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.Sc. (Biotechnology)

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.Sc. 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

- This course will facilitate the graduates to be professionally competent in Biotechnology to solve the problems in agricultural, 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 concepts in modern biology and help them to build their carrier in related fields.
- 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 enhance confidence to them to venture into 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 behaviour.

PROGRAMME OUTCOMES

- Graduates of the course will have strong background in the interface of modern biology and skill based courses and are able to use these tools in business/industry and/or institutes wherever necessary.
- Graduates will identify, formulate, research literature, and analyze complex science problems reaching substantiated conclusions using first principles of mathematics, natural science, and applied sciences.
- Graduates will demonstrate knowledge and understanding of the science and
  management principles and apply these to one's own work, as a member and
  leader in a team, to manage projects and in multidisciplinary and diverse environment.
- Graduates of the course will be capable to get engaged in independent and life-long learning in the broadest context of technological changes.
- Graduates of the course will function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary industrial settings.
- Graduates of the course will communicate effectively on complex science activities with the science community and with the society at large.
- Graduates of the course will apply ethical principles and commit to professional ethics and responsibilities and norms of the Science, engineering and technology practice.
- Graduates of the course will design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and cultural, societal, and environmental considerations.

PROGRAMME SPECIFIC OUTCOMES

- Acquire information on the basics of biotechnology for comprehensive and compact base which enables them to understand the emerging concepts in life sciences.
- Acquire Information on various domains of advanced biotechnology and their applications and research.
- Students will acquire techniques of Biotechnology that will help to interact with multi-disciplinary aspects of Biotechnology
- Students acquire key areas such as Patent drafting and application, Artificial Intelligence in diagnostic Medicine and precision agriculture, Bioentrepreneurship, Computer aided Drug Design, Regenerative Medicine, Biomass and Bioenergy will help to meet the necessities of Indian and international Biotech industries.

REGULATIONS - 2021

B.A. / BBA/ B.Com. / BCA / B.Sc. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.A. / BBA / BCA / B.Com. / B.Sc. Degree Programmes.

ii) **"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, etc.,

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

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

v) **"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.

vi) **"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.

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

viii) **"Dean of the School"** means the Dean of the School of the deparment concerned.

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

2.0 PROGRAMMES OFFEREDAND ELIGIBILITY CRITERIA FOR ADMISSION

2.1 UGProgrammesOffered

Degree	Mode of Study
B.A.	FullTime
BBA	
B.Com.	
BCA	
B.Sc.	

2.2 Eligibility Criteria

Students for admission to the first semester of the undergraduate degreeprogrammemust have passed the Higher Secondary Examination of the 10 +2 curriculum (Academic stream) or any other examination of any authority accepted bythisInstitution as equivalent thereto.

S.No.	Programme	Eligibility Criteria
1	BCA	10+2 (Higher Secondary) with Mathematics or equivalent subject
2	B.Sc. Computer Science	10+2 (Higher Secondary) with Mathematics or equivalent subject
3	B.Sc. Biotechnology	10+2 (Higher Secondary) with Chemistry and Biology as subjects
4	BBA (Financial Services)	10+2 (Higher Secondary)
5	BBA (General)	
6	B.Com. (General)	10+2 (Higher Secondary) with Mathematics, Physics and Chemistry / Physics, Chemistry, Botany and Zoology / Commerce / Statistics as subjects.
7	B.Com (Accounts and Finance)	
8	B.Com. (Hons.)	
9	B.A. English (Hons.)	10 +2 (Higher Secondary)
10	B.A. Islamic Studies	
11	B.A. Public Policy	

2.4 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 / statuatory authorities from time to time.

3.0 STREAMS / SPECIALISATION OF STUDY

The following are the details of specialization / streams offered in various programmes:

S.No.	Program	Streams / Specialisation of Study
1.	**BCA**	i. Cloud Technology and Information Security ii. Mobile Applications and Information Security iii. Data Science iv. Multimedia and Web Application Development
2.	**B.Sc.**	i. Computer Science ii. Biotechnology
3.	**BBA**	i. General ii. Financial Services
4.	**B.Com**	i. General ii. Honours iii. Accounts and Finance
5.	**B.A.**	i. English (Honours) ii. Islamic Studies iii. Public Policy

4.0 STRUCTURE OF THE PROGRAMME

4.1 The curriculum of the UG programmes consists of the following components:

- Core Courses (CC)
- Allied Courses (AC)
- Ability Enhancement Courses (AEC)
- Skill Enhancement Courses (SEC)
- Elective Courses (EC)
- Laboratory Courses (LC)
- Laboratory Integrated Theory Courses (LITC)
- Value added courses
- Mandatory courses (MC)
- Generic Elective Courses (GEC)
- Discipline Specific Elective (DSE)
- Project - PROJ (Project work, seminar, and internship in

industry or at appropriate workplace)

4.1.1 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
- 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.

4.1.2 Online Courses for Credit Transfer

Students are permitted to undergo department approved online courses under SWAYAM up to 10% of credits of courses in a semester excluding project semester (if any) 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.

4.1.3 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 Dean, Academic Affairs for approval. The students may also undergo the valued added course 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.

4.1.4 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 a research organization / eminent academic institution 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.

4.1.5 Industrial Visit

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

4.2 Each course is normally assigned certain number of credits:

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

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

4.4 For successful completion of the programme, a student must earn a minimum total credit specified in the curriculum of the respective programme of study.

4.5 The medium of instruction, examinations and project report shall be English, except B.A. Islamic Studies (Arabic medium) and for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is expected to complete the programme in 6 semesters but in any case not more than 10 continuous semesters reckoned from the date of first admission.

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

6.3 Change of 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 / Dean of School of the student.

6.4 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 / Dean of School 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:

7.1.1Medical 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 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 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 will be nominated by the Head of the Department / Dean of School as class advisor for the class throughout the period of study.

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

8.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School of the students will 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 advisors 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 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 comprising faculty members handling the courses, student representatives and a senior faculty member not handling the courses as chairman will be constituted semester-wise by the Head of the Department.

10.1 The composition of the class committee will be as follows:

- One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department.
- All the faculty members handling courses of the semester.
- Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors.
- All faculty advisors and the class advisors
- Head of the Department - Ex-Officio Member

10.2 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.

10.3 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.

10.4 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 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

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

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

11.2 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.

11.3 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.

11.4 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 components.

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 semesterend theory examination.The evaluation of practical components shall be through continuous assessment.

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

11.6 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.

11.7 Project Work

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School shall 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.

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

11.9 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 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.

12.0 SUBSTITUTE EXAMINATIONS

12.1 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 examination.

12.2 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.

13.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

13.1 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 “I” grade in that course.

13.2 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.

13.3 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.

13.4 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.

13.5 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 Head of the Department / Dean of the School.

13.6 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 in the evening 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.

13.7 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.

14.0 REDO COURSES

14.1 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.

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

15.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

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

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

"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.

15.2 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.

15.3 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 Examination shall further approve and declaretheresults.

15.4 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.

15.5 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 first semester onwards.

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

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

15.6 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 six semesters.
First Class	6.50 and above, having completed within a period of eight semesters.
Second Class	Others

15.6.1 Eligiblity 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 programmewithin the minimum prescribed period of study (except clause 7.1.1)

15.6.2 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 clause 7.1.1)

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

15.6.4 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.

16.0 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. The students can apply for supplementary examination within three weeks of the declaration of results in the even semester.

17.0 DISCIPLINE

17.1 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.

17.2 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.

18.0 ELIGIBILITY FOR THE AWARD OF DEGREE

18.1 A student shall be declared to be eligible for the award of B.A. / BBA / BCA / B.Com. / B.Sc. 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 10 semesters 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.

