysis, Variation analysis to identify SNV / MNV / SV, dbSNP Annotation / Variation Effect Prediction, Variation Frequency Analysis, Exome Copy Number Variation Analysis, Data Visualization, Function & Structure based Comparative Genome Analysis.

### **MODULE IV TRANSCRIPTOME RESEQUENCING AND CHIP SEQUENCING ANALYTICS 9**

Introduction to RNA-Seq Sequencing Alignment, Indexing the reference genome, Alignment Tools and its Parameters, Aligning Single End / Paired End reads to the indexed genome, Alignment quality Assessment, Statistical Analysis and genome Visualization, Qualitative & Quantitative Gene Expression Profiling, Gene Modifications & Alternative Splicing Analysis, Gene Fusion identification, Differential Gene Expression Profiling, Gene Ontology and Pathway Analysis; Introduction to CHIP Sequencing Experimental Designs, Aligning ChIPSeq data to genome, Peak Calling Analysis, Replicate / IDR Peak Analysis, Peak Annotation, Peak Visualization tools, Motif Analysis, Statistical Analysis, Significant Biology Analysis for Annotated Genes.

### **MODULE V DENOVO WHOLE GENOME AND TRANSCRIPTOME ASSEMBLY ANALYTICS 9**

Introduction to Whole Genome De-novo Sequencing, Understanding Various Assembly Algorithms, Assembly Tools and its Parameters, Scaffolding and Constructing Draft Genome, Repeat Identification and Masking Analysis, SSR Marker Identification & Analysis, Introduction to Gene Prediction Algorithms (Coding & Non-coding), Gene Prediction Tools and its parameters, Sequence Homology Based Annotation & Gene Ontology / Pathway Mapping, Introduction to Transcriptome De-novo Sequencing, Assembly Tools &

Parameters, Transcriptome Clustering and Assembly Evaluation, Qualitative & Quantitative Analysis of Assembled Transcriptome, SSR Marker Identification & Analysis, Differential Gene Expression Profiling (For Multiple Samples), Gene Ontology and Pathway Analysis.

**L – 30; T – 15; TOTAL HOURS –45**

### TEXT BOOKS

1. Ali Masoudi-Nejad, Zahra Narimani, Nazanin Hosseinkhan; “Next Generation Sequencing and Sequence Assembly”, Methodologies and Algorithms, Springer; 2013.
2. Sumitabha Das, “Unix Concepts and Applications”, McGraw - Hill; 4 edition. Units I and II – Chapters in book 1,2,3,4,7,10,14, (2006).

### REFERENCES

1. Mark I. Rees, “Challenges and Opportunities of Next-generation Sequencing for Biomedical Research”, Academic Press, 2012.
2. Wu, Wei, Choudhry, Hani (Eds.), “Next Generation Sequencing in Cancer Research: Volume 1: Decoding the Cancer Genome”, Springer, 2013.

### COURSE OUTCOMES:

**CO1:** Describe process extract meaningful insights, such as hidden patterns, unknown correlations, market trends, and customer preferences.

**CO2:** Demonstrate knowledge better decision making, preventing fraudulent activities, among other things.

**CO3:** Provide information about Microarray analysis

**CO4:** Perform Whole Genome / Exome / Targeted Resequencing Analytics

**CO5:** Execute Denovo Whole Genome and Transcriptome Assembly analytics

### Board of Studies (BoS):

8<sup>th</sup>BoS of SLS held on 5.07.2021

### Academic Council:

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



<b>BTDX 04</b>	<b>MEDICAL BIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:****COB1:** Understanding of proteins as therapeutic agents**COB2:** Preparation and use on monoclonal antibodies**COB3:** Understanding of human diseases**COB4:** Concepts of different types of vaccines**COB5:** Application of new technologies in healthcare settings

<b>MODULE I</b>	<b>SIMPLE PROTEINS AND THERAPEUTIC AGENTS</b>	<b>9</b>
-----------------	---	----------

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins Engineering human interferons and human growth hormones Regulatory aspects of therapeutic proteins - Enzymes as therapeutic agents Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis.

<b>MODULE II</b>	<b>MONOCLONAL ANTIBODY AS THERAPEUTIC AGENT</b>	<b>9</b>
------------------	---	----------

Production of monoclonal antibodies Production of antibodies- Human monoclonal antibodies, its scope and limitations - Hybrid human – Mouse antibodies – in E.coli Approaches for producing HIV therapeutic agents.

<b>MODULE III</b>	<b>HUMAN DISEASES</b>	<b>9</b>
-------------------	-----------------------	----------

Viral and bacterial diseases - Diseases caused by protozoan and parasitic worms (helminths) - Emerging infectious diseases – Active and passive immunity – Autoimmunity- Rational of immunization - Diseases controllable by vaccination – Vaccines, designing vaccines adjuvants - Whole organisms vaccines - Attenuated viruses and bacteria - Inactivation of pathogenic organisms by heat and chemical treatment

<b>MODULE IV</b>	<b>VACCINES</b>	<b>9</b>
------------------	-----------------	----------

Bacterial polysaccharides, proteins and toxins as vaccines - Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS - Commercial and regulatory aspects of vaccine production and its distribution



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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

### SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

### SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

**SEMESTER V**

<b>BTDX 11</b>	<b>CANCER BIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** the origins of cancer and the genetic and cellular basis for cancer.

**COB2:** It will examine the factors that have been implicated in triggering cancers

**COB3:** the intercellular interactions involved in cancer proliferation

**COB4:** current treatments for cancer and how these are designed

**COB5:** and future research and treatment directions for cancer therapy.

**MODULE I      FUNDAMENTALS OF CANCER BIOLOGY      9**

The six hallmarks of cancer, characteristic properties of cancers and cancer cells, benign tumors, classification of cancers, causes of cancer, regulation of cell cycle, cyclin dependent protein kinase, cell cycle check points, mutations, DNA damage and DNA repair.

**MODULE II      TUMOR MICROENVIRONMENT      9**

Physiological parameters- hypoxia, gene expression and metastasis, Malignant cells-aberrant DNA methylation, vascular and stroma, immune mediated cells, extracellular matrix, secreted proteins.

**MODULE III      CANCER GENETICS      9**

Cancer genes, Oncogenes-retroviral oncogenes, approaches to the identification of human oncogenes, Tumor suppressor genes in hereditary cancers, TP53 as a different kind of tumor suppressor, cancer epigenetics.

**MODULE IV      CANCER SIGNALING      9**

Cancer gene pathways, individual biochemical reactions, multistep pathways and network, signal from cell surface: protein tyrosine kinase, the ras pathways, The PI3K/AKT pathways, The WNT/APC pathways, TGF-Beta/SMAD signaling.

**MODULE V TUMOR IMMUNOLOGY****9**

Historical perspectives, Tumor Antigen, Mechanism to immune response to cancer, role of gene rearrangement in tumor response, Heat shock protein as the regulator for immune response, Inflammation and cancer, Immunotherapy, Adoptive immunotherapy.

**L – 30; T – 15; TOTAL HOURS –45****TEXT BOOKS:**

1. Dimmock, N., Keith., Introduction to Modern Virology, Blackwell Scientific Publications, Oxford, 6th Edition, 2007
2. Maly, B.W.J., Virology a Practical Approach, IRL Press, Oxford, 2nd Edition, 1995

**COURSE OUTCOMES:**

**CO1:** Explain how scientists Hippocrates and Galen coined the terms cancer and oncology.

**CO2:** Describe how surgeon John Hunter and microscopic researcher Rudolf Virchow connected their observations to the pathology and treatment of cancer.

**CO3:** List the common theories used to describe the cause of cancer.

**CO4:** Overview the impact that the discovery of DNA by scientists Watson and Crick had on the cancer immunity.

**CO5:** Discuss the finding of Nobel Prize winner Peyton Rous, that certain viruses can cause cancer.

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 12</b>	<b>GENOME EDITING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>1</b>	<b>1</b>	<b>2</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the principles of gene editing

**COB2:** To know about engineered enzymes

**COB3:** To understand the principles of MAGE

**COB4:** To understand the principles of transgenic organisms

**COB5:** To understand applications of GM organisms

**MODULE I INTRODUCTION 9**

Overview of traditional methods: homologues recombination for gene knockout. RNAi system, Cre-LoxP and Flp-FRT systems. Design of sgRNA.

**MODULE II ENGINEERED ENZYME SYSTEMS 9**

Zinc finger nucleases (ZFNs), transcription-activator like effector nucleases (TALEN), meganucleases and the clustered regularly interspaced short palindromic repeats (CRISPR/Cas9) system.

**MODULE III MULTIPLEX AUTOMATED GENOMIC ENGINEERING (MAGE). 9**

Applications in Targeted gene mutation, Gene therapy, creating chromosome rearrangement, Study gene function with stem cells,

**MODULE IV TRANSGENICS 9**

Transgenic animals, Endogenous gene labeling, targeted transgene addition,

**MODULE V GENETICALLY MODIFIED ORGANISMS 9**

GM plants, application is biofuel production and in bioremediation. Ethics, safety and risk of targeted gene editing

**PRACTICALS****List of Experiments**

1. Zinc Finger Nucleases-ZNFs as gene editing tools
2. TALENs as gene editing tools
3. CRISPR/Cas9 as gene editing tools
4. Types of therapeutic genome modifications-Gene disruption tool
5. Non homologous end joining - NHEJ gene correction tool
6. HDR gene correction and HDR gene addition tool

**L – 15;T – 15; P – 30; TOTAL HOURS – 60**

**TEXT BOOKS:**

1. CRISPR Gene Editing, Methods and Protocols, Editors: Luo, Yonglun (Ed.)
2. Genome Editing and Engineering, From TALENs, ZFNs and CRISPRs to Molecular Surgery. Edited by KrishnaraoAppasani.
3. Progress in Molecular Biology and Translational Science Vol 149-Genome Editing in Plants. Edited by Donald P. Weeks and Bing Yang. Academic Press.
4. Precision Medicine, CRISPR, and Genome Engineering, Moving from Association to Biology and Therapeutics, Editors: Tsang, Stephen H. (Ed.). Springer.

**COURSE OUTCOMES:**

**CO1:** Become familiar to the principles of gene editing

**CO2:** Become familiar to the principles of GM plants

**CO3:** Become familiar to the principles of transgenic animals and plants

**CO4:** Become familiar to engineered enzymes

**CO5:** Become familiar to the application of MAGE

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	H	L	L	-	H	-	L
CO2	H	L	-	L	-	H	L	L	-	H	-	L
CO3	H	L	-	L	-	H	L	L	-	H	-	L
CO4	H	L	-	L	-	H	M	L	-	H	-	L
CO5	H	L	-	L	-	H	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



<b>BTDX 15</b>	<b>DEVELOPMENTAL BIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide insight on the history, formulation of theories and the processes associated with embryonic development in humans.

**COB2:** To enlighten on the molecular intricacies of the organ formation.

**COB3:** To highlight the types, significance, advantages and disadvantages of model organisms.

**COB4:** To introduce the different molecular techniques employed to decipher the molecules/ process/ signalling mechanism of developmental processes.

**COB5:** To impart the application of developmental biology in other fields of life science.

<b>MODULE I</b>	<b>BASIC CONCEPTS IN DEVELOPMENTAL BIOLOGY AND STAGES OF DEVELOPMENT</b>	<b>8</b>
-----------------	--	----------

Theories in Developmental Biology, Stages of development, Gametogenesis, Egg types, Cell division or cleavage- types, purpose, laws, regulation. Cell specification and determination, Different types of cell specification (autonomous and conditional) - organiser, morphogen, gradient theory. Gastrulation- different modes, molecular mechanism and process.

<b>MODULE II</b>	<b>ORGANOGENESIS: NEURULATION, SOMITOGENESIS, LIMB DEVELOPMENT, HEART FORMATION</b>	<b>8</b>
------------------	---	----------

Neurulation- different stages, Hensen's node, primitive streak, Neural crest, neural tube, notochord, Molecular mechanism, Neuronal cell proliferation- vertical and horizontal, neuronal birthday. Somitogenesis- Stages, Molecular mechanism- clock and wave model of somite formation, Hox genes (master genes) Limb formation- Stages, Molecular details- specification and coordination of different axes. Heart formation- Heart field, Heart tube formation, cardiac looping and chamber heart formation , left and right specification.