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

19.0 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.Sc. BIOTECHNOLOGY
CURRICULUM & SYLLABI, REGULATIONS 2021
(SIX SEMESTERS / FULL TIME)

SEMESTER I

Sl. No.	Course Group	Course Code	CourseTitle	L	T	P	C
1.	AEC	LND 1181	General Tamil – I	2	1	0	3
		LND 1182	German – I	2	1	0	3
		LND 1183	Arabic Language	3	0	0	3
2.	AEC	END 1183	General English– I	3	0	0	3
3.	CC	LSD 1101	Cell Biology	4	0	0	4
4.	CC	LSD 1102	Cell Biology Laboratory	0	0	4	2
5.	CC	LSD 1103	Microbiology	4	0	0	4
6.	CC	LSD 1104	Microbiology Laboratory	0	0	4	2
7.	GEC		General Elective I	4	0	0	4
8.	GEC		Laboratory for General Elective- I	0	0	4	2
			Credits				**23**

SEMESTER II

Sl. No.	Course Group	Course Code	CourseTitle	L	T	P	C
1.	CC	LSD 1201	Biomolecules	4	0	0	4
2.	CC	LSD 1202	Biomolecules Laboratory	0	0	4	2
3.	CC	LSD 1203	Basics of Genetics	4	0	0	4
4.	CC	LSD 1204	Basics of Genetics Laboratory	0	0	4	2
5.	GEC		General Elective II	4	0	0	4
6.	GEC		Laboratory for General Elective- II	0	0	4	2
7.	AEC	GED 1207	Environmental Studies	2	0	0	2
			Credits				**20**

SEMESTER III

Sl. No.	Course Group	Course Code	CourseTitle	L	T	P	C
1.	CC	LSD 2101	Biochemistry	4	0	0	4
2.	CC	LSD 2102	Biochemistry Laboratory	0	0	4	2
3.	CC	LSD 2103	Molecular Biology	4	0	0	4
4.	CC	LSD 2104	Molecular Biology Laboratory	0	0	4	2
5.	CC	LSD 2105	Enzymology	4	0	0	4
6.	CC	LSD 2106	Enzymology Laboratory	0	0	4	2
7.	SEC	GED 2102	Aptitude and Interpersonal Skills	0	0	2	1
8.	GEC		General Elective III	4	0	0	4
9	GEC		Laboratory for General Elective- III	0	0	4	2
			Credits				**25**

SEMESTER IV

Sl. No.	Course Group	Course Code	CourseTitle	L	T	P	C
1.	CC	LSD 2201	Bioprocess Technology	4	0	0	4
2.	CC	LSD 2202	Bioprocess Technology Laboratory	0	0	4	2
3.	CC	LSD 2203	Medical Biotechnology	4	0	0	4
4.	CC	LSD 2204	Medical Biotechnology Laboratory	0	0	4	2
5.	CC	LSD 2205	Bioinformatics	4	0	0	4
6.	CC	LSD 2206	Bioinformatics Laboratory	0	0	4	2
7.	GEC		General Elective IV	4	0	0	4
8.	GEC		Laboratory for General Elective- IV	0	0	4	2
9.	SEC	GED 2204	Aptitude and Workplace Skills	0	0	2	1
			Credits				**25**

SEMESTER V

Sl. No.	Course Group	Course Code	CourseTitle	L	T	P	C
1.	CC	LSD 3101	Plant Biotechnology	4	0	0	4
2.	CC	LSD 3102	Plant Biotechnology Laboratory	0	0	4	2
3.	CC	LSD 3103	Animal Biotechnology	4	0	0	4
4.	CC	LSD 3104	Animal Biotechnology Laboratory	0	0	4	2
5.	DSE		Discipline Specific Elective I	4	0	0	4
6.	DSE		Discipline Specific Elective I Laboratory	0	0	4	2
7.	DSE		Discipline Specific Elective II	4	0	0	4
8.	DSE		Discipline Specific Elective II Laboratory	0	0	4	2
9	AEC		Internship	0	0	0	1
			Credits				**25**

SEMESTER VI

Sl. No.	Course Group	Course Code	CourseTitle	L	T	P	C
1.	CC	LSD 3201	Immunotechnology	4	0	0	4
2.	CC	LSD 3202	Immunotechnology Laboratory	0	0	4	2
3	CC	LSD 3203	Genomics and Proteomics	4	0	0	4
4	CC	LSD 3204	Genomics and Proteomics Laboratory	0	0	4	2
5	DSE		Discipline Specific Elective III	4	0	0	4
6	DSE		Discipline Specific Elective III Laboratory	0	0	4	2
7	DSE		Discipline Specific Elective IV	4	0	0	4
8	DSE		Discipline Specific Elective IV Laboratory	0	0	4	2
			Credits				**24**

TotalCredits–142

GENERAL ELECTIVE COURSES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	GEC	LSDX 001	Basics of Computer	4	0	0	4
2.	GEC	LSDX 002	Basics of Computer Laboratory	0	0	4	2
3.	GEC	LSDX 003	Artificial Intelligence in Medicine	4	0	0	4
4.	GEC	LSDX 004	Artificial Intelligence Laboratory	0	0	4	2
5.	GEC	LSDX 005	Intellectual Property Rights	4	0	0	4
6.	GEC	LSDX 006	Patent drafting and application Laboratory	0	0	4	2
7.	GEC	LSDX 007	Biostatistics	4	0	0	4
8.	GEC	LSDX 008	Biostatistics and Experimental Designing Laboratory	0	0	4	2
9.	GEC	LSDX 009	Bioinstrumentation	4	0	0	4
10.	GEC	LSDX 010	Bioinstrumentation Laboratory	0	0	4	2
11.	GEC	LSDX 011	Herbal Technology	4	0	0	4
12.	GEC	LSDX 012	Herbal Technology Laboratory	0	0	4	2
13.	GEC	LSDX 013	Bioentrepreneurship	4	0	0	4
14.	GEC	LSDX 014	Bioentrepreneurship Laboratory	0	0	4	2
15.	GEC	LSDX 015	Waste Management	4	0	0	4
16.	GEC	LSDX 016	Waste Management Laboratory	0	0	4	2
17.	GEC	LSDX 017	Phytochemistry	4	0	0	4
18.	GEC	LSDX 018	Phytochemistry Laboratory	0	0	4	2
19.	GE	LSDX 019	Pharmacology	4	0	0	4

20.	GE	LSDX 020	Pharmacology Laboratory	0	0	4	2
21.	GE	LSDX 021	Biopharmaceutics and Pharmacokinetics	4	0	0	4
22.	GE	LSDX 022	Biopharmaceutics and Pharmacokinetics Laboratory	0	0	4	2
23.	GE	LSDX 023	Basic Biomedical Instrumentation	4	0	0	4
24.	GE	LSDX 024	Basic Biomedical Instrumentation Laboratory	0	0	4	2
25.	GE	LSDX 024	Environmental Biotechnology	4	0	0	4
26.	GE	LSDX 025	Environmental Biotechnology Laboratory	0	0	4	2

DISCIPLINE SPECIFIC ELECTIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	DSE	LSDX 051	Disease Management	4	0	0	4
2	DSE	LSDX 052	Disease Management Laboratory	0	0	4	2
3	DSE	LSDX 053	Cytogenetics	4	0	0	4
4	DSE	LSDX 054	Cytogenetics Laboratory	0	0	4	2
5	DSE	LSDX 055	Agricultural Biotechnology	4	0	0	4
6	DSE	LSDX 056	Agricultural Biotechnology Laboratory	0	0	4	2
9	DSE	LSDX 057	Nanobiotechnology	4	0	0	4
10	DSE	LSDX 058	Nanobiotechnology Laboratory	0	0	4	2
11	DSE	LSDX 059	Regenerative Medicine	4	0	0	4
12	DSE	LSDX 060	Regenerative Medicine Laboratory	0	0	4	2
13	DSE	LSDX 061	Cancer Biology	4	0	0	4

14	DSE	LSDX 062	Cancer Biology Laboratory	0	0	4	2
15	DSE	LSDX 063	Developmental Biology	4	0	0	4
16	DSE	LSDX 064	Developmental Biology Laboratory	0	0	4	2
17	DSE	LSDX 065	Food Biotechnology	4	0	0	4
18	DSE	LSDX 066	Food Biotechnology Laboratory	0	0	4	2
19	DSE	LSDX 067	Biofertilizer Technology	4	0	0	4
20	DSE	LSDX 068	Biofertilizer Technology Laboratory	0	0	4	2
21	DSE	LSDX 069	Computer aided Drug Design	4	0	0	4
22	DSE	LSDX 070	Computer aided Drug Design Laboratory	0	0	4	2
23	DSE	LSDX 071	Biomass and Bioenergy	4	0	0	4
24	DSE	LSDX 072	Biomass and Bioenergy Laboratory	0	0	4	2
25	DSE	LSDX 073	rDNA Technology	4	0	0	4
26	DSE	LSDX 074	rDNA Technology Laboratory	0	0	4	2
27	DSE	LSDX 075	Industrial Biotechnology	4	0	0	4
28	DSE	LSDX 076	Industrial Biotechnology Laboratory	0	0	4	2
29	DSE	LSDX 077	Molecular Farming	4	0	0	4
30	DSE	LSDX 078	Molecular Farming Laboratory	0	0	4	2
31	DSE	LSDX 079	Biophysics	4	0	0	4
32	DSE	LSDX 080	Biophysics Laboratory	0	0	4	2
33	DSE	LSDX 081	Molecular Diagnostics	4	0	0	4
34	DSE	LSDX 082	Molecular Diagnostics Laboratory	0	0	4	2
35	DSE	LSDX 083	Downstream Process	4	0	0	4

36	DSE	LSDX 084	Downstream Process Laboratory	0	0	4	2
37	DSE	LSDX 085	Epidemiology	4	0	0	4
38	DSE	LSDX 086	Epidemiology Laboratory	0	0	4	2

SEMESTER I

LND 1181	பொதுத் தமிழ் - I	L	T	P	C
SDG 16	GENERAL TAMIL -I	2	1	0	3

நோக்கங்கள்

- சமூக மாற்றச்சிந்தனைகளை உள்ளடக்கிய தற்காலஇலக்கியங்களை அறிமுகம் செய்தல்
- இருபதாம் நூற்றாண்டு மரபுக்கவிதைகளை அறிமுகம் செய்தல்
- புதுக்கவிதை, சிறுகதை, உரைநடை ஆகிய இலக்கியங்களை நயம் பாராட்டுதல்
- புதுக்கவிதை மற்றும் சிறுகதையின் தோற்றம் வளர்ச்சி குறித்து எடுத்துரைத்தல்
- சந்திப் பிழையின்றி எழுத மாணவர்களைப் பயிற்றுவித்தல்
- கவிதை மற்றும் சிறுகதை எழுதமாணவர்களை ஊக்கப்படுத்துதல்

அலகு I	இருபதாம் நூற்றாண்டு மரபுக்கவிதைகள்	8

கவிமணி தேசிய விநாயகம் பிள்ளை - உடல் நலம் பேணல், பாரதியார்– செந்தமிழ் நாடு, பாரதிதாசன்– நீங்களே சொல்லுங்கள், கண்ணதாசன்– குடும்பம் ஒரு கதம்பம்.

அலகு II	புதுக்கவிதைகள்	8

இன்குலாப்– போராட்டம், அப்துல்ரகுமான்– மண், வைரமுத்து–விதைச் சோளம், நா.காமராசன்–அலிகள், ஆண்டாள் பிரியதர்சினி– தொலைந்து போனது, மு.மேத்தா–தேசப்பிதாவுக்கு ஒரு தெருப்பாடகனின் அஞ்சலி, ஹைக்கூ கவிதைகள்.

அலகு III	சிறுகதைகள்	8

ஜெயகாந்தன்–நந்தவனத்தில் ஓர் ஆண்டி, கி.இராஜநாராயணன்– கதவு, சு.சமுத்திரம்- ஏழை-ஆப்பிள்-நட்சத்திரம், மாதவிக்குட்டி–நெய்ப்பாயாசம், தி.ஜானகிராமன்–முள்முடி.

அலகுIV	மொழிப்பயிற்சி	7

கலைச்சொல்லாக்கம், பிழைத்திருத்தம் (ஒருமை, ல-ள-ழகர, ர-ற-கர, ண-ந-னகரவேறுபாடுகள்), அயற்சொற்களைதல்.

அலகு V	இலக்கிய வரலாறு	7

பாடந்தழுவியது (இருபதாம் நூற்றாண்டு மரபுக் கவிதைகள், புதுக்கவிதையின் தோற்றமும் வளர்ச்சியும், சிறுகதையின் தோற்றமும் வளர்ச்சியும்)

அலகு VI	படைப்பிலக்கியம்	7

கவிதை எழுதுதல், சிறுகதை வரைதல்

L – 30 ; T – 15 ; TOTAL HOURS – 45

குறிப்புகள்

1. பொதுத் தமிழ்– செய்யுள் திரட்டு– தமிழ்த் துறை வெளியீடு
2. தமிழ் இலக்கிய வரலாறு–சோம. இளவரசு
3. சிறுகதைத் தொகுப்பு (கட்டுரைக் களஞ்சியம்)

வெளிப்பாடு				

- மாணவர்கள் சமூக மாற்றச்சிந்தனைகளை அறிந்து கொள்வர்
- இருபதாம் நூற்றாண்டு மரபுக்கவிதைகள் குறித்த அறிவினைப்பெறுவர்.
- சந்திப்பிழைகளைநீக்கி எழுதும் திறன் பெறுவர்
- இருபதாம் நூற்றாண்டு தமிழ் இலக்கியத்தின் வரலாறு, வளர்ச்சி, பாடுபொருள் ஆகியவற்றை உணர்ந்து கொள்வர்.
- இருபதாம் நூற்றாண்டு தமிழ் இலக்கியப் படைப்பாளர்களைப் பற்றி அறிந்து கொள்வர்.
- புத்திலக்கியங்களைப் படைக்கும் திறனையும் திறனாய்வு செய்யும் திறனையும்பெறுவர்

Board of Studies (BoS):
15th BoS of the Department of Commerce held on 24.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3	PSO4
CO1							M	M	M	M		M				
CO2							L	L	L	M		M				
CO3							L	M	L	L		L				
CO4							L	L	M	L		L				
CO5							L	L	L	L		L				
CO6							M	M	M	M		L				

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

SDG 16: Peace, Justice and Strong Institutions

Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime through the Quranic, Vedic and Biblical literature.

LND 1182	GERMAN – I	L	T	P	C
SDG: 4		2	1	0	3

COURSE OBJECTIVES:

COB1: To improve the proficiency of students in German language.

COB2: To create awareness of using vocabulary among students.

COB3: To expose them to correct grammatical forms of the language.

COB4: To empower them for successful communication in the society.

COB5: To understand matters which are of daily usage

COB6: To understand them for describe the people need and their requirements.

MODULE I GUTEN TAG! 7

Learn alphabet, introduction to German -greetings, identifying countries and their capital cities and languages, introducing oneself, read and write Cardinal numbers till 100, Read and write telephone numbers and e-mail addresses. Grammar - question words, sentence structure and formation, Regular verbs - Conjugation and personal pronouns.

MODULE II FREUNDE, KOLLEGEN UND ICH 7

Introducing Others and Family Members, To speak about hobbies, jobs, learn Cardinal numbers from 101, Days, Months, Seasons, Colours, Day Timings, directions; Vocabulary: related to the topic; Grammar: Definite Articles, Irregular Verbs & Conjugations, Auxiliary verbs, ja/neinFragenundAntworten, Nouns singular/plural.