<b>MODULE III</b>	<b>MODEL ORGANISM IN DEVELOPMENTAL BIOLOGY</b>	<b>8</b>
-------------------	--	----------

Ideal characteristics of model organisms, Genetic and Non genetic model organism, Genetic model- Bacteria, Fungi, Slime mold, Nematode, Fruit fly, Mice. Non-Genetic Model- Chick, Frog, Rat. Life cycle, Applications, advantages and disadvantages of model organisms. Importance of unicellular

organisms, Drosophila a genetic work horse- segmentation genes, C.elegans- cell number constancy (defined number of cells), Dictyostelium- unicellular and multicellular, Mice-Mammalian model.

**MODULE IV      MOLCEULAR TECHNIQUES TO DECIPHER                      8**  
**DEVELOPMENTAL PROGRAM**

Forward genetics- approaches- chemical, physical and genetic- genetic screens (random mutant library)-REMI- Random mutagenesis, Reverse Genetics- Knock out, homologous recombination, traditional and conditional knock out. Knock in, Gene Silencing/knock down- importance and different strategies- RNAi, RNA morpholino. Advantages and disadvantages. Differential Screening- Transcriptomics and Proteomics Approaches

**MODULE V      POST EMBRYONIC DEVELOPMENT                                      8**

Different types of post embryonic development- Growth, Metamorphosis, aging and regeneration. Growth- different modes-hyperplasia, hypertrophy and accretion- regulation by hormones, Metamorphosis- types of metamorphosis, universal set of events. Amphibian and insect -stages and molecular details, Regeneration- 4 Types with example, Aging- Mechanisms.

**L –45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Scott Gilbert and Micheal JF Barresi, Developmental Biology, 11th edition., 2003
2. Jonathan Slack, Essentials of Developmental Biology, 3rd Edition., 2001

**COURSE OUTCOMES:**

**CO1:** To design simple experiments and interpret concepts of embryonic development.

**CO2:** To appreciate and describe the signaling orchestra involved in organogenesis

**CO3:** To make the right choice of model organism for a problem related to development.

**CO4:** To strategize a molecular method to tweeze the intricacies of signalling in development.

**CO5:** To predict the impact of exogenous factors on the development of an organism.

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	H	L	L	-	H	-	L
CO2	H	L	-	L	-	H	L	L	-	H	-	L
CO3	H	L	-	L	-	H	L	L	-	H	-	L
CO4	H	L	-	L	-	H	M	L	-	H	-	L
CO5	H	L	-	L	-	H	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

## SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

## SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 16</b>	<b>TISSUE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Basic concept of types of tissues, cell migration and therapeutic importance of tissue engineering

**COB2:** Different aspects of cell culture and 3-dimensional cell culture

**COB3:** Importance of growth factors, hormones and signaling method

**COB4:** Scaffold synthesis and its application in tissue engineering

**COB5:** Case studies and regulatory issues

**MODULE I INTRODUCTION 9**

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

**MODULE II CELL-CELL COMMUNICATION and IN VITRO CULTURE 9**

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, 3-D cell culture, Bioreactors.

**MODULE III MOLECULAR BIOLOGY ASPECTS 9**

Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

**MODULE IV SCAFFOLD AND TRANSPLANT- SYNTHESIS AND APPLICATION 9**

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stem cells: introduction, hematopoiesis.

**MODULE V CASE STUDY AND REGULATORY ISSUES 9**

Case study of multiple approaches: cell transplantation for liver, cardiovascular, neural, fetal tissue engineering and artificial womb, prosthetics. Ethical, FDA and regulatory issues of tissue engineering.

**L – 30; T-15 ; TOTAL HOURS –45****TEXT BOOKS:**

1. Robert Lanza, Robert Langer, Joseph Vacanti, Anthony Atala, Principles of Tissue Engineering, 5th edition., 2020
2. Jennifer Elisseeff, Nicolas L'Heureux, Song Li, Stem cells and Tissue engineering, 3rd Edition., 2011
3. Lanza, Langer and Vacanti(eds). Principles of Tissue engineering. Academic Press, 2<sup>nd</sup> Edition 1999
4. Minoth, Strehl, Schumacher. Introduction to Tissue engineering. Wiley VCH., 3<sup>rd</sup> Edition, 2005

**COURSE OUTCOMES:**

**CO1:** understand fundamentals of tissue engineering

**CO2:** understand cell-cell communication and cell culture techniques

**CO3:** understand how cell signaling molecules help in cell proliferation

**CO4:** understand and apply the knowledge of scaffold synthesis and tissue engineering application

**CO5:** apply to concept to different tissue engineering applications and will know the ethical and regulatory issue

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	H	L	L	-	H	-	L
CO2	H	L	-	L	-	H	L	L	-	H	-	L
CO3	H	L	-	L	-	H	L	L	-	H	-	L
CO4	H	L	-	L	-	H	M	L	-	H	-	L
CO5	H	L	-	L	-	H	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 17</b>	<b>DRUG DESIGN AND DEVELOPMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** framework of the drug development process

**COB2:** its regulation as well as its impact on workers

**COB3:** environment, toxicology, pharmaceuticals, comparative medicine, bioengineering, occupational and environmental health

**COB4:** professional disciplines such as medicine, pharmacology, and nursing interested in working with the biotechnology industry

**COB5:** learn peptide-based drug designing

**MODULE I DRUG DISCOVERY AND DEVELOPMENT 9**

Organized drug discovery and development – Target identification and validation strategies -Microbial, recombinant - Biochemical and molecular level screening systems and assay development - Alternative strategies in lead identification - Lead optimization.

**MODULE II DRUG DESIGNING 9**

Rational basis of drug designing, criteria for synthesizing drugs -Drug designing approaches - structure based drug design process - Receptor based design - Drug designing using known receptor structure - Drug design by receptor site fit, active site simulations using PDB structure data and homology modeling-Current research in drug designing, a case study

**MODULE III COMPUTATION FOR DRUG DESIGNING 9**

Overview of computer-based tools for drug designing – Ligand Based drug design - Scoring and docking mode-QSAR principles and methods in drug designing - Pharmacophore based drug design. Similarity Principle-Molecular fingerprinting-Tanimoto coefficients- Current research in drug designing, a case study

**MODULE IV MIMICKING IN DRUG DESIGNING 9**

Rational design of enzyme inhibitors - Enzyme catalytic principles - Recapitulation affinity labels - Illustrative examples - Principle of suicide inactivation – Design strategies - Scope and limitations. Principles and practice of transition state mimicry – Illustrative examples - HIV protease inhibitors – Collected substrate analog inhibitors and design strategies, illustrative examples

**MODULE V PEPTIDE BASED DRUG DESIGNING****9**

Synthetic peptide libraries –Advantage sand limitations-venome peptides-  
Peptide libraries through phage display - Applications in epitope and agretope  
mapping, synthetic vaccine design - Artificial combinatorial - Peptides,  
bezodiazepines and other current examples - Selection strategies and  
screening methodologies

**L – 30; T – 15; TOTAL HOURS –45****TEXT BOOKS:**

1. Gary Walsch, Biopharmaceuticals: Biochemistry and Biotechnology, Wiley Publishers, 2003.
2. Burger's Medicinal Chemistry and Drug Discovery Sixth Edition, Volume 1: Drug Discovery Edited by Donald J. Abraham 3 Rational Design of Covalently Binding Enzyme ISBN 0-471-27090-3 O 2003 John Wiley & Sons, Inc
3. Computational methods in drug discovery, <http://dx.doi.org/10.1124/pr.112.007336>
4. PHARMACOLOGICAL REVIEWS Pharmacol Rev 66:334–395, January 2014
5. The Future of peptide-based drugs, 2012 John Wiley & Sons A/S. doi: 10.1111/cbdd.12055

**COURSE OUTCOMES:**

**CO1:** To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agent.

**CO2:** To outline the drug manufacturing process including the role of quality control

**CO3:** To quality assurance in protecting the public, workers, and the environment.

**CO4:** To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical age

**CO5:** Able to design peptide-based drugs

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	H	L	L	-	H	-	L
CO2	H	L	-	L	-	H	L	L	-	H	-	L
CO3	H	L	-	L	-	H	L	L	-	H	-	L
CO4	H	L	-	L	-	H	M	L	-	H	-	L
CO5	H	L	-	L	-	H	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

## SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

## SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.





genomic research: pedigree studies, genetic engineering, therapeutic trials including gene therapy.

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Legal Perspectives on Bioethics by Ana S Iltis& Sandra H Johnson& Barbara A Hinze, 1<sup>st</sup> Edition 2007
2. Genetically Modified Microorganisms Han, Lei, 1<sup>st</sup> Edition, 2004

**COURSE OUTCOMES:**

**CO1:** the importance of safety related to biological hazards and how to handle that.

**CO2:** the ethics related to every field nowadays.

**CO3:** the good lab practices and the recent status of GMO and human cloning worldwide.

**CO4:**environment and genetics, related regulations and laws

**CO5:**national and international regulations, bio-ethical issues in medicine.

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

**SEMESTER VI**

<b>BTDX 31</b>	<b>INTELLECTUAL PROPERTY RIGHTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** This course is aimed at familiarizing researchers with the nuances of Intellectual Property Rights (IPR) so as to help them integrate the IPR process in their research activities.

**COB2:** To make the students familiar with basics of IPR and their implications in Research, development and commercialization.

**COB3:** Knowledge about patent

**COB4:** IPR issues in India

**COB5:** knowledge about patents in biotechnology

**MODULE I WTO 9**

As an international agency controlling trade among nations. WTO with reference to biotechnological affairs, TRIPs.

**MODULE II GENERAL INTRODUCTION TO PATENT 9**

Patent claims, the legal decision – making process, ownership of tangible and intellectual property. Basic Requirements of Patentability, Patentable subject matter, novelty and the public domain, non-obviousness

**MODULE III SPECIAL ISSUES IN BIOTECHNOLOGY PATENTS 9**

Disclosure requirements, Collaborative research, Competitive research, plant, Plant biotechnology Indian patents and foreign patents, The strategy of protecting plants.

**MODULE IV PATENT LITIGATION AND FARMER RIGHTS 9**

Substantive aspects of patent litigation, Procedural aspects of patent litigation. Farmer rights – PPVFR act – Role and regulations

**MODULE V IPR ISSUES IN INDIAN CONTEXT 9**

Role of patent in pharmaceutical industry, computer related innovations, microbiological and biotechnological products

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. The law and strategy of Biotechnological patents by Sibley. Butterworth publications. 1<sup>st</sup> Edition, 1994
2. Intellectual property rights – Ganguli – Tat McGrawhill, 1<sup>st</sup> Edition, 2001
3. Intellectual property right – Wattal – Oxford Publishing House, 1<sup>st</sup> Edition, 1994

**COURSE OUTCOMES:**

**CO1:** Communicate in depth knowledge on selected topics within the area of biotechnology

**CO2:** Identify current technical problems within the area of biotechnology

**CO3:** Describe the relationship between patenting and scientific discovery

**CO4:** Describe the patenting process and how it relates to the international patent authorities and organizations.

**CO5:** Understand patents as strategic tools in business development

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	H	L	L	-	H	-	L
CO2	H	L	-	L	-	H	L	L	-	H	-	L
CO3	H	L	-	L	-	H	L	L	-	H	-	L
CO4	H	L	-	L	-	H	M	L	-	H	-	L
CO5	H	L	-	L	-	H	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 9. Industry, Innovation and Infrastructure

Statement: Understanding of the fundamentals of this course can help in promoting innovative research for the benefit of human kind.

<b>BTDX 32</b>	<b>PHARMACEUTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>BIOTECHNOLOGY</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Introduction to terms and concepts used in pharmaceuticals

**COB2:** Concepts of drug metabolism

**COB3:** Introduction to drug manufacturing process

**COB4:** Regulation in drug development and manufacture

**COB5:** Understanding the role of different agencies in this field

**MODULE I INTRODUCTION OF BIOPHARMACEUTICALS 9**

Development of drug and pharmaceutical industry – Therapeutic agents, their use and economics Regulatory aspects. current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals.