MODULE III IN DER STADT 8

To know places, buildings, know transport systems, understand international words, Shopping, talk to sales person while purchasing goods, return faulty goods at a shop, asking someone to repeat something , read and write Ordinal numbers till 100,; Vocabulary: related to the topic; Grammar: Indefinite articles, Negotiation, Imperative - Sie form.

MODULE IV GUTEN APPETIT! 8

To speak about food, Daily routine ,Going to the market – asking prices, filling up simple forms; Vocabulary: related to the topic; Grammar: Verb position, Simple Present Tense with regular and irregular verbs.

MODULE V TAG FÜR TAG 7

To learn time related expressions and asking Time, speak about family, ask excuse; Vocabulary: related to the topic; Simple Conversation skills (pertaining chiefly to simple dialogues in everyday situations), Grammar: Preposition – am, im, um, von bis, Modal verbs, Present perfect Tense with regular and irregular verbs

MODULE VI ZEIT MIT FREUNDEN 8

To speak about birthdays, understand and write an invitation, converse in the restaurant and Pay; Vocabulary: related to the topic; Simple Text -Translation and Reading Comprehension Practice German Into English Vice versa: Grammar: Accusative personal pronouns, Possessive Pronomen, Verbs and prepositions, Gern - word Usage in Sentence formation.

L – 30; T – 15; Total Hours – 45

TEXT BOOKS:

1. Stefanie Dengler, “Netzwerk A1.1”, Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2015.

PRACTICE BOOK:

1. Johannes Gerbes, “Fit fürs Goethe-Zertifikat A1”, Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2010.

REFERENCES:

1. Paul Rusch, “Einfach Grammatik”, Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2012.
2. Hermann Funk, “studio d A1”, Goyal Publishers & Distributors Pvt. Ltd., Delhi, 2009. 15OH78 German Language.

COURSE OUTCOMES:

On successful completion of this course learners will be able to

CO1: Show their proficiency in German Language.

CO2: Use appropriate vocabulary in real life contexts.

CO3: Use appropriate grammatical forms while communicating with people.

CO4: Effectively use the language in social and academic contexts.

CO5: Comprehend matters which are of daily usage

CO6: Communicate as per people’s need and requirement.

Board of Studies (BoS): 14th BoS of the Department of Commerce

Academic Council: 17th AC held on 15.07.2021

held on 22.04.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H		H	H	H	M	H	M	H				
CO2				H		H	H	H	H	H		H				
CO3				H		H	H	H	H	H		H				
CO4				H		H	H	H		H		H				
CO5				H		H	H	H		H		H				
CO6				H		H	H	H		H		H				

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

SDG 4 : Quality Education

The substantially improve the relevant skills which develop the confidence in young people, including technical and vocational skills, help for employment, decent work and entrepreneurship.

LND 1183	ARABIC LANGUAGE	L	T	P	C
SDG 4		3	0	0	3

COURSE OBJECTIVES:

The course aims to teach

COB1: Arabic alphabets, reading and writing and pronunciation.

COB2: Listening and writing of words related to market, doctor, parts of body, dining.

COB3: Arabic simple sentences using names of animals, birds, singular and plural.

COB4: Listening and writing of Countries' names, singular, dual and plural.

COB5: Arabic sentences using verbs, tenses and numbers.

MODULE I **INTRODUCTION TO ARABIC READING AND WRITING** **9**

Introduction to Arabic alphabets - reading from right to left - Listening to audio & video – practice correct pronunciation – Writing join letters from right to left - (lessons: 1 and 2): (حجرةالدراسة ، حجرةالدراسة 2، المرور) - introduction to Arabic words in and around the classroom – Transport - Vocabulary related to market - introduction of verbs (lessons: 4 – 6).

MODULE II **LISTENING ARABIC COMMUNICATION** **9**

Reading skill: Lessons 4 – 6. Words related to doctor, parts of body, dining, fruits, food items, family members, house and air travel (أسماءأعضاءالجسموالمطعموالفواكهوغيرها) Vocabulary related to names of animals, birds (lessons: 7 – 12).

MODULE III **SIMPLE SENTENCES** **9**

Home – singular and plural - introduction to gender: irst person, second person and third person – inerrogatory sentences - arabic simple sentences – nominal sentence and verbal sentence (الجملةالاسميةوالفعلية) (lessons: 13 & 14) Words related to kitchen utensils – cooking (أسماءأوانيالمطبخوالطبخ)– introduction to gender: firt person, second person and third person (التذكيروالتأنيث) – singular and plural – vocabulary related to office – possession (الإضافة) -
(lessons: 15 – 17)

MODULE IV **COMMUNICATION PRACTICE** **9**

Countries names – world map - performing ablution – vocabulary related to prayer - singular, dual and plural - situational communication - emphasis on interrogation (المحادثةالعربية) (lessons: 18 – 20)

MODULE V TENS, SINGULAR & PLURAL 9

Sentence making – words related to prayer – verbs and tenses – communication on dining – gender - singular and dual – numbers – discussion of evening – dining manners (المفردوالتثنيةوالجمعوالعدد) (lessons: 21 – 25)

L – 30; Total Hours – 30

TEXT BOOKS:

1. Al QirathulArabiyya Lil Mubtadiyeenالقراءةالعربيةللمبتدئين (UmmulQura University, Makkah), BukhariAalim Arabic College, 2005.

REFERENCES:

1. Al Arabiya Lin Nashiyeen (Education Ministry, K.S.A.), BukhariAalim Arabic College, 2005.
2. Dr. V. Abdur Raheem, Durus Al LugathilArabiyya Li GhairinNatiqeenBiha, Islamic Foundation Trust, Chennai, 2002.

COURSE OUTCOMES:

At the end of the course, the student is expected to:

CO1: Vocabulary related to the market, doctor, parts of body, dining.

CO2: Identify Arabic names of animals, birds, singular and plural, interrogatory sentences.

CO3: Recognize Arabic alphabets, reading and writing and pronunciation.

CO4: Use countries names, singular, dual and plural.

CO5: Form Arabic sentences using verbs, tenses and numbers.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO3	PSO4	PSO5
CO1						L									
CO2							M								
CO3							M								
CO4						L									
CO5							M								

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

SDG 4: Developing Language skill

Statement: Arabic language enhances effective communication in the workplace.

END 1183	GENERAL ENGLISH - I	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To enable students to read, comprehend and appreciate the value of literature to life

COB2: To help them acquire language skills through Literature

COB3: To develop LSRW skills through practice in variety of contexts

COB4: To improve their vocabulary and correct English usage.

MODULE I **9**

Poetry: No Man is an Island – John Donne;
O Captain! My Captain! –Walt Whitman

Speaking: Introducing oneself and Introducing each other

Writing: Hints Development

Language: Articles, Adjectives & Adverbs (comparisons), Punctuation

Vocabulary: Homophones and homographs

MODULE II **9**

Prose: "Spoken English and Broken English" – G.B.Shaw

Listening: Listening for gist (general meaning)
The Speech that made Obama President. (6.12 minutes)

Speaking: Conversations - formal and semi formal contexts

Writing: Jumbled sentences

Language: Pronouns and Linking words, Conjunctions

Vocabulary: Register – Formal, semi-formal and Informal

MODULE III **9**

Short story: "The Cherry Tree" - Ruskin Bond

Speaking: Asking questions (about companies. Products, Jobs)

Creative Writing: Open ended stories

Language: Question Forms – 'Wh' & Yes/No

Vocabulary: Prefixes and Suffixes, negative prefixes

MODULE IV **9**

Short story: "The Last Leaf" - O. Henry

Speaking: Role play (Telephone call to a supplier, enquiry about products)

Writing: Letter of Enquiry, Replies to Enquiry

Language: Tenses

Vocabulary: Synonyms and Antonyms

MODULE V **9**

Prose: "Voluntary Poverty" – Mahatma Gandhi

Listening: Listening for specific information - You must follow if you want success by SundarPichai. (8.42 minutes)

Speaking: Giving the summary of an article (from newspapers)

Writing: Order Letter, Complaint Letter

Language: Subject -Verb Agreement

Vocabulary: Business Vocabulary (marketing, air travel)

L – 45; Total Hours- 45

REFERENCES:

1. Guy Brook-Hart, Business Benchmark Upper- Intermediate Student's Book, CUP, 2006
2. Sriraman.T, Macmillan College Prose, Laksmi Publications, 2015
3. Whitby, Norman, Business Benchmark: Pre-intermediate to Intermediate, 2nd Edition, CUP, 2014.
4. Swan.M, Practical English Usage, OUP, 2005.
5. https://www.thehindu.com/opinion/open-page/it-has-done-more-harm-than-good/article5129459.ece
6. https://www.youtube.com/watch?v=OFPwDe22CoY
7. https://www.youtube.com/watch?v=iAlsg_orac8

COURSE OUTCOMES:

CO1: Respond to literary texts efficiently

CO2: Appreciate and critically analyze literary texts

CO3: Display effective LSRW skills in academic and professional contexts

CO4: Demonstrate a range of appropriate vocabulary in a variety of situations

CO5: Communicate effectively using grammatically correct language

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021.

Academic Council:
17th AC held on 15.07.2021

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

Statement: The acquisition of LSRW skills of English language could help students in promoting lifelong learning opportunities.

LSD 1101	CELL BIOLOGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To get an overview of classes of cells and structural and function aspects of membrane structure and functions

COB2: To develop a detailed knowledge of cell organelle

COB3: To understand cytoskeleton structure

COB4: To familiarize with principles of cell signalling mechanisms

COB5: To develop basic understanding of Cell division

MODULE I INTRODUCTION TO CELLS 12

Discovery of cells-a brief history: Cell Theory; Basic properties of cell, Different classes of cell: Prokaryotic and eukaryotic cell; difference between plant cell and animal cell.

MODULE II CELL MEMBRANE 12

Structure and function of plasma membrane, Transport of substances through cell membrane- osmosis, diffusion and its types, Active transport (sodium pump) and passive transport; membrane potential, measuring membrane potential, ion channels- Na+ and K+ channels, action potential and nerve impulse.

MODULE III CELL ORGANELLE AND CYTOSKELETON 12

Nucleus-structure and function, concept of chromosomes; Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi apparatus, lysosome, Membrane transport- exocytosis and endocytosis, cytoskeleton structures- intermediate filaments, microtubules tubulin, centrosome structure, actin filaments, muscle contraction.

MODULE IV CELL SIGNALING 12

Principles of cell signalling, cell surface receptors, ion channel coupled receptors, G-protein coupled receptors, GCCRs, cAMP signalling pathway, Calcium signalling pathway, Enzyme coupled receptors, RTKs, Ras pathway.

MODULE V CELL DIVISION AND CELL CYCLE 12

Cell cycle, regulation of cell cycle, mitosis-different stages of mitosis and proteins involved, meiosis- stages of meiosis I and II; genetic recombination, Meiotic nondisjunction.

L – 60; Total Hours – 60

TEXT BOOKS:

1. Albert et.al. “Essential Cell Biology”, John Wiley & Sons, 4Ed, New York, 2015.
2. Cooper and Hausman. “The Cell: A molecular approach.” ASM Press, 4Ed, Washington D.C. 2007.

REFERENCES:

1. Harris, H. 1995. The Cells of the Body: A History of Somatic Cell Genetics. Cold Spring Harbor Laboratory Press.
2. Watson J D , McKenna H J . Novel factors from stromal cells: bone marrow and thymus microenvironments. Int’l. J. Cell Cloning. 1992;10:144–252.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Familiar with the basic make up of cells.

CO2: Develop the structure and function of biological membrane

CO3: Understand how the different cell organelle functions

CO4: Understand the cell signaling network and their role in body functioning

CO5: Identify and analyze the significance of cell division and the regulatory molecules

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	H					H			
CO2	M	M	H	H					H			
CO3	M	M	H	H					H			
CO4	M	M	H	H		H			H			M
CO5	M	M	H	H					H			

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSD 1102	CELL BIOLOGY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn the technique of microscopic observation of cell

COB2: To understand the process of cellular organelle

COB3: To learn the cell cycle study technique

COB4: To learn buccal smear techniques

COB5: To learn about Mitochndria and chlroplast

PRACTICALS

List of Experiments:

1. Introduction to microscopes used for cell biology studies
2. Microscopic study of cell and cell organelles
3. Cell counting and viability
4. Mitosis and the Cell Cycle in Onion Root-Tip Cells
5. Blood smear preparation
6. Buccal Smear Preparation
7. Isolation of Mitochondria
8. Isolation of Chloroplast

P – 60; Total Hours – 60

TEXT BOOKS:

1. Debarati Das. Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology, 1st Ed, Academic Press, 2017 ISBN: 9789383420599, 9383420596.

REFERENCES:

1. Celis “Cell Biology: A Laboratory Handbook” 3Rd Edition, Elsevier, 2008, ISBN 9788131219683

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: develop expertise in microscopic techniques

CO2: conduct experiments related to cell organelle

CO3: conduct experiments relating cell cycle

CO4: Acquire knowledge to learn buccal smear

CO5: gain knowledge on isolating the mitochondria and chloroplast

Board of Studies (BoS) :
8thBoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H		H	M			M	H	L	H	
CO2	M	H		H	M			H	H	L	M	
CO3	M	H		H	M			H	H	L	H	
CO4	M	H		H	M			H	H	L	H	
CO5	M	H		H	M			H	H	L	H	

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

SDG 3. Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSD 1103	MICROBIOLOGY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1: To offer a sense of the history of microbial science, its methodology and its many contributions to humanity.

COB2: To ensures the students to understand about the sterilization and disinfection techniques.

COB3: To give knowledge about the role of microbes in food production

COB4: Cultivate an understanding about the importance of Pathogenesis, lab diagnosis, prevention and control of important microbial diseases.

COB5: To educate the students about the role of microbes in the ecosystems

MODULE I BASICS OF MICROBIOLOGY 12

Microbiology - history and scope– General structure & functions -viruses, bacteria, algae, fungi, protozoa –Microscopy - Principles & classification of microbes – Whittaker five kingdom classification.

MODULE II STERILIZATION 12

Sterilization and disinfection - stain and staining methods –. Microbial media – methods of obtaining pure cultures - Phases of growth curve, Factors influencing the growth of microbes –classification of microorganisms.

MODULE III FOOD AND INDUSTRIAL MICROBIOLOGY 12

Role of microbes in food production - Microbiology of fermented food and dairy products - Alcoholic beverages- Food spoilage and Preservation processes. Production of antibiotics, amino acids and organic Acids.

MODULE IV MEDICAL MICROBIOLOGY 12

Pathogenesis, lab diagnosis, prevention and control of important microbial diseases. Pathogenic bacterial diseases, Fungal diseases, Viral Diseases and Protozoan diseases.

MODULE V ENVIRONMENTAL MICROBIOLOGY 12

Role of microbes in the ecosystems – Microorganisms in soil, air and water. Sewage treatment methods - biological nitrogen fixation - biofertilizers.

L – 60; Total Hours – 60

TEXT BOOKS:

1. Microbiology: An Introduction: Tortora, Funke & Case. 7th edition, 2001

REFERENCES:

1. A. H. Patel, “Industrial microbiology”, Macmillan Publishers India, 2nd Edition, 2002.
2. Pelezar, chan, “Microbiology ”– Krieg Tata McGraw Hill Publications, 3rdEdition, 2007.
3. Prescott, Harley and Klein, “Microbiology”, McGraw Hill publications, Fifth edition, 2003.
4. Wulf Crueger and Anneliese Crueger, “Biotechnology – A textbook of Industrial Microbiology”, Panima publishing corporation, New Delhi , 2000, reprint 2005.
5. Jacquelyn G.Black, “Microbiology -Principles and Explorations” Wiley publications, 4th Edition, 2008.