**MODULE II DRUG METABOLISM AND PHARMACOKINETICS 9**

Definition, rationales, absorption, distribution and metabolism pathway. Factors governing, LD50, LC50, ED50, absorption of drug, Pharmacokinetics and Pharmacodynamics, Dose response relationship, interspecies scaling, In vitro studies, In vivo studies. Route of Administration of Drugs, Angle of Injection of drug, Drug Toxicities, Animal Models in Biopharmaceutical Research

**MODULE III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS 9**

Bulk drug manufacturers - Type of reactions in bulk drug manufacture and processes - Special requirement for bulk drug manufacture.

**MODULE IV MANUFACTURING PROCESSES & THEIR USE 9**

Manufacturing Process for Tablets, Dry granulation process, Wet granulation process, Dose conversion from preclinical studies to clinical studies, Route of administration of drugs, angle of injections of drug, different phases of clinical trials of drugs.

**MODULE V REGULATORY AGENCIES AND THEIR CONTROL 9**

Role of Regulatory agencies in drug development, FDA guidelines for drug development, Patenting process in India, Possible therapeutic intervention against COVID-19, Scheduling process of Drugs, Amphetamines,

Cannabinoids, Benzodiazepines, CNS stimulant Drugs, Drug designing against apoptotic mediated diseases

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Curtis D. Klaassen, Casarett&Doull's Toxicology: The Basic Science of Poisons, 9th edition, 2004.
2. Pharmaceutical Biotechnology; Authors, S. P. Vyas, V. Dixit; Publisher, CBS Publishers & Distributors, 2018

**COURSE OUTCOMES:**

**CO1:** To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agents.

**CO2:** To outline the drug manufacturing process including the role of quality control

**CO3:** To quality assurance in protecting the public, workers, and the environment.

**CO4:** To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical age

**CO5:** To outline the role of drug manufacturing agencies and regulating agencies.

<b>Board of Studies (BoS):</b> 8 <sup>th</sup> BoS of SLS held on 5.07.2021								<b>Academic Council:</b> 18th AC held on 24.02.2022				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 33</b>	<b>MOLECULAR AND CELLULAR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>DIAGNOSTICS</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Developing the basic concept of molecular diagnostics

**COB2:** Understand the techniques involving identification of microorganism

**COB3:** Understand the techniques of clinical genetics

**COB4:** Understand immunological diagnostic technique

**COB5:** understand biosensors activity

**MODULE I MOLECULAR AND CELLULAR DIAGNOSTICS 9**

Collection, preservation and storage of clinical samples, biopsy, Principles, and application of biological assays used in diagnostics- PCR, ELISA, FISH, Flow cytometry, gene sequencing, microarrays, protein arrays. GLP, SOP and ethics in molecular diagnostics.

**MODULE II DETECTION AND IDENTIFICATION OF MICROORGANISMS 9**

Specimen Collection, Sample Preparation, Quality Control, Bacterial Targets of Molecular-Based Tests, Molecular Detection of Bacteria, Detection of Respiratory Tract Pathogens, Molecular Testing for Urogenital Tract Pathogens, Mechanism and Molecular Detection of Resistance, Molecular Strain Typing Methods for Epidemiological Studies, Viruses- Human Papillomavirus, HIV-1, Hepatitis C, Dengue, Viral Load Determination

**MODULE III CLINICAL GENETICS 9**

Overview of Molecular Genetics, Nucleic Acid Amplification, Molecular Detection of Inherited Diseases, Molecular Oncology, Analysis of Human Splicing Defects, Detection of Genomic Duplications and Deletions, Molecular Techniques for DNA Methylation Studies, DNA Microarrays and Genetic Testing, Genetic Counseling, Preimplantation Genetic Diagnosis

**MODULE IV IMMUNODIAGNOSTICS 9**

Introduction to immunodiagnosics, antigen-antibody reactions, antibody production, antibody markers, CD markers, FACS, Human Leukocyte Antigen (HLA) typing, agglutination (ABO/ Bacterial), immunoprecipitation, immunodiffusion

**MODULE V      BIOSENSORS****9**

Concepts and applications, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, Introduction to Nanotechnology.

**L – 30; T – 15; TOTAL HOURS –45****TEXT BOOKS:**

1. George P. Patrinos and Wilhelm J. Ansorge (ed.) Molecular Diagnostics Second Edition, Academic Press, 2010
2. Lela Buckingham and Maribeth L. Flaws, Molecular Diagnostics. Fundamentals, Methods, & Clinical Applications. F A Davis Company, 2007

**COURSE OUTCOMES:**

**CO1:** Learners will be able to define function, ethics and basic technique used in molecular diagnostic lab

**CO2:** Students will be able to understand different molecular techniques used to identify microbial pathogens

**CO3:** Students will learn different molecular biology techniques to identify nucleic acid polymorphisms

**CO4:** Students will learn different immunological techniques used in molecular diagnostic lab to identify diseases

**CO5:** Students will be able to understand concept of biosensor and its application in diagnostics

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation      M - Medium Correlation      H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



<b>BTDX 34</b>	<b>MOLECULAR PATHOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** introduction to cellular and molecular basis of diseases

**COB2:** molecular biology and genetics of disease and human genome and techniques

**COB3:** principle of molecular pathology

**COB4:** molecular basis of human diseases

**COB5:** molecular therapeutics

**MODULE I INTRODUCTION TO MOLECULAR BASIS OF DISEASE 9**

Mechanisms of cell death, apoptosis, necrosis, pathways to apoptosis, acute and chronic inflammation, infection and host response, neoplasia

**MODULE II MOLECULAR BIOLOGY AND GENETICS 9**

Structure and organization of human genome, human genome project, genetic diseases, gene expression profiling- microarray, SAGE, RNA-seq, genetics of Acute myeloid leukemia and cystic fibrosis

**MODULE III PRINCIPLES OF MOLECULAR PATHOLOGY 9**

History of approaches to disease, current practice and future prospect, role of computer in disease diagnosis, pathogenesis of Hepatitis C, HIV, Dengue

**MODULE IV MOLECULAR BASIS OF HUMAN DISEASES 9**

Cardiovascular diseases-atherosclerosis, ischemic heart diseases, cardiomyopathies; Cancer-genetic basis, major types, pathology of breast and colon cancer, leukemia; diseases of immune system- types, pulmonary diseases-Asthma, COPD, diseases of gastrointestinal tract, neuropathological disorders- ALS, Alzheimers, Huntington's

**MODULE V MOLECULAR THERAPEUTICS 9**

Pharmacogenetics, SNPs, cytochrome P450 system, High throughput, screening techniques, Gene therapy- emphasis to CRISPR-Cas system, Immunotherapy.

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Coleman and Tsongalis (Eds.). Essential Concepts in Molecular Pathology. Elsevier, 3<sup>rd</sup> Edition, 2010

**COURSE OUTCOMES:**

**CO1:** Understand basic cellular and molecular processes in cell that cause disease

**CO2:** Learn structure of human genome, expression techniques and diseases with gene mutation

**CO3:** Understand principle of molecular pathology and infectious disease

**CO4:** Learn fundamentals of different types of diseases

**CO5:** Understand different types of molecular therapeutics

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 35</b>	<b>ARTIFICIAL INTELLIGENCE FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>BIOTECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Introduce fundamental concepts in AI

**COB2:** Demonstrate the capability to create simple applications

**COB3:** Present various modelling and formulations using AI techniques

**COB4:** Introduction to state-of-art AI tools and AI techniques

**COB5:** Understanding to solve problems faced by engineers using AI tools

**MODULE I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9**

Basics of AI. Applications of AI. Advanced search, Constraint satisfaction problems, Knowledge representation & reasoning, Non-standard logics, Uncertain and probabilistic reasoning. Conceptual introduction to Machine Learning: Introduction to Neural Networks, Supervised, Unsupervised, and Semi-Supervised Learning, Deep Learning, Reinforcement Learning, Linear Regression. Conceptual introduction to Natural Language Processing: Natural language Understanding, Sentiment Analysis, Segmentation and recognition. Conceptual introduction to Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modeling, Speech Recognition, Speech Synthesis, Text-to-Speech. Conceptual introduction to Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Segmentation, Edge Detection, Optical Character Recognition, Feature Detection & Recognition

**MODULE II BOT TECHNOLOGIES AND VIRTUAL ASSISTANTS 9**

Chatbots: Introduction to a Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, Designing elements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots. Virtual Assistants: Architecture of a Virtual Assistant.

**MODULE III IMAGE PROCESSING AND COMPUTER VISION 9**

Image - Definition and Tagging. Classification of images. Tagging. Image formation, Deep Learning algorithms for Object detection & Recognition. Face recognition, Instance recognition, Feature detection and matching, Segmentation, Recognition Databases and test sets Applications -- Feature extraction, Shape identification. Face detection, Applications: Automation,

Agriculture[Crop and Soil Monitoring, Grading farm produce, PredictiveAnalytics], Retail and Retail Security[Amazon Go], Autonomous vehicles

#### **MODULE IV REINFORCEMENT LEARNING**

9

Introduction to Reinforcement Learning, Game Playing [ Deep Blue in Chess, IBM Watson in Jeopardy,Google’s DeepMind in AlphaGo ], Agents and Environment, Action-Value Function, Deep ReinforcedLearningApplications : Robotics, Gaming, Diagnostic systems, Virtual Assistants

#### **MODULE V SMART APPLICATIONS**

9

Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, SmartTransportation and Autonomous Vehicles, Smart Homes, Smart Cities.

**L – 30; T – 15; TOTAL HOURS –45**

#### **TEXT BOOKS:**

1. Stuart J. Russell and Peter Norvig,Artificial Intelligence A Modern Approach
2. Tom Markiewicz & Josh Zheng,Getting started with Artificial Intelligence,Published by O’ReillyMedia,2017

#### **COURSE OUTCOMES:**

**CO1:** Understand the importance of AI.

**CO2:** Understand concepts of Machine Learning algorithms and their limitations.

**CO3:** Develop Chatbots based on the requirements.

**CO4:** Analyse complex problems involving image processing, such as quality control, visual surveillance,multimodal human-machine interfaces, and image compression.

**CO5:** Understand the application of Reinforcement Learning

#### **Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### **Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 36</b>	<b>WASTE MANAGEMENT AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>UPCYCLING</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** describe the relation between biodiversity and environmental pollution

**COB2:** describe sources of pollution

**COB3:** describe methods for biomonitoring of pollution

**COB4:** describe applications of biotechnology for environmental remediation

**COB5:** explain potential of genetically engineering microbes for bioremediation

**MODULE I INTRODUCTION 9**

Issues and Scope of Environmental Biotechnology: Introduction to Biodiversity, environmental pollution, chemical pesticides and their effects, metal pollution, bioaccumulation of toxicants, Biotechnological methods for measurement of pollution. Biomonitoring of air and water pollution, remediation of pollutants.

**MODULE II BIOLOGICAL TREATMENT OF WASTE WATER 9**

Biological Treatment of waste water: Aerobic suspended and attached growth system- activated sludge process, trickling filters, Rotating biological contractors (RBC). Anaerobic suspended and attached growth systems- anaerobic digestion, anaerobic filter process, UASB. Removal of biological nitrogen and phosphorus.

**MODULE III TREATMENT OF WASTE WATER FOR FOOD INDUSTRIES 9**

Treatment of waste water of food processing industries: Starch, Dairy, Fruit & Vegetable, Confectionary, Beverages, meat and vegetable oil .

**MODULE IV SOLID WASTE TREATMENT 9**

Solid waste management- Sources, preliminary operations, sludge thickening, sludge stabilization, conditioning of sludge, dewatering, heat drying, disposal of sludge, Composting, Vermicomposting, Biofertilizers.

**MODULE V BIODEGRADATION AND BIOREMEDIATION 9**

Biodegradation and bioremediation- In situ and ex situ bioremediation, biodegradation of hydrocarbons, pesticides, herbicides and xenobiotics. Bioremediation of contaminated soil, Genetically engineered microorganisms

in bioremediation. Phytoremediation.