COURSE OUTCOMES:

At the end of the course the students will be able to

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 utilisation in laboratory settings

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

CO4: collect, organise, analyse, evaluate and interpret experimental data using appropriate quantitative, technological and critical thinking skills

CO5: able tocommunicate microbiological principles and information effectively to diverse audiences, using a variety of formats

Board of Studies (BoS) : 8thBoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H			H		M	M	M	H	H	M	
CO2	H			H		M	M	M	H	H	M	
CO3	H		H	H	H	M	M	M	H	H	M	
CO4	H		H	H	H	M	M	M	H	H	M	
CO5	H		H	H	H	M	M	M	H	H	M	

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

SDG 3. Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course foucussed on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 1104	MICROBIOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

COB1: Provides an opportunity to experimentally verify the theoretical concepts already studied

COB2: Develop their skills in the preparation, identification and quantification ofMicroorganisms

COB3: To give knowledge about the staining methods used microorganisms

COB4: Support an understanding about the importance of production and demonstration of antibiotic resistance

COB5: To educate the students about the Biochemical tests to identify various organisms

PRACTICALS

List of Experiments:

1. Bio-safety guideline.
2. Preparation of media for growth of various organisms.
3. Identification and culturing of various organisms
4. Staining of microorganisms. – Gram's staining,
5. Staining of microorganisms - spore staining,
6. Staining of microorganisms -capsular staining.
7. Measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.
8. Assay of antibiotics production and demonstration of antibiotic resistance.
9. Biochemical tests to identify various organisms

P – 60; Total Hours –60

TEXT BOOKS:

1. A Photographic Atlas for the Microbiology Laboratory, 4thEdition, Michael J. Leboffe, San Diego City College, Burton E. Pierce, Morton Publishing Company, 2011.
2. Laboratory Exercises in Microbiology, Fifth Edition, John P. Harley, Lansing M. Prescott, The McGraw−Hill Pub Ltd. 2002

REFERENCES:

1. Pelezar, chan, "Microbiology"– Krieg Tata McGraw Hill Publications, 3rdEdition, 2007.
2. Prescott, Harley and Klein, "Microbiology", McGraw Hill publications, Fifth edition, 2003.

3. Wulf Crueger and Anneliese Crueger, “Biotechnology – A textbook of Industrial Microbiology”, Panima publishing corporation, New Delhi, 2000, reprint 2005.
4. Jacquelyn G.Black, “Microbiology -Principles and Explorations” Wiley publications, 4th Edition, 2008.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: characterize and isolate of bacteria isolated from different sources.

CO2: demonstrate proficiency in Growth kinetics of bacteria.

CO3: demonstrate familiarity with staining of microorganisms

CO4: collect, organise, analyse, evaluate and interpret experimental data of bacterial population by turbidometry

CO5: able tofamiliarity with production and demonstration of antibiotic resistance

Board of Studies (BoS) : **Academic Council:**

8thBoS of SLS held on 5.07.2021 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	H		H	M			M	H	L	H	
CO2	M	H		H	M			H	H	L	M	
CO3	M	H		H	M			H	H	L	H	
CO4	M	H		H	M			H	H	L	H	
CO5	M	H		H	M			H	H	L	H	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course foucussed on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

SEMESTER II

LSD 1201	BIOMOLECULES	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To familiarize students with various molecules of life

COB2: To familiarize students with biomolecules with regard to their structures and functions

COB3: The course will also acquaint them with the basic knowledge about biochemistry

COB4: The course will also acquaint them with the basic knowledge about molecular biology.

COB5: The course will also make the student understand the knowledge at genetic level.

MODULE I CHEMICAL BONDS AND BIOMOLECUES 12

Physical properties and hydrogen bonding of water; structure of water and its solvent properties; hydrophobic interactions. Ionization of water and ion product of water; the pH scale; relationship between pH and pKa (Henderson-Hasselbalch equation); buffers and its properties.

MODULE II PROTEIN 12

Biological functions of proteins; structure of alpha-amino acids, abbreviations and classification of 20 amino acids; zwitterion nature of amino acid in aqueous solutions; essential amino acids; peptide bond formation; backbone structure of Proteins/polypeptides; basic understanding of primary, secondary, tertiary, and quaternary structure of proteins/peptides; fibrous and globular proteins; elementary ideas on protein denaturation and renaturation.

MODULE III CARBOHYDRATES 12

Definition and biological functions of carbohydrates; classification into monosaccharides, oligosaccharides and polysaccharides; optical isomerism, open chain and ring structures of carbohydrates; mutarotation; structure of biologically important carbohydrates (D-glucose, D-galactose, D-mannose, D-fructose, D-ribose, D-2-deoxyribose, D-maltose, D-lactose, D-sucrose); polysaccharides starch, cellulose, glycogen and mucopolysaccharides; suitability of polysaccharides as storage material.

MODULE IV LIPIDS 12

Introduction of lipids, biological functions; general formulae, nomenclature and properties of fatty acids; essential and non-essential fatty acids; classification of lipids; general structure and function of major lipid subclasses: acylglycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins; saponifiable and non-saponifiable lipids; suitability of triglycerides as storage lipids; saponification number and iodine number; bio membranes structure.

MODULE V NUCLEIC ACID 12

Nucleosides and nucleotides; generalized structural plan of nucleic acids. Evidence of DNA as genetic material; Watson-Crick model of DNA; size of DNA in prokaryotic and eukaryotic cells. Central dogma of molecular biology; gene, genome and chromosome. Basic ideas of DNA replication, transcription and protein biosynthesis; genetic code and codons. RNA structure and functions, types of DNA and RNA.

L – 60; Total Hours – 60

TEXT BOOKS:

1. Lehninger: Principles of Biochemistry (2017) by Nelson and Cox. Seventh edition. WH Freeman and Co.
2. Biochemistry (2015) by Berg, Tymoczko, Gatto, Stryer. Eighth Edition. WH Freeman and Co.

REFERENCES:

1. Outlines of Biochemistry by Conn and Stumpf (5th Edition, 1987) Wiley, New Delhi.
2. Introducing Biochemistry (1982) by Wood and Pickering. ELBS/John Muray.

COURSE OUTCOMES:

CO1: After the completion of the course students will understand significance water as a solvent of life and know the relationship with biomolecules.

CO2: understand the structure and function of proteins as building block of life.

CO3:understand the knowledge on carbohydrates as monosaccharides and polysaccharides.

CO4:understand the structures, function, and classification of lipids.

CO5: understand the structure of nucleic acids, along with basic steps in the processing of genetic engineering.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M		H			H		H	L		
CO2	H	M		H			H		H	L		
CO3	H	M		H			H		H	L		
CO4	H	M		H			H		H	L		
CO5	H	M		H			H		H	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSD 1202	BIOMOLECULES LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To explore about the biomolecules and their reaction.

COB2: To have an idea about the buffersbehaviour and its preparation according to calculation.

COB3: To obtain the knowledge about the analysis of different biomolecules.

COB4: To gain an idea about some basic principles which is important for estimation of biomolecules.

PRACTICALS

List of Experiments:

1. Preparation of Phosphate Buffer Saline at pH7.
2. Qualitative analysis of proteins from given samples.
3. Qualitative analysis of carbohydrates from given samples
4. Qualitative analysis of Lipids from given samples
5. Qualitative analysis of Nucleic acid from given samples
6. Protein estimation by Lowry methods

P – 60; Total Hours –60

TEXT BOOKS:

1. Nelson D. L, Cox M. M. Lehninger's Principle of Biochemistry. 5th Ed.,W. H. Freeman, 2008.
2. Martin D. W, Mayer P. A. and Rodwell V. W. Harper's Review of Biochemistry 30th Ed., Maruzen Asian Lange Med.,2010.
3. Dixon M, Webb E. C,Thorne C.J.R and Tipton K.F.Enzymes. 3rd Ed., Longmans, Green &Co.,Academic Press, New York, 1979.

REFERENCES:

1. Wilson K., Walker J, Practical biochemistry Fifth Edition Cambridge Press.
2. R David Freifelder., Physical biochemistry: Application to biochemistry and Molecular biology
3. Second edition. W.H. Freeman and Company, New York.

COURSE OUTCOMES:

CO1: On the completion of the above objective's student will be able to explore about the technical knowledge to handle the instrument.

CO2: On the completion of the course students will have an idea about basic principles of estimation technique.

CO3: Students will be expert in gain the knowledge on lipid estimation

CO4: Student will acquire the knowledge of carbohydrate estimation**.**

CO5: student will get the idea to do the protein estimation from any sample

Board of Studies (BoS) :
8thBoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	H	M	L	H	H	H	M	
CO2	H	H	M	H	H	M	L	H	H	H	M	
CO3	H	H	M	H	H	M	L	H	H	H	M	
CO4	H	H	M	H	H	M	L	H	H	H	M	
CO5	H	H	M	H	H	M	L	H	H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSD 1203	BASICS OF GENETICS	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1: To introduce students to basics genetics

COB2: To introduce students to concept of allelic interaction

COB3: To introduce students to genome organization

COB4: To introduce students to sex linkage

COB5: To introduce students to extrachromosomal inheritance

MODULE I INTRODUCTION TO GENETICS 12

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 12

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 12

Structure and characteristics of bacterial and eukaryotic chromosomes, chromosome morphology, concept of euchromatin and heterochromatin. Packaging of DNA molecules 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 12

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 mapping.

MODULE V EXTRA CHROMOSOMAL INHERITANCE 12

Rules of extranuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Evolution and population genetics: Inbreeding and outbreeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

L – 60; Total Hours –60

TEXT BOOKS:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. Principles of Genetics. VIII Edition John Wiley & Sons, 2006
2. Snustad, D.P., Simmons, M.J. Principles of Genetics. V Edition. John Wiley and Sons Inc., 2009.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. Concepts of Genetics. IX Edition. Benjamin Cummings., 2009
4. Russell, P. J. Genetics- A Molecular Approach. III Edition. Benjamin Cummings. 5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co., 2009.

COURSE OUTCOMES:

CO1: To introduce students to basics genetics

CO2: To introduce students to concept of allelic interaction

CO3: To introduce students to genome organization

CO4: To introduce students to sex linkage

CO5: To introduce students to extrachromosomal inheritance

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1		L	H	H			M		H			
CO2		L	H	H			M		H			
CO3		L	H	H			M		H			
CO4		L	H	H			M		H		H	
CO5		L	H	H			M		H			

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course foucussed on the the genetic make up of human beings. Studying this course will help the students to understand the living things and its importance.

LSD 1204	BASICS OF GENETICS LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

COB1: To understand mitosis

COB2: To understand meiosis

COB3: To understand mendelian inheritance

COB4: To understand pedigree charts

COB5: To understand genotyping

PRACTICALS

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.
8. Staining based karyotyping analysis of cancer cells
9. Genotyping

P – 60; Total Hours – 60

TEXT BOOKS:

1. G. Koliantz and D.B. Szymanski. Genetics A Laboratory Manual, 2nd edition Spi Lab Edition, 2009.

COURSE OUTCOMES:

CO1: To understand cell cycle

CO2: To understand karyotyping

CO3: To understand mendelian inheritance

CO4: To understand pedigree charts

CO5: To understand genotyping

Board of Studies (BoS) :
8thBoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	H			M	H	H	H	H	
CO2	H	H	L	H			M	H	H	H	H	
CO3	H	H	L	H			M	H	H	H	H	
CO4	H	H	L	H			M	H	H	H	H	
CO5	H	H	L	H			M	H	H	H	H	

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course foucussed on the the genetic make up of human beings. Studying this course will help the students to understand the living things and its importance.

GED 1207	ENVIRONMENTAL STUDIES	L	T	P	C
SDG: All		2	0	0	2

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 MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **8**

Definition, scope and importance, Need for public awareness.

Natural resources and associated problems(a) Land resources: Land as a resource, land degradation, soil erosion and desertification -(b) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forest and tribal people -(c) Water resources: Use and over-utilization of surface and ground water,conflicts over water, dams-benefits and problems,Water conservation: rain water harvesting, watershed management -(d) Mineral resources: Use and exploitation, environmental effects of extractingand using mineral resources,mining -(e) Food resources: World food problems, changes caused by agriculture andovergrazing, effects of modern agriculture - (f) Energy resources: Growing energy needs, renewable and non-renewableenergy sources, use of alternate energy sources.

MODULE II ECOSYSTEMS AND BIODIVERSITY **8**

Ecosystems: Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of thefollowing ecosystem(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:Classification: genetic, species and ecosystem diversity; Bio-

geographical classification of India and India as a mega-diversity nation;Invasive, endangered, endemic and extinct species;Hot sports of biodiversity and Red Data book;Values of biodiversity, Threats to biodiversity; Conservation of biodiversity.

MODULE III ENVIRONMENTAL POLLUTION AND ITS CONTROL 8

Definition, 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 hazards, (h) ill-effects of fireworks and upkeep of clean environment - El Nino and La Nina.

Solid waste Management - Causes, effects and control measures of urban, industrial wastes and e-waste -Disaster management: flood, drought, cyclone, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, SOCIAL ISSUES AND HEALTH 6

Population, population growth, variation among nations; population explosion; Family Welfare Programme - Unsustainable to sustainable development - Resettlement and rehabilitation of people - Environment Protection Act - Public awareness -Human Rights - Value Education - Women and Child Welfare - HIV/AIDS - Environment and human health: air-borne, water borne, infectious diseases, contagious diseases and immunization (all types of vaccines from birth), risks due to chemicals in food and water, endocrine disrupting chemicals, cancer and environment.

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 BlackswanPvt. Ltd., Hyderabad, India, 2013.
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, “Environmental Science and Engineering”, Sri Krishna Publications, Tamil Nadu, India, 2018.
4. Raman Sivakumar, “Introduction to Environmental Science and Engineering”, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, “Principles of Environmental Science and Engineering”, Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., “Environmental Science and Engineering”, New Age International Pvt. Ltd., New Delhi, India, 2009.

REFERENCES:

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

COURSE OUTCOMES:

The student will be able to

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

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

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

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

.

Board of Studies (BoS) : 11thBoS of Chem held on 17.06.2021

Academic Council: 17th AC held on 15.07.2021

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

LSD 2101	**BIOCHEMISTRY**	**L**	**T**	**P**	**C**
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

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

COB2: to 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: Studentss acquire knowledge in energy yielding pathways such as Glycogen metabolsim, TCA cycles and Gluconeogenesis

COB4: Students will acquire knowledge in fatty acid metabolism

COB5: Students will learn the mechanism of photosynthetic process

MODULE I WATER, ACIDS, BASES AND BUFFER 12

Dissociation of water, ionic product of water, concepts of pH, pOH, simple numerical problems of pH, determination of pH using indicators, pH meter and theoretical calculations. Dissociation of weak acids and electrolytes, Brönsted theory of acids and bases, shapes of titration curve of strong and weak acids and bases. Meaning of Ka and pKa values, buffers and buffer action.Buffers in biological system, Henderson -Hasselbalch equation with derivation, simple numerical problems involving application of this equation, simple numerical problems on buffer composition.

MODULE II METABOLISM- I GLYCOLYSIS AND GLUCONEOGENEISIS 12

Introduction to Metablosm, Carbohydrate metabolism: Embden-Meyerhof pathway, regulation of glycolysis in Liver and Muscles, fermentation, anaerobic fate of pyruvate, Entry of different sugars in glycolysis, gluconeogenic pathway and its regulation,

MODULE III METABOLISM- II GLYCOGEN METABOLISM, TCA CYCLE AND ELECTRON TRANSPORT CHAIN 12

Glycogen metabolism (glycogenolysis and glycogenesis), regulation of glycogen metabolism, TCA cycle and its regulation- ATP production. Electron transport chain system: ATP synthase structure and function, Boyer's conformational model.