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. M.H. Fulekhar, Environmental biotechnology, 2017, CRC publishers
2. U. Satyanarayana, Biotechnology, 1st Edition, Books and Allied (P) Ltd, 2005

**COURSE OUTCOMES:**

**CO1:**describe methods for biomonitoring of pollution

**CO2:**describe principles and methods for biological treatment of waste water

**CO3:**describe methods for solid waste management

**CO4:**describe principles and applications of biodegradation and bioremediation

**CO5:**explain potential of genetically engineering microbes for bioremediation

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	H	L	L	-	H	-	L
CO2	H	L	-	L	-	H	L	L	-	H	-	L
CO3	H	L	-	L	-	H	L	L	-	H	-	L
CO4	H	L	-	L	-	H	M	L	-	H	-	L
CO5	H	L	-	L	-	H	H	L	-	H	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTCX 37</b>	<b>STEM CELLS IN HEALTH CARE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To introduce the underlying principles and applications in the emerging field of Stem Cell Technology

**COB2:** To analyze the key concepts used in the debate about stem cell research

**COB3:** To list the properties that define a stem cell and explain how stem cells are derived for scientific research

**COB4:** To list the common and extrapolated potential clinical uses of stem cells

**MODULE I INTRODUCTION TO STEM CELLS 9**

Stem Cell Biology, Fate Mapping of Stem Cell, Stem Cell Pattern, differentiated parental DNA chain causes stem cell pattern of cell type switching in *Schizosaccharomyces pombe*

**MODULE II CELL CYCLE CONTROL 8**

Checkpoints, and Stem Cell Biology, Senescence of Dividing Somatic Cells, The *Drosophila* Ovary, An In Vivo Stem Cell System, Male Germ-line Stem Cells

**MODULE III PRIMORDIAL GERM CELLS 7**

Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Embryonal Carcinoma Cells as Embryonic Stem Cells, Trophoblast Stem Cells

**MODULE IV HEMATOPOIETIC STEM CELLS 9**

Repopulating Patterns of Primitive Hematopoietic Stem Cells, Molecular Diversification and Developmental Interrelationships, Hematopoietic Stem Cells: Lymphopoiesis and the Problem of Commitment Versus Plasticity, Hemangioblast, Mesenchymal Stem Cells of Human Adult Bone Marrow

**MODULE V TYPES & APPLICATIONS OF STEM CELLS 12**

Stem Cells and Neurogenesis, Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon. Cancer stem cells, neural stem cells for CNS repair, embryonic stem cells for heart diseases, stem cells in treatment of diabetes, stem cells in regenerative medicine, stem cell gene therapy

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Essentials of stem cell biology, Robert Lanza, 2nd Ed, Academic press, 2009



2. Stem cell biology in health and diseases. Thomas Dittmar and Kurt S. Zänker, Springer, 2009
3. Stem cell biology and Gene therapy. PETER J. QUESENBERR, Wiley, 2003

#### REFERENCES:

1. Developments in stem cell research. Prasad S Koka, Nova biomedical books, 2009

#### COURSE OUTCOMES:

**CO1:** Search and read current stem cell technology literature applied to a particular problem domain

**CO2:** Classify tumor stem cells which give rise to metastases and treatment-resistant remnant cells that cause relapse, and how this impacts on the development of future cancer treatment strategies.

**CO3:** Outline how stem cells are currently being used in the clinic and what kinds of future treatments lie on the horizon. Students will also be exposed to current Norwegian projects lying at the frontier of stem cell research

**CO4:** To demonstrate an interdisciplinary understanding of central concepts in tissue engineering, biomaterials and stem cell science, and critically evaluate different methods and techniques used

#### Board of Studies (BoS):

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### Academic Council:

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

#### SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

#### SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 38</b>	<b>GENE EXPRESSION AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>TRANSGENICS</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Understand the basic concepts of molecular techniques

**COB2:** Have a knowledge of gene delivery systems

**COB3:** Understand the basic concepts of cell lines

**COB4:** Have knowledge of protein expression

**COB5:** Gain knowledge about transgenic plants and animals

**MODULE I INTRODUCTION 9**

Overview of recombinant protein expression vectors and promoters:

Vectors with tags His, GST, MBP, GFP. Cleavable tag and non-cleavable tags.

**MODULE II VECTORS 9**

Vectors for tag free protein expressions. Over-expression of integral membrane proteins. Overexpression in *E. coli*, *B. subtilis*, *Corynebacterium*, *Pseudomonas fluorescens*, yeasts like *S.cerevisiae* and *Pichia pastoris*, insect cell lines like Sf21, Sf9 and BTI-TN-5B1-4,

**MODULE III CELL LINES 9**

Mammalian cell line like Chinese Hamster ovary (CHO) and Human embryonic kidney (HEK), Plant single cell. Chloroplast transformation and protein expression in chloroplasts.

**MODULE IV PROTEIN EXPRESSION 9**

Cell free protein Expression-Cell free extracts from *E. coli*, rabbit, wheatgerm, insects. Purification of tagged and tag-free proteins. GMP and GLP requirements.

**MODULE V TRANSGENICS 9**

Use of transgenic animals. History, safety and ethics of transgenic animals. Methods for creation of transgenic animals-DNA microinjection, Embryonic stem cell-mediated gene transfer, Retrovirus-mediated gene transfer. Use transgenic animals in medical research, in toxicology, in mammalian developmental genetics, in molecular biology in the pharmaceutical industry,

in biotechnology, in aquaculture and in xenografting. Humanised animal models

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Gene Expression Systems, Using Nature for the Art of Expression. Edited by Joseph M. Fernandez and James P. Hoeffler.
2. Regulation of Gene Expression, By Perdedew, Gary H., Vanden Heuvel, Jack P., Peters, Jeffrey M. Springer.
3. Prokaryotic Gene Expression. Edited by Simon Baumberg. Oxford Press
4. Transgenic Animal Technology, 3rd Edition, A Laboratory Handbook By Carl Pinkert. Elsevier.
5. Ethical Use of Transgenic Animals (English, Paperback, Shah Krunal V). Lambert
6. Transgenic Animals as Model Systems for Human Diseases. Edited E. F. Wagner F. Theuring. Springer

**COURSE OUTCOMES:**

**CO1:** Understand the basic concepts of molecular techniques

**CO2:** Have a knowledge of gene delivery systems

**CO3:** Understand the basic concepts of cell lines

**CO4:** Have knowledge of protein expression

**CO5:** Gain knowledge about transgenic plants and animals

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

**SEMESTER VII**

<b>BTDX 60</b>	<b>RATIONAL DRUG DISCOVERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** framework of the drug development process

**COB2:** its regulation as well as its impact on workers

**COB3:** environment, toxicology, pharmaceuticals, comparative medicine, bioengineering, occupational and environmental health

**COB4:** professional disciplines such as medicine, pharmacology, and nursing interested in working with the biotechnology industry

**COB5:** knowledge about regulations in drug design

**MODULE I INTRODUCTION TO DRUG DESIGN AND DEVELOPMENT 9**

Drug testing toxicities, LD50, EC50, ED50, Dose response curve, Biotransformation of drugs, Detoxification of drugs, Phase I and Phase II reaction in drug metabolism, Preclinical and clinical drug formulation, In vitro and In vivo models for drug designing, drug cytotoxicity assays

**MODULE II DRUG TESTING PROCEDURES 9**

Manufacturing Process for Tablets, Dry granulation process, Wet granulation process, Dose conversion from preclinical studies to clinical studies, Route of administration of drugs, angle of injections of drug, different phases of clinical trials of drugs.

**MODULE III MANUFACTURING OF MEDICINES AND THEIR CONTROL 9**

Preparation of capsules, hard gelatin capsules, soft gelatin capsules, manufacturing process for ointment preparation, narco-drug testing, narco-analysis process, drug doping control procedures, vaccine development against infectious diseases.

**MODULE IV REGULATORY AGENCIES FOR DRUG DEVELOPMENT 9**

Role of Regulatory agencies in drug development, FDA guidelines for drug development, Patenting process in India, Possible therapeutic intervention against COVID-19, Scheduling process of Drugs, Amphetamines,

Cannabinoids, Benzodiazepines, CNS stimulant Drugs, Drug designing against apoptotic mediated

### **MODULE V RESEARCH MODEL FOR DRUG DESIGNING 9**

Introduction of Research Models, Primary cell culture, Secondary cell culture, role of pharmaceutical companies in drug testing procedures, Cancer, Diabetes, Ageing and neurodegenerative animals models, role of biopharmaceuticals in vaccine development.

**L – 30; T – 15 ;TOTAL HOURS –45**

#### **TEXT BOOKS:**

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues, CRC Press, 2006.
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes into drugs, 1st Edition, Wiley Liss, 2003.
3. Curtis D. Klaassen, Casarett & Doull's Toxicology: The Basic Science of Poisons

#### **COURSE OUTCOMES:**

**CO1:** To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agent.

**CO2:** To outline the drug manufacturing process including the role of quality control

**CO3:** To quality assurance in protecting the public, workers, and the environment.

**CO4:** To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical agent

**CO5:** To be able to face regulatory agencies in the process of drug design

#### **Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### **Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 61</b>	<b>STATE OF THE ART IMAGING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Students will learn the basics of imaging

**COB2:** Students will learn SSIM microscopy

**COB3:** Students will learn the photo activated microscopy and its uses

**COB4:** Students will learn the electron microscopic imaging

**COB5:** Students will learn the real time imaging

**MODULE I INTRODUCTION TO IMAGING 9**

Overview and limitations of traditional imaging methods. Fluorescent microscopy, Confocal microscopy, Super-resolution microscopy- Deterministic functional techniques

**MODULE II SATURATED STRUCTURED ILLUMINATION MICROSCOPY 9**

Stimulated emission depletion (STED), Ground state depletion (GSD), Saturated structured illumination microscopy (SSIM), Laser capture microscopy and uses

**MODULE III PHOTO ACTIVATED AND FLOURESCENT MICROSCOPY 9**

Stochastic optical reconstruction microscopy (STORM), photo activated localization microscopy (PALM) and fluorescence photo-activation localization microscopy (FPALM), Points accumulation for imaging in nanoscale topography (PAINT), Label-free localization microscopy.

**MODULE IV ELECTRON MICROSCOPY 9**

Principle and Transmission and scanning electron microscopic imaging, tissue and cell processing and analysis

**MODULE V REAL TIME IMAGING 9**

Multi-photon imaging systems, Real time imaging, computerized tomography (CT) imaging, Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI), Functional MRI (fMRI), Tissue imaging through mass spectroscopy. Image recognitions and artificial intelligence.

**L – 30; T – 15 ;TOTAL HOURS –45**

**TEXT BOOKS:**

1. Super-Resolution Microscopy: A Practical Guide, By Udo J. Birk. Wiley
2. Super-Resolution Microscopy, Methods and Protocols, Editors: Erfle, Holger (Ed.).Springer
3. Super-Resolution Imaging in Biomedicine, By Alberto Diaspro, Marc A. M. J. vanZandvoort. CRC Press
4. Multiphoton Microscopy. Editors: Hartveit, Espen (Ed.). Springer
5. Confocal and Two-Photon Microscopy: Foundations, Applications and Advances byAlberto Diaspro (Editor). Academic Press
6. Basics of PET Imaging, Physics, Chemistry, and Regulations, By Saha, Gopal B.
7. MRI and Spectroscopy in Pharma. & Clinical Research by N. R. Jagannathan
8. Magnetic Resonance Imaging: Physical and Biological Principles, By Stewart C.Bushong. Elsevier
9. Imaging Mass Spectrometry, Protocols for Mass Microscopy. Editors: Setou,Mitsutoshi.

**COURSE OUTCOMES:**At the end of this course the students will know about modern stateof-the-art imaging techniques

**CO1:** Students can understand the basics of imaging

**CO2:** understand uses ofSSIM microscopy

**CO3: understand the uses of** photo activated microscopy

**CO4:** understand the importance ofelectron microscopic imaging

**CO5:**understand the key aspect of real time imagin

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.



**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 62</b>	<b>PRECISION MEDICINE AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>WELLNESS</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Explain how the HGP has advanced technology in biomedical research.

**COB2:** Understand how the diversity of life evolves over time by processes (leading to) of genetic change, particularly the role of genetic and genomic variation throughout the genome in health and disease.

**COB3:** Describe recent advances in disease risk prediction, molecular diagnosis and progression of diseases, and targeted therapies for individuals.

**COB4:** Understand how to translate research findings and technology into healthcare delivery that benefits the general public.

**COB5:** Critically evaluate primary and secondary precision medicine research

**MODULE I INTRODUCTION 9**

Introduction to Precision Medicine, the Human Genome, and Human Genomic Variation

**MODULE II GENOME 9**

Genome: Whole Genome Sequencing, Pharmacogenome, Epigenome: DNA Methylation, Histone modifications, Chromatin remodelling factors,

**MODULE III TRANSCRIPTOME 9**

Comparative genomics: Basic concepts and applications, BLAST2, MegaBlast algorithms, PipMaker, AVID, Vista, MUMmer, applications of suffix tree in comparative genomics, synteny and gene order comparisons Comparative genomics databases: COG, VOG Functional genomics: Application of sequence based and structure-based approaches to assignment of gene functions –e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc. Use of various derived databases in function assignment, use of SNPs for identification of genetic traits. Gene/Protein function prediction using Machine learning tools viz. Neural network, SVM etc.

**MODULE IV METABOLOME 9**

Molecular interactions: Protein-Protein interactions, Protein-DNA interactions. Methods to predict molecular interactions: Y2H method, Phage-Display method, Phylogenetic footprinting, Gene fusion method, Protein profiling, Molecular-Docking. Database, Server and tools for analysis of protein-protein interaction,

Docking. Tools of analyzing Proteomics data (ExpASy server) and GCG utilities and EMBOSS

## MODULE V MICROBIOME

9

Developing Evidence for PM & Designing PM Clinical Trials, educating public and providers

### PRACTICALS

#### List of Experiments

1. World tour of human genome
2. Mining the The Cancer Genome Atlas (TCGA) with cBioPortal, Broad GDAC Firehose and Firebrowse
3. Data Summary and Hypothesis Refinement
4. qRT-PCR primer design
5. cDNA synthesis

L – 30; T – 15 ; TOTAL HOURS – 45

#### TEXT BOOKS:

1. Genomic and Precision Medicine, 3rd Edition, Geoffrey Ginsburg and Huntington Willard, 2016
2. The Language of Life: DNA and the Revolution in Personalized Medicine, Francis S. Collins, 2010

#### COURSE OUTCOMES:

**CO1:** To explain the therapeutic mode of action, and understand structural considerations of at least four classes of precision medicine.

**CO2:** To outline the drug manufacturing process using genome

**CO3:** To quality assurance in protecting the public, workers, and the environment using metabolome.

**CO4:** To understand microbiome

**CO5:** To understand transcriptome.

#### Board of Studies (BoS):

8<sup>th</sup>BoS of SLS held on 5.07.2021

#### Academic Council:

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 63</b>	<b>INDUSTRIAL BIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of biotechnology.

**COB2:** To update students' knowledge of new developments in biology of industrial relevance.

**COB3:** To give students a broad understanding and experience of technological processes

**COB4:** To give students a broad understanding and experience of metabolites

**COB5:** To give students a broad understanding and experience of applications of industrial biotechnology.

**MODULE I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9**

Overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Biotechnology and the developing world.

**MODULE II METABOLIC STRATEGIES 9**

General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis, Bioprocess/fermentation technology: Bioreactor, Scale-up, Media design, Technology for microbial, mammalian and plant cell culture, Downstream processing.

**MODULE III PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 9**

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.); amino acids (glutamic acid, phenylalanine, aspartic acid etc.) and alcohols (ethanol, butanol etc.) Study of production processes for various classes of secondary metabolites.

**MODULE IV ENZYME TECHNOLOGY & BIOPHARMACEUTICALS 9**

Nature, Application, Genetic engineering & protein engineering, Immobilised enzymes and Technology of enzyme production, Introduction to genetic engineering, Antibiotics, Therapeutic proteins, Vaccines & monoclonal

antibodies, Gene therapy.

## MODULE V APPLICATIONS

9

Introduction, Fermentation, Food processing, Sweeteners, Food wastes, Rapid diagnostics, Public acceptance & safety, Plant biotechnology, Forestry, Biological control, Animal biotechnology, Diagnostics in agriculture, Bioremediation. IPR, Safety, Social, moral and ethical aspects of Biotechnology.

**L – 30; T – 15; TOTAL HOURS –45**

### TEXT BOOKS:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY, 3<sup>rd</sup> Edition, 2004
2. Biochemistry by Zubey. Wm. C. Brown publishers, 1<sup>st</sup> Edition 1998
3. Biotechnology, John E. Smith, 1<sup>st</sup> Edition, 2000
4. Bioprocess Engineering Principles, Pauline M. Doran, 5<sup>th</sup> Edition, 2009

### COURSE OUTCOMES:

**CO1:** The facts, concepts, principles and theories relevant to the broad area of Biotechnology.

**CO2:** The professional and ethical responsibilities of the Biotechnologist.

**CO3:** Current themes and/or insights, at/or informed by, the forefront of the Biotechnology Industry and its related disciplines.

**CO4:** The techniques applicable to the area of Biotechnology

**CO5:** Processes which facilitate the critical evaluation of research, scholarship and methodologies within the area of Biotechnology.

### Board of Studies (BoS):

8<sup>th</sup>BoS of SLS held on 5.07.2021

### Academic Council:

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 64</b>	<b>BIO SEPARATION TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** recovery, of biological products on a large scale.

**COB2:** isolation, of biological products on a large scale.

**COB3:** purification of biological products on a large scale.

**COB4:** polishing of biological products on a large scale.

**COB5:** drying of biological products on a large scale.

**MODULE I INTRODUCTION TO BIOSEPARATION 9**

Definition, Role of bioseparation in Bioprocess technology, challenges in bioseparation, Ideal bioseparation process

**MODULE II REMOVAL OF SOLIDS 9**

Principle and types of Filtration, Large scale filtration system, Large scale microfiltration, Large scale centrifugation, Sedimentation centrifugation, Decanter Centrifuges, Disc Stack Centrifuges, Hydrocyclones, Filter Centrifuges, Ultracentrifugation

**MODULE III VOLUME REDUCTION 9**

Extraction, Soxhlet extraction, Maceration extraction, Ultrasound assisted extraction, Microwave assisted extraction, supercritical fluid extraction, Aqueous two-phase systems, precipitation, selective precipitation, affinity precipitation

**MODULE IV PURIFICATION 9**

Adsorption, Mixed mode expanded bed adsorption, adsorbents, Nano-based adsorbents, Chromatography, electrophoresis, crystallization

**MODULE V DRYING AND POLISHING 9**

Drying biological materials, intermittent drying, pulse combustion drying, impinging stream drying, cyclic pressure vacuum drying, spray-freeze-drying, atmospheric freeze-drying, vacuum fluidized bed drying, low-pressure spray drying, superheated steam drying, heat pump drying, inert medium drying, supercritical fluid drying, sorption drying, spouted bed drying, jet spouted bed drying, vibrating fluidized bed drying, pulse fluidized bed drying, high electric field drying, and microwave drying, auxiliary process



**L – 30; T – 15; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Industrial Bioseparations: Principles and Practice, Daniel Forciniti, Wiley, 1<sup>st</sup> Edition, 2008
2. Bioseparations Science and Engineering (2nd ed.), Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, 2008

**COURSE OUTCOMES:**

**CO1:** apply different technologies involved in the reduction of bulk quantity after the large-scale process in bioreactor and to remove specific impurities

**CO2:** make rational decisions to achieve the product specifications and enrich target products

**CO3:** make rational decisions to achieve the product purification

**CO4:** make rational decisions to achieve the product drying

**CO5:** make rational decisions to achieve the product polishing

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 65</b>	<b>PROTEOMICS &amp; GENOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Advanced level training on gene expression and gene therapy by covering topics such as genome mapping, proteomic techniques.

**COB2:** To familiarize and expose the students to the principle of gene expression,

**COB3:** Concepts of functional genomics and proteomics in biopharmaceutical industry.

**COB4:** Understanding of proteomics tools

**COB5:** Applications of proteomics

**MODULE I      OUTLINE ABOUT GENOME      9**

Genome organization (prokaryotes and Eukaryotes) – Viral genomes, bacterial genomes, fungal genome, worm genome, plant genome and animal genomes. High capacity vectors- cosmid, Fosmid, PAC, P1 derived vectors, BAC, YAC

**MODULE II      FUNCTIONAL GENOMICS      9**

Introduction, Northern blot, Subtractive hybridization, Differential Display reverse transcription PCR (DDRT-PCR), Serial Analysis Gene Expression (SAGE), microarray technology. DNA sequencing methods-chemical degradation, chain termination, next generation sequencing.

**MODULE III      PROTEOMICS AND THE PROTEOMES      9**

Introduction - Traditional route of protein study, Protein isolation methods-extraction methods, protein separation technique. Branches of proteomics-quantitative proteomics, Characteristics of proteomics.

**MODULE IV      TOOLS OF PROTEOMICS      9**

Two-dimensional gel electrophoresis of proteins- principle, 2D apparatus, sample preparation, first dimensional IEF, equilibration, second dimensional separation by SDS, image analysis, application of 2D PAGE. Mass spectrometry- protein sample preparation. Application of MS proteomics. Peptide Mass fingerprinting

**MODULE V      APPLICATION OF PROTEOMICS      9**

Mining Proteomes, protein expression profiling, protein-protein interactions

and protein complexes, Mapping protein modification, new direction in proteomics.

**L – 30; T – 15; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Saccone, C., Pesole, G., Hand book of Comparative Genomics – Principles and Methodology, John Wiley and Sons Publication, New Jersey, 1st Edition, 2003.
2. Lesk, A.M., Introduction to Protein Science. Architecture, Function and Genomics, Oxford University press, New York, 2nd Edition, 2004.
3. Creighton, T.E., Protein Structure – A Practical Approach, Oxford University Press, New York, 4th Edition, 2004.
4. Brown, T.A., Genomes III, Garland Science, Taylore and Francis Group, New York, 3<sup>rd</sup> edition, 2007.

**COURSE OUTCOMES:**

**CO1:** Describe DNA sequencing technologies and recent advances for high throughput genomic sequencing.

**CO2:** Compare and contrast different methods for functional genomic analysis

**CO3:** Provide examples of how genomics technologies have been applied to improve our understanding of biological systems.

**CO4:** Compare and contrast classical approaches to understanding protein

**CO5:** Application-based approach of the course

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



**MODULE IV MEDICAL IMAGING****9**

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems.

**MODULE V ASSISTING AND THERAPEUTIC EQUIPMENTS****9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

**L – 30; T – 15; TOTAL HOURS – 45****TEXT BOOKS:**

1. R.S. Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J. Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', IInd edition, Pearson Education, 2002 / PHI

**COURSE OUTCOMES:**

**CO1:** he course will help the student to acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance.

**CO2:** The students will be trained in radiology process

**CO3:** They will be able to analyse the radiology data

**CO4:** Will have latest idea of electrical devices

**CO5:** Will have latest idea of medical imaging

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 67</b>	<b>MEDICAL BIOTECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**SDG: 3, 15**

**COURSE OBJECTIVES:**

**COB1:** Understanding of proteins as therapeutic agents

**COB2:** Preparation and use on monoclonal antibodies

**COB3:** Understanding of human diseases

**COB4:** Concepts of different types of vaccines

**COB5:** Application of new technologies in healthcare settings

**MODULE I SIMPLE PROTEINS AND THERAPEUTIC AGENTS 9**

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins  
Engineering human interferons and human growth hormones Regulatory aspects of therapeutic proteins - Enzymes as therapeutic agents Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis.

**MODULE II MONOCLONAL ANTIBODY AS THERAPEUTIC AGENT 9**

Production of monoclonal antibodies Production of antibodies- Human monoclonal antibodies, its scope and limitations - Hybrid human – Mouse antibodies – in E.coli Approaches for producing HIV therapeutic agents.

**MODULE III HUMAN DISEASES AND VACCINES 9**

Viral and bacterial diseases - Diseases caused by protozoan and parasitic worms (helminths) - Emerging infectious diseases – Active and passive immunity – Autoimmunity- Rational of immunization - Diseases controllable by vaccination – Vaccines, designing vaccines adjuvants - Whole organisms vaccines - Attenuated viruses and bacteria - Inactivation of pathogenic organisms by heat and chemical treatment

Bacterial polysaccharides, proteins and toxins as vaccines - Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS - Commercial and regulatory aspects of vaccine production and its distribution

**MODULE IV APPLICATION OF GENETIC ENGINEERING IN HEALTH CARE 9**

Production of Recombinant Proteins having therapeutic and diagnostic

applications, Recombinant vaccine.

**MODULE V DIAGNOSIS AND KIT DEVELOPMENT 9**

Use of enzymes in clinical diagnosis - Use of biosensors for rapid clinical analysis - Diagnostic kit development for microanalysis

**L – 45 ; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Glick, B.R., Pasternak, J. J., Molecular Biotechnology, Principles and Application of Recombinant DNA, ASM press, Washington, 2nd Edition, 1998
2. Ratledge, C., Kristiansen, B., Basic Biotechnology, Cambridge University Press, USA, 2nd Edition, 2001.
3. David, E., Technology and Future of health care, Preparing for the Next 30 years, Jhon Wiley, Singapore, 2nd Edition, 2000.

**COURSE OUTCOMES:**

**CO1:**Research, evaluate and critically assess the theoretical basis and practical application of selected medical biotechnologies

**CO2:**Demonstrate knowledge and understanding of selected medical biotechnologies

**CO3:**Describe in detail essential facts and theory in molecular biology and biotechnology when applied to medicine

**CO4:**Describe and critically evaluate aspects of current research in the biosciences with reference to reviews and research articles

**CO5:**With limited guidance, deploy established techniques of analysis and enquiry within the biosciences.

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	L	-	L	-	-	L	L	-	-	-	L	H	L	-
CO2	H	L	-	L	-	-	L	L	-	-	-	L	H	L	-
CO3	H	L	-	L	-	-	L	L	-	-	-	L	H	L	-
CO4	H	L	-	L	-	-	M	L	-	-	-	L	H	L	-
CO5	H	L	-	L	-	-	H	L	-	-	-	L	H	L	-

**Note:** L - Low Correlation M - Medium Correlation H - High Correlation



**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 68</b>	<b>MATERIAL SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To introduce concepts of materials, surface and tissue placement in biomaterial functions

**COB2:** To understand diverse elements controlling biological responses to materials

**COB3:** To provide contemporary biomaterial principles

**COB4:** To provide ceramic implant material

**COB5:** To provide toxicological screening of biomaterials

**MODULE I INTRODUCTION 9**

Fundamentals of biomaterials science. Concept of biocompatibility. Classes of biomaterials used in medicine, basic properties, medical requirements and clinical significance. Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.

**MODULE II METALLIC IMPLANT MATERIALS 9**

Metallic implant materials: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vascular implants, Heart valve implants -Tailor made composite in medium.

**MODULE III POLYMERIC IMPLANT MATERIALS 9**

Polymeric implant materials: Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers). Viscoelastic behavior: Importance of molecular structure, hydrophilic and hydrophobic surface properties.

**MODULE IV CERAMIC IMPLANT MATERIALS 9**

Ceramic implant materials: Definition of bio ceramics. Common types of bio ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction

(e.g. ceramic/bone tissue reaction).

## **MODULE V TOXICOLOGICAL SCREENING OF BIOMATERIALS**

**9**

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

**L – 30; T – 15; TOTAL HOURS – 45**

### **TEXT BOOKS:**

1. J.H.U. Brown (Ed), Advances in Bio Medical Engineering, Academic Press 1975.
2. Andrew F.VonRacum, Hand Book of Bio Medical Evaluation, Mc-Millan Publishers, 1980.
3. Jacob Cline, Hand Book of Bio Medical Engineering, Academic Press in Sandiego, 1988.
4. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.
5. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering, 2005.
6. Buddy D.Ratner, Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine, 2nd Edition, Elsevier Academic Press, San Diego, 2004.

### **COURSE OUTCOMES:**

**CO1:** Widen rational design approaches to biomaterials engineering Identify significant gap required to overcome challenges and further development

**CO2:** Develop critical analyses of biomaterials through proposal writing and review.

**CO3:** Be able to develop protocols for biomaterial development

**CO4:** Be able to develop protocols for ceramic implants development

**CO5:** Be able to develop protocols for toxicity screening of biomaterials

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

Statement: The holistic understanding of welding, moulding, machining, wiring, and electronic circuit increases the access of small-scale industrial and other enterprises in developing countries.

<b>BTDX 69</b>	<b>BIOMEDICAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the application of biomedical instrumentation

**COB2:** To introduce the student to the various devices of electrical origin and non-electrical origin.

**COB3:** To provide awareness of electrical safety of medical equipment.

**COB4:** To know the important and modern methods of imaging techniques.

**COB5:**

<b>MODULE I</b>	<b>FUNDAMENTALS OF MEDICAL INSTRUMENTATION</b>	<b>9</b>
-----------------	--	----------

Role of technology in medicine, landmark developments in biomedical instrumentation, physiological systems of the body, sources of biomedical signals, basic medical instrumentation system, performance requirements of medical instrumentation systems, intelligent medical instrumentation systems, consumer and portable medical equipment, implantable medical devices, Basic components of a biomedical system, Transducers, Piezoelectric, ultrasonic transducers, Temperature measurements, Fibre optic temperature sensors. Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers Isolation amplifier.

<b>MODULE II</b>	<b>THERAPEUTIC EQUIPMENTS AND PATIENT SAFETY</b>	<b>9</b>
------------------	--	----------

Audiometers and Hearing Aids, Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart – Lung machine, Dialysers, Lithotripsy, electric shock hazards, leakage currents, safety codes for electromedical equipment, electrical safety analyzer, testing of biomedical equipment.

<b>MODULE III</b>	<b>BIOMEDICAL RECORDER</b>	<b>9</b>
-------------------	----------------------------	----------

Measurement of blood pressure, Heart rate, Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analysers: pH of blood measurement of blood pCO<sub>2</sub>, pO<sub>2</sub>, finger-tip oxymeter - ESR, GSR measurements, Electrocardiograph, vectorcardiograph (VCG), phonocardiograph (PCG), digital stethoscope, electroencephalograph (EEG), electromyography, other biomedical recorders, biofeedback instrumentation.



**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

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

Statement: The holistic understanding of welding, moulding, machining, wiring, and electronic circuit increases the access of small-scale industrial and other enterprises in developing countries.

<b>BTDX 70</b>	<b>HEALTHCARE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>BIOTECHNOLOGY</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** Will enable students to acquire knowledge on the fundamentals of healthcare biotechnology

**COB2:** Enables them to understand emerging and advanced concept in molecular pathogenesis of disease and role of biotechnology in diagnosis, prevention and therapeutics

**COB3:** Facilitate the students to acquire knowledge in fields various aspects and molecular tools used in clinical application in alleviation of human disease

**COB4:** Empower the students to have advanced focus on the molecular basis of diseases and development of advanced therapeutics.

**COB5:** Understand the principles of chemotherapy

<b>MODULE I</b>	<b>INTRODUCTION AND THERAPEUTIC BIOMOLECULES</b>	<b>9</b>
-----------------	--	----------

Molecular basis of disease, Biotechnology in disease prevention, therapeutics and diagnosis, Personalized Medicine; Therapeutic Biomolecules: Introduction, Nucleic acid, protein, carbohydrate and lipids, Role of biomolecules in diseases.

<b>MODULE II</b>	<b>MOLECULAR DIAGNOSTICS AND IMMUNOLOGICAL PRODUCTS</b>	<b>9</b>
------------------	---	----------

Molecular diagnostics: gene-based diagnosis, tools for screening of infectious disease, genetic disease; Immunological products: Overview, Vaccines, Cancer immunotherapy, Monoclonal Antibodies in Solid Organ Transplantation Monoclonal Antibodies in Anti-inflammatory Therapy.

<b>MODULE III</b>	<b>OLIGONUCLEOTIDES AND OLIGOSACCHARIDES</b>	<b>9</b>
-------------------	--	----------

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozyme; Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate based cancer Vaccines

<b>MODULE IV</b>	<b>RADIOLOGICAL AGENTS AND CARDIOVASCULAR DRUGS AND ENDOCRINE DRUGS</b>	<b>9</b>
------------------	---	----------



Radiological Agents: Radiosensitizers and Radioprotective agents; Cardiovascular Drugs and endocrine drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, antithrombotics and Haemostatics, Sex hormones and analogs.

**MODULE V CHEMOTHERAPEUTIC AGENTS 9**

Chemotherapeutic Agents: Synthetic antibacterial agents, antifungal, anti protozoal, Antihelminthic agents Antiamoebic agents, Antiviral agents

**L – 30; T – 15; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Pharmaceutical Chemistry by Christine M. Bladon. John Wiley & Sons, Ltd.(2002).
2. Burger's Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E.Wolff. A Wiley (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. Wiley-VCH. (2002).
4. Medical Biotechnology, by JuditPongracz, Dr.Habil and Mary Keen. Churchill Livingstone (2008).
5. Healthcare Biotechnology: A Practical Guide 1st Edition by Dimitris Dogramatzis. CRC Press (2010)
6. Biotechnology in Healthcare: An Introduction to Biopharmaceuticals. Gavin Brooks, Pharmaceutical Press, (1998)
7. Biotechnology in Medical Sciences, By FirdosAlam Khan, CRC press, Taylor and Francis, (2014)

**COURSE OUTCOMES:**

**CO1:** understand therapeutic biomolecules and their applications

**CO2:** get knowledge of molecular diagnostics know the applications of oligonucleotides and oligosaccharides

**CO3:**get knowledge about oligonucleotides and oligosaccharides

**CO4:**understand relation between radiological agents as cardiovascular drugs

**CO5:**develop protocols for use of chemotherapeutic agents

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12
CO1	H	L	-	L	-	-	L	L	-	-	-	L
CO2	H	L	-	L	-	-	L	L	-	-	-	L
CO3	H	L	-	L	-	-	L	L	-	-	-	L
CO4	H	L	-	L	-	-	M	L	-	-	-	L
CO5	H	L	-	L	-	-	H	L	-	-	-	L

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

## SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

## SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 71</b>	<b>MOLECULAR FARMING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To introduce molecular pharming

**COB2:** To create complete knowledge about the recombinant protein production.

**COB3:** To create awareness about the production of pharmaceutical proteins in plants

**COB4:** To create awareness about the chloroplast derived antibodies, edible vaccines

**COB5:** To create awareness about the downstream processing of plant derived recombinant proteins

**MODULE I INTRODUCTION AND FOREIGN PROTEIN EXPRESSION 9**

Introduction, foreign protein production systems -Plant tissue culture - Suspended cultures. Hairy root cultures, shoot teratoma cultures. Strategies for improving FP production in tissue culture. modifications to existing expression constructs. Secretion of foreign proteins - Foreign protein stability - Stability inside the cells

**MODULE II NOVEL SPROUTING TECHNOLOGY FOR RECOMBINANT PROTEIN PRODUCTION 9**

Biology of sprouting - Dicotyledonous seeds - Germination, sprout Rubisco synthesis, rubisco promoters- Inhibition of endogenous gene expression - Expression cassette design, sprouting- equipment's, conditions - Sterilization, time and temperature, light, inhibition of endogenous gene expression, Growth regulators, nitrogen fertilizer - Seed production, quality and environmental aspects

**MODULE III MONOCOT AND PLANT VIRAL EXPRESSION SYSTEMS 9**

Technical aspects, cereal transformation, expression construct design - Prodi gene and Maize. Recombinant proteins expressed in Rice - Recombinant proteins expressed in Wheat, Barley. Plant RNA viruses as expression vectors- TMV, PVX - Plant RNA viruses as expression vectors-CPMV, AIMV. Biological activity of target molecules. Efficacy of plant virus antigens. Vaccine antigens- particle based

**MODULE IV CHLOROPLAST DERIVED ANTIBODIES, EDIBLE VACCINES 9**

Introduction, expression of therapeutic and human proteins in plants. Transgenic chloroplast system. Chloroplast derived human antibodies, biopharmaceuticals. Human Serum Albumin. Human insulin like growth factor-1, Human interferon, antimicrobial peptides. Chloroplast derived vaccine antigens, *Cholera* toxin B subunit, *Bacillus anthracis* protective antigen. *Yersinia pestis* F1-V fusion antigen, Canine Parvovirus VP2 protein.

**MODULE V DOWNSTREAM PROCESSING OF PLANT DERIVED RECOMBINANT THERAPEUTIC PROTEINS 9**

Similarities and differences in the processing of pharmaceutical proteins from different sources Process scale. Individual steps of a Downstream process. Initial processing and extraction Chromatographic purification, Regulatory requirements for downstream processing of plant derived products. Regulatory requirements for downstream processing of plant derived products.

**L – 30; T – 15; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Molecular Farming – Plant-made Pharmaceuticals and Technical Proteins, Rainer Fischer and Stefan Schillberg. Wiley.VCH Verlag GmbH and Co. KGaA. 2004
2. Molecular Pharming: Applications, Challenges and Emerging Areas 1<sup>st</sup> Edition, Liwen Jiang 2017

**COURSE OUTCOMES:**

**CO1:** The student will be aware about the basics of molecular farming

**CO2:** The student will be aware about production of pharmaceutical proteins in plants

**CO3:** The student will be aware about chloroplast derived antibodies, edible vaccines

**CO4:** The student will be aware about downstream processing of plant derived recombinant proteins

**CO5:** The student will be aware about applications of course in daily life

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

## SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

## SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



component), equations of continuity for each species, equation of energy (multi-component).

#### **MODULE IV MASS TRANSPORT**

**9**

Diffusivity, theory of diffusion, analogy between mass heat and momentum transfer, role of diffusion in bioprocessing, film theory, concentration distribution with more than one independent variable- unsteady diffusion, boundary layer theory, concentration distribution in turbulent flow- Corrosion equation. Definition of binary mass transfer coefficients, transfer coefficients at high mass transfer rates-boundary layer theory, penetration theory. Convective mass transfer, Liquid -solid mass transfer, liquid-liquid mass transfer, gas-liquid mass transfer

#### **MODULE V OXYGEN TRANSPORT**

**9**

Oxygen uptake in cell cultures, Factors affecting cellular oxygen demand, oxygen transfer from gas bubbles to aerobic culture, oxygen transfer in fermenters, bubbles factors affecting oxygen transport- sparging, stirring, medium properties, antifoam agents, temperature, mass transfer correlations, measurements of  $k_L a$  – oxygen balance method, dynamic method.

**L – 30; T – 15; TOTAL HOURS – 45**

#### **TEXT BOOKS:**

1. R. B. Bird, W. E. Stewart, E. N. Lightfoot, Transport Phenomena, 2nd edition, John Wiley and sons Singapore, 2006.
2. P. M. Doran, Bioprocess Principles, 2nd edition, Academic Press, 2012.
3. Harvey W. Blanch, Douglas S. Clark Biochemical Engineering, Marcelcel, Dekker, 2007.
4. Byron, R. B., Stewart, W. E., Lightfoot, E. N., "Transport Phenomena", John Wiley & Sons, 1960.

#### **COURSE OUTCOMES:**

**CO1:** Assessment by ability to differentiate Newtonian and Non-Newtonian fluids.

**CO2:** Assessment by ability to demonstrate interphase transport in isothermal system and interactions.

**CO3:** Assessment by ability to demonstrate the effect of heat transfer on cell concentration and stirring conditions in stirred tank reactor.

**CO4:** Assessment by ability to analyze and demonstrate the diffusion concepts during the transport.

**CO5:** To understand the requirement and effect of oxygen in the process.

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

## SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

## SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.



<b>BTDX 73</b>	<b>VACCINE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide the knowledge on conventional to recent technology of vaccine production.

**COB2:** To learn the types of vaccines, its immunological effects and regulatory guidelines.

**COB3:** To learn updates on vaccine research, design and development

**COB4:** To understand the requirement of animal testing for vaccine research, design and development

**COB5:** To learn about commercialisation, quality control related to vaccine development

**MODULE I FUNDAMENTAL CONCEPTS I 9**

Fundamental concepts and anatomy of the immune system, Components of innate and acquired immunity, Humoral and Cell mediated immunity, Haematopoiesis, Antigens, immunogens, haptens, Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing.

**MODULE II FUNDAMENTAL CONCEPTS II 9**

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants, Multigene organization of immunoglobulin genes, Immunological basis of self –non-self discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity, Antigen processing and presentation- endogenous antigens and exogenous antigens.

**MODULE III CLASSIFICATION OF VACCINES AND ITS PREPARATIONS 9**

A short history of vaccination, Active and passive immunization, General immunization practices, Vaccination of immunocompromised hosts, Vaccination of human immunodeficiency virus- infected persons, Vaccines, Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines.

**MODULE IV VACCINE RESEARCH AND DESIGN****9**

Licensed vaccines, Viral Vaccine (Poliovirus vaccine-inactivated & Live, Rabies vaccines Hepatitis A & B vaccines), Bacterial Vaccine (Anthrax vaccines, Cholera vaccines, Diphtheria toxoid), Parasitic vaccine (Malaria Vaccine).

**MODULE V ANIMAL TESTING, COMMERCIALISATION, QUALITY CONTROL****9**

The vaccine industry, Vaccine manufacturing, Evolution of adjuvants across the centuries, Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Vaccine safety and Legal issues.

**L – 45; TOTAL HOURS –45****TEXT BOOKS:**

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999. 4. Paul, Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.
4. Stanley A. Plotkin & Walter Orenstein & Paul A. Offit, Vaccines, 6th Edition 2013 BMA Medical Book Awards Highly Commended in Public Health! Elsevier Publication.
5. Roitt's Essential Immunology. 11th ed. P. Delves, et al., ed., Blackwell Publishing, 2006.

**COURSE OUTCOMES:**

**COB1:** The knowledge on conventional to recent technology of vaccine production.

**COB2:** Assessment by ability on the types of vaccines, its immunological effects and regulatory guidelines.

**COB3:** Updated on vaccine research, design and development

**COB4:** Understood the requirement of animal testing for vaccine research, design and development

**COB5:** Understood Commercialisation, quality control related to vaccine development

**Board of Studies (BoS):**8<sup>th</sup>BoS of SLS held on 5.07.2021**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

## SDG 3. Good Health and Well Being

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

## SDG15: Life on Earth

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

<b>BTDX 75</b>	<b>REGULATORY AFFAIRS FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 15</b>	<b>BIOTECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

By the end of this module the students will be able

**COB1:** To demonstrate through presentations and in discussions their understanding of different international policies, regulations and agreements that govern the use of biotechnology and show how these can be used as a framework for developing national biosafety laws.

**COB2:** To demonstrate using specific case-studies an understanding of the effectiveness and reliability of biosafety regulations in governing the use of biotechnology

**COB3:** To discuss in written essays their understanding of consumer rights and why labelling of genetically modified foods has become such a controversial issue.

**COB4:** To discuss using presentations and in written essays the influence of politics and science in the regulation of biotechnology.

**COB5:** To explain in written assignments the risks and benefits of genetic modification from a regulatory perspective

**MODULE I INTRODUCTION 9**

Validation and Regulatory Affairs in Bio (Pharmaceutical) Manufacturing: An Introduction to FDA Operations & Industry Compliance Regulations, The Fundamentals of Regulatory Compliance with respect to Good Clinical Practice (GCP), Good Manufacturing Practice (GMP) & Good Laboratory Practice (GLP). An Introduction to the Basic Concepts of Process Validation & how it Differs from Qualification (IQ, OQ & PQ) Procedures, A Review of Prospective, Concurrent, Retrospective Validation & Revalidation. ISO 9000 Series & International Harmonization & their effect upon GMP's.

**MODULE II VALIDATION 9**

Validation of Water & Thermal Systems, including HVAC Facilities & Cleaning Validation. Validation of Active Pharmaceutical Ingredients (APIs) & Aseptic Processes. Validation of Non-Sterile Processes (used in the manufacture of Solids, Liquids, & Semisolid Dosage Forms). Overview of method evolution, FDA and ICH guidelines, Development and validation, Basic statistical concepts, Outliers, Specificity: sample preparation, Specificity: separations, Specificity: detectors, Linearity, Accuracy, Precision, Limits of detection (LOD) and quantification (LOQ), Minimum detectable amount (MDA), Sample

stability and method robustness, Window diagrams, System suitability, Statistical process control for HPLC, Sustainable validation, Troubleshooting out-of control systems, case studies.

### **MODULE III RISK AND SAFETY APPROACHES 9**

Concerns about genetically modified organisms- Socio-political attitudes and values- acceptance of particular applications of genetically modified foods- demand for information about gm- issues of traceability of gm foods and ingredients- non-involvement of public decision making processes- differences in food safety regulation in different jurisdictions- integrated assessment tools.

### **MODULE IV QUALITY AND IMPLEMENTATION 9**

Terminology Relating to Quality, Quality Requirement, Customer Satisfaction, Capability; Terms Relating to Management, Management System, Quality Management System, Quality Policy, Quality Objectives, Quality Planning, Quality Control, Quality Assurance, Quality Improvement, Continual Improvement, Effectiveness, Efficiency, Terms relating to Characteristics, Quality Characteristics; Terms Relating to Conformity, NonConformity, Defect, Preventive Action, Corrective Action, Correction, Rework, Repair, Scrap, Concession, Deviation Permit, Release; Objective Evidence, Inspection, Test, Metrological Confirmation. Final Inspection and Testing.

### **MODULE V QUALITY MANAGEMENT 9**

The development of regulatory requirements for validation, The V model and Life Cycle model approach to validation and documentation, Risk Analysis Techniques: Impact Assessment; Failure Mode and Effects Analysis (FMEA), Validation Master Plans, Contamination Control, Risk Management in the Pharmaceutical Industry, Solid Dose Manufacture Principles and Practices, Liquid and Cream Manufacture Principles and Practices, Good Laboratory Practices (for Non-Clinical Laboratories), Computer Systems Validation Principles and Practices, Good Aseptic Practices and Sterile Products, Clinical Trials Quality Assurance Management, Pharmaceutical Engineering-Facility, Equipment and Process Design, Fundamentals of Process Analytical Technology, Quality and Continuous Improvement in the Biotech Industry.

**L – 45; TOTAL HOURS – 45**

#### **TEXT BOOKS:**

1. Pharmaceutical Process Validation Robert Nash and Alfred Wachter, Marcel Dekker New York : Marcel Dekker, 2003.

2. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control from Manufacturer to Consumer Sidney J. Willig, Marcel Dekker New York : Marcel Dekker, 2001
3. Validation of Pharmaceutical Processes: Sterile Products Frederick J. Carlton and James Agalloco New York : Marcel Dekker, 3rd Edition 2008
4. Validation Standard Operating Procedures: A Step by Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotech Industries Syed ImtiazHaider Saint Lucie Press 2001

**COURSE OUTCOMES:**By the end of this module the students will be able:

**CO1:** demonstrate through presentations and in discussions their understanding of different international policies, regulations and agreements that govern the use of biotechnology and show how these can be used as a framework for developing national biosafety laws.

**CO2:** demonstrate using specific case-studies an understanding of the effectiveness and reliability of biosafety regulations in governing the use of biotechnology

**CO3:** understand in written essays their understanding of consumer rights and why labelling of genetically modified foods has become such a controversial issue.

**CO4:** discuss using presentations and in written essays the influence of politics and science in the regulation of biotechnology.

**CO5:** explains in written assignments the risks and benefits of genetic modification from a regulatory perspective

**Board of Studies (BoS):**

8<sup>th</sup>BoS of SLS held on 5.07.2021

**Academic Council:**

18th AC held on 24.02.2022

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

**Note:** L - Low Correlation    M - Medium Correlation    H - High Correlation

**SDG 3. Good Health and Well Being**

Statement: Understanding of the fundamentals of this course can help in maintains systems to promote good health and well being.

**SDG15: Life on Earth**

Statement: This course gives knowledge about the living and non living and relation with all the levels of life in the earth.

**HUMANITIES ELECTIVE – I (SEMESTER III)**

<b>SSDX 01</b>	<b>ENGINEERING ECONOMICS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4, 8, 9,12</b>	<b>MANAGEMENT</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To present the major concepts and techniques of engineering economic analysis that is needed in the decision making process by providing insights to the basic microeconomic concepts of demand, supply and equilibrium.

**COB2:** To generate theoretical knowledge and understanding of macroeconomic aggregates such as national income and inflation and the major challenges associated with the measurement of these aggregates.

**COB3:** To develop analytical and critical thinking skills on money, banking and public finance and use them to judge the appropriateness of economic development and policy options.

**COB 4:** To introduce the basic concepts of management and planning and highlight the contribution of planning to the attainment of organization's objectives.

**COB 5:** To apprise the students about important management concepts and create awareness about the corporate social responsibilities and ethical aspects.

**MODULE I DEMAND AND SUPPLY ANALYSIS 9**

Introduction to Engineering Economics – Engineering efficiency – Economic efficiency - Scope of Engineering Economics, Engineers' contributions to economic growth- Problem solving and decision making - Laws of Demand and Supply - Difference between Microeconomics and Macroeconomics - Equilibrium between Demand and Supply, Elasticity of Demand - Pricing strategies.

**MODULE II NATIONAL INCOME AND INFLATION 8**

Concepts of National Income and measurement – GDP Growth Rate - Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – Meaning of Inflation, its types causes and preventive measures.

**MODULE III MONEY, BANKING AND PUBLIC FINANCE 10**

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary Policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and expenditures – Fiscal policy - Its



objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) – Economic Reforms in India – LPG Policy.

**MODULE IV PRINCIPLES OF MANAGEMENT AND PLANNING 8**

Nature of management and its process - Importance of Management-Functions and Principles of Management - Nature, Purpose and Kinds of Planning.

**MODULE V ENGINEERING MANAGEMENT 10**

Strategic Management-Manager and Environment - Globalization and Technology Intermediation, Corporate Social Responsibility of business - meaning, importance, arguments for and against Corporate Social Responsibility - Business Ethics- Role of Ethics in Engineering Practice- meaning, importance - State intervention in business - Pros and Cons of intervention.

**L – 45 ; Total Hours – 45**

**TEXT BOOKS:**

1. Krugman, P, Wells, R, and Graddy, K., “Essentials of Economics”, Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, “Economics for Engineers”, Himalaya Publishing House, 1<sup>st</sup>Edition, New Delhi, India, 2015.

**REFERENCES:**

1. Andrew Gillespie, “Foundations of Economics”, OUP Oxford, England, 2007.
2. Acemoglu, D., Laibson, D., & List, J., “Microeconomics”, Pearson Education, 2nd Edition, Boston, 2017.
3. Brinkman John , “Unlocking the Business Environment”, Routledge, 1<sup>st</sup> Edition, London, United Kingdom, 2010.( ISBN 9780340942079)
4. Cleaver Tony, “Economics: The Basics”, Routledge, 3<sup>rd</sup> Edition, London, United Kingdom, 2014.
5. H. L. Ahuja, “Macroeconomics”, S Chand Publishing; Twenty Edition, New Delhi, India, 2019.
6. Koutsoyiannis A, “Modern Microeconomics”, Palgrave Macmillan, 2nd Edition, U.K, 2003.
7. R.A. Musgrave and P.B. Musgrave, “Public Finance in Theory and Practice” , McGraw Hill Education India, Fifth Edition, India, 2017.
8. Mell Andrew and Walker Oliver, “The Rough Guide to Economics”, Rough Guide Ltd, 1<sup>st</sup> Edition, London, 2014.
9. R. Paneerselvam, “Engineering Economics”, PHI Publication, 2nd Edition, New Delhi, India, 2014.

10. Robbins S.P. Decenzo David A and Coulter, "Fundamentals of Management: Essential Concepts and Applications", Pearson Education, 9<sup>th</sup> Edition, London, England, 2014.

### COURSE OUTCOMES:

On successful completion of this course, students will be able to

**CO1:**interpret the forces driving demand and supply and their impact on market conditions.

**CO2:**demonstrate various dimensions of macroeconomic variables like national income, money supply, employment, etc. in analyzing the effects on business.

**CO3:**explicate the different aspect of Governmental activities and their rationality and describe how they can be pursued through fiscal and monetary policy.

**CO4:**develop skills to plan, organize, direct and control the resources of the organization for obtaining common objectives or goals.

**CO5:** augment managerial skills and adopt ethical practices in various functional areas and engineering practices.

### Board of Studies (BOS) :

5<sup>th</sup>BoS of SSSH held on 29.12.2021

### Academic Council:

18<sup>th</sup> Academic council held on 24.02.2022

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

**Note:** L- Low Correlation    M - Medium Correlation    H -High Correlation

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

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

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

**SDG 12:** Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

<b>SSDX 02</b>	<b>SOCIOLOGY OF SCIENCE AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 17</b>	<b>TECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.

**COB2:** To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.

**COB3:** To demonstrate the relationship between science, technology and society.

**COB4:** To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.

**COB5:** To appraise the impact of science and technology on different socio-cultural institutions and processes.

**MODULE I INTRODUCTION 8**

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

**MODULE II INDIVIDUAL AND SOCIETY 9**

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

**MODULE III SCIENCE, TECHNOLOGY AND SOCIETY 9**

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and post-independence science - Science education in contemporary India –

primary level to research level - Performance of universities in the development of technology - Interrelationship between industry and universities.

**MODULE IV SCIENCE, TECHNOLOGY AND SOCIAL ISSUES 10**

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development -Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

**MODULE V GLOBALIZATION, SCIENCE, TECHNOLOGY 9 AND CHANGE**

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society - Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. Giddens A. "Sociology" Wiley India Pvt. Ltd 2017
2. Heald Haralambos, R.M "Sociology Themes and Perspectives", Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

**REFERENCES:**

1. Atal Yogesh, "Changing Indian Society" Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al "Introductory Sociology", Palgrave, New York. 2002
3. Das Gupta, Samir and "An Introduction to Sociology", Pearson, Delhi. 2012.
4. Francis Abraham M. "Contemporary Sociology: An Introduction to Concepts and Theories", New Delhi, Oxford University Press. 2014
5. Inkless, A, "What is Sociology", Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M "Social Stratification", Prentice Hall, New Delhi. 1969.

**COURSE OUTCOMES:**

At the end of the course, the students will be able to

**CO1:** recognize the fundamental tenets of Sociology.

**CO2:** interpret the relationship between individual and society in a sociological perspective.

**CO3:** categorize and constructively identify their own assumptions about the relationships among society, science and technology

**CO4:** appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.

**CO5:** able to link and reflect on current and ongoing sociological debates on development and role of technology.

**Board of Studies (BOS) :**

5<sup>th</sup>BoS of SSSH held on 29.12.2021

**Academic Council:**

18<sup>th</sup> Academic council held on  
24.02.2022

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

**Note:** L- Low Correlation    M - Medium Correlation    H -High Correlation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

To inculcate knowledge and socialize youth in building participation, institutions and partnership for inclusive development for the implementation of sustainable development goals.

<b>SSDX 03</b>	<b>INDUSTRIAL ECONOMICS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8 and 9</b>	<b>MANAGEMENT</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide a wholesome idea about the concept of industrial economics and identify the classifications of firms based on ownership and control.

**COB2:** To impart theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

**COB3:** To equip the students with the framework that will be useful for applying economic models in business strategy, competition policy and regulations.

**COB4:** To understand the importance of Industrial Policy in the development of Industries in India.

**COB5:** To elucidate industrial growth in India by examining its performance and problems in industrial sector.

**MODULE I INTRODUCTION TO INDUSTRIAL ECONOMICS 9**

Definition and scope of industrial economics - Concept and importance of industry; Concept and organization of a firm - Classification of firms based on ownership - sector (industries, formal vs. Informal) - size and use - based classification - Separation of ownership and control - Localization of industries .

**MODULE II MARKET STRUCTURE 9**

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot Kinked Demand and Price Leadership – Measurement of economic concentration – Policy against monopoly and restrictive trade practices – Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

**MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9**

Production and Production function – Types, Factor Inputs – Input-Output Analysis, Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin's small and large number case - Kinked demand curve theory - Bain's limit pricing – Production Possibility Frontier.

**9****MODULE IV INDUSTRIAL POLICY**

Industrial Policy: Industrial Policy in India -1948, 1956, 1977, 1980, 1990, 1991 - Industrial Performance after Independence.

**MODULE V INDUSTRIAL GROWTH IN INDIA****9**

Trends and prospects - Public enterprises; efficiency - Productivity and performance constrain - Small scale industries: definition, role - Policy issues and performance - Capacity utilization - Industrial sickness and Exit - Technology transfer - Privatization.

**L – 45 ; Total Hours – 45****TEXT BOOKS:**

1. Barthwal R R “Industrial Economics: An Introductory Textbook”, New Age International Pvt. Ltd Publishers, 2017
2. P.J. Devine, N. Lee, R.M. Jones, W.J. Tyson, “An Introduction to Industrial Economics”, Routledge.2019.

**REFERENCES:**

1. Ferguson, Paul R. and Glenys J. Ferguson, “Industrial Economics - Issues and Perspectives”, Macmillan, London. 1994
2. Gregory Mankiw “Principles of Microeconomics”, Havcourt Asia Publishers, 2001.
3. Mohanty Binode Ed. “Economic Development Perspectives”, Vol. 3, Public Enterprises and Performance, Common Wealth Publishers, New Delhi, 1991
4. Mote and Paul “Managerial Economics, Tata McGraw Hill, 2001
5. Peterson and Lewis “Managerial Economics”, 4th Ed., Prentice Hall, 2004

**COURSE OUTCOMES:**

**CO1:** Develop knowledge on the concept and organization of firms and the implications of the separation of ownership and control.

**CO2:** Acquire familiarity with various market structures and formulate appropriate pricing strategies.

**CO3:** Think analytically using various economic models concerning market structures and apply them to the real world of industry.

**CO4:** To compare the various Industrial Policies introduced in India and recognize the role of these policies in making required industrial development in India.

**CO5:** Clearly diagnose and illustrate the challenges in industrial economy in India and develop effective and comprehensive solution on them.

**Board of Studies (BoS) :**

5<sup>th</sup>BoS of SSSH held on 29.12.2021

**Academic Council:**

18<sup>th</sup> Academic council held on  
24.02.2022



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

**Note:** L- Low Correlation    M - Medium Correlation    H -High Correlation

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

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

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

<b>SSDX 04</b>	<b>DYNAMICS OF INDIAN SOCIAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 10, 16</b>	<b>STRUCTURE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide knowledge on the components of the Indian social structure.

**COB2:** To learn the nature and contemporary structure of Indian social institutions.

**COB3:** To sensitize students about social stratification in Indian Society.

**COB4:** To create awareness about the social problems occurring in contemporary India.

**COB5:** To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

**MODULE I INDIAN SOCIAL STRUCTURE 9**

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

**MODULE II INDIAN SOCIAL INSTITUTIONS 9**

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family , dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

**MODULE III SOCIAL STRATIFICATION IN INDIA 9**

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste - Caste - class interface - Religious minorities.

**MODULE IV SOCIAL PATHOLOGY 9**

Social Problem - nature, social disorganization - Population explosion- causes, effects, relationship with development - Child Labour- causes, magnitude and consequences – Unemployment - nature, types, causes and effects - Gender issues - social status of women, violence against women and women in work place - Contemporary issues - communalism, terrorism and corruption.

**MODULE V SOCIAL CHANGE IN INDIA 9**

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

**L – 45; Total Hours –45**

**TEXT BOOKS:**

1. Sharma,K.L., “Indian Social Structure and Change”, Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., “Social Problems in India”, Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., “Society in India”, Rawat Publication: New Delhi, 2014.

**REFERENCES:**

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Dube S.C., “India's Changing Villages: Human Factors in Community Development”, London, Routledge and Kegan Paul, 2003.
3. Hasnain N., “Indian Society: Themes and Social Issues”, Mc Graw Hill, 2019.
4. Jayapalan, N., “Indian Society and Social Institutions” Atlantic Publishers, 2001.
5. Pandey Vinita., “Indian Society and Culture”, Rawat Publications, New Delhi, 2016
6. Rao Sankar., “Sociology of Indian Society”, S. Chand Publisher, New Delhi, 2004.

**COURSE OUTCOMES:**

At the end of the course, the students will be able to

**CO1:**explain about the social structure and social institutions that constitute society in India.

**CO2:**differentiate the various categories of inequalities and their challenges.

**CO3:** describe the social stratification and its impact in society.

**CO4:**analyze the social problems encountered in contemporary India.

**CO5:**correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

**Board of Studies (BoS) :**5<sup>th</sup>BoS of SSSH held on 29.12.2021**Academic Council:**18<sup>th</sup> Academic council held on  
24.02.2022

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	M			M		
CO2			M			M	H	L				H
CO3			M			M	H	L				H
CO4			H			H	H		M			M
CO5			H		H	M	H	M		H		H

Note: L- Low Correlation    M - Medium Correlation    H -High Correlation

SDG 10: Reduce inequality within and among countries.

SDG16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

To sensitize and impart pertinent knowledge to youths to combat the contemporary issues and challenges facing Indian society in order to remedy its social pathos and injustices in the path of achieving sustainable development in India.