MODULE IV FATTY ACID AND AMINO ACID METABOLISM 12

Lipid Metabolism: Lipolysis, β-oxidation, energy yield, role of Carnitine. Essential aminoacids, nonessential aminoacids, glucogenic and ketogenic amino acids, amino acids biosynthesis (glutamate, glutamine, alanine, aspartate, asparagine serine, glycine, praline, cysteine, tyrosine), pathways of amino acids degradation (acetyl CoA family α- ketoglutarate family, succinyl CoA family), urea cycle.

MODULE V PHOTOSYNTHESIS 12

Introduction, Significance, Historical aspects, Photosynthetic pigments, Concept of two photosystems, Light phase: Cyclic and Non cyclic photophosphorylation (z scheme), Dark phase: Calvin cycle (C3), Hatch and slak cycle (C4) and CAM pathway, Photorespiration (C2 cycle), significance of Photosynthesis.

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Biochemistry by LubertStryer. W. H. Freeman & Company, NY, 2000
2. Biochemistry by Lehninger. McMillan publishers, 2003
3. Biochemistry by Zubey. Wm. C. Brown publishers, 2007

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) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L			L	L	H	L	M	
CO2	H	H	L	L			L	L	H	L	M	
CO3	H	H	L	L			L	L	H	L	M	
CO4	H	H	L	L			L	L	H	L	M	
CO5	H	H	L	L			L	L	H	L	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 2102	BIOCHEMISTRY LABORATORY	L	T	P	C
SDG: 3,15		0	0	4	2

COURSE OBJECTIVES:

COB1: Provides opportunities to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

COB2: Accuracy and Precession of analysis

COB3: Analyze the carbohydrates

COB4: Identification of amino acids and proteins

COB5: Quantitative analysis of nucleic acids and enzymes.

PRACTICALS

1. Introductory class for biochemistry lab instrumentations.
2. pH measurements and preparation of buffers.
3. Qualitative tests for Carbohydrates.
4. Estimation of reducing sugars.
5. Estimation of proteins by Lowry's method
6. Estimation of cholesterol by Zak's method.

P – 60; TOTAL HOURS – 60

REFERENCES:

1. Lab Manual

COURSE OUTCOMES:

CO1: Students will learn about the basics of Biomedical instrumentation

CO2: Students understand the importance of pH and how to prepare the buffers

CO3: Students understand the method to qualtitavely analyze the carbohydrates

CO4: Students learn the estimation of proteins

CO5: Students learn the estimation of cholesterol

Board of Studies (BoS) :	**Academic Council:**
8th BoS of SLS held on 5.07.2021	17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 2103	MOLECULAR BIOLOGY	L	T	P	C
SDG: 3,15		4	0	0	4

COURSE OBJECTIVES:

COB1: To understand the basic principles of DNA replication

COB2: To develop concepts about DNA mutations

COB3: to understand the process of transcription

COB4: to understand the translational machinery

COB5: To learn the working principles of molecular biology techniques

MODULE I DNA REPLICATION 12

Models of DNA replications-conservative, semi conservative and dispersive mode of replication, Mechanism of Prokaryotic and Eukaryotic DNA replication, DNA polymerase structure, Enzymes and accessory proteins involved in DNA replication, telomerase and end replication problem.

MODULE II DNA DAMAGE AND REPAIR 12

Chemical modifications of DNA, Ionizing radiations and DNA damage, DNA double strand breaks, DNA damage repair, Mismatch repair in bacteria, Base excision repair and Nucleotide excision repair, NHEJ and homologous recombination in DNA double strand break repair.

MODULE III TRANSCRIPTION 12

Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, Chain elongation models, Transcription termination in prokaryotes and eukaryotes, General and specific transcription factors, Regulatory elements, 5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

MODULE IV TRANSLATION 12

Codon, Prokaryotic and Eukaryotic translation, the translation Machinery; tRNA structure and function, tRNA charging, Mechanisms of initiation, elongation and termination, regulation of translation.

MODULE V TOOLS IN MOLECULAR BIOLOGY 12

Recombinant DNA generation, Molecular cloning, DNA and RNA isolation techniques, agarose gel electrophoresis, Protein isolation and polymerase gel electrophoresis, polymerase chain reaction

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. James D Watson “Molecular Biology of the Gene” 7Ed. Cold Spring Harbor, New York, 2014
2. Nancy L Craig “Molecular Biology: Principles of Genome Function” 1st Ed. Oxford University Press, New York, 2010.

REFERENCES:

1. Kellenberger E. The evolution of molecular biology. EMBO Rep. 2004 Jun;5(6):546-9. doi: 10.1038/sj.embor.7400180.
2. Molecular biology techniques. Curr Protoc Cell Biol. 2001 May; Appendix 3: Appendix 3A. doi: 10.1002/0471143030.cba03as08.

COURSE OUTCOMES:

At the end of the course the students should be able to**:**

CO1: understand the basic principles of DNA replication

CO2: conceptualize the basics of DNA mutation and repair

CO3: familiarize with the process of transcription

CO4: conceptualize the fundamentals of transcription

CO5: apply their knowledge of molecular biology techniques

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L			L	L	H	L	M	
CO2	H	H	L	L			L	L	H	L	M	
CO3	H	H	L	L			L	L	H	L	M	
CO4	H	H	L	L			L	L	H	L	M	
CO5	H	H	L	L			L	L	H	L	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 2104	MOLECULAR BIOLOGY LABORATORY	L	T	P	C
SDG: 3,15		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn the DNA isolation techniques

COB2: To learn the RNA isolation techniques

COB3: To learn agaose gel electrophoresis and analzye the DNA

COB4: To learn the process of resolving isolated DNA

COB4: To learn the technique of amplifying DNA fragments

PRACTICALS

List of Experiments:

1. Extraction of genomic DNA from bacteria
2. Extraction of plasmid DNA from bacteria
3. Agarose gel electrophoresis of chromosomal & plasmid DNA
4. Isolation of RNA from bacteria
5. Recovery of DNA from Low-Melting-Temperature Agarose Gels: Organic Extraction
6. cDNA synthesis
7. Polymerase chain reaction

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Sample:

1. Green and Sambrook ‘Molecular Cloning: A Laboratory Manual’ 4th Edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, 2012.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: develop DNA isolation skills

CO2: conduct experiments with isolated DNA

CO3: Conduct experiment with RNA

CO4: conduct experiment with plasmid DNA

CO5: Conduct PCR experiments

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 2105	ENZYMOLOGY	L	T	P	C
SDG: 3,15		4	0	0	4

COURSE OBJECTIVES:

COB1: obtain a general knowledge about how enzymes work

COB2: understand the kinetics of enzyme action

COB3: understand the biotechnological applications of enzymes and their purification methods.

COB4: To learn the various ways of extracting enzymes

COB5: To learn the applications of enzymes

MODULE I INTRODUCTION 12

The Enzyme- Introduction-- General concept and background, Nomenclature and Classification of Enzymes. Enzyme activity- chemical nature of enzymes, Distinct features of Enzymes, Characteristics of Enzyme Catalysis, Specificity of Enzyme action- The active site-General features and regulation, Coenzymes and Cofactors- Prosthetic group, Metalloenzymes and metal activated enzymes, Proenzymes, Isozymes, Abzymes, Synzyme, Hypothesis and Models for Enzyme Substrate action. Enzyme classification and Nomenclature.

MODULE II ENZYME KINETICS 12

Kinetics of single substrate reactions; estimation of Michaelis – Menten parameters, multi substrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics. Enzyme inhibition- Competitive, Uncompetitive and Mixed. Effect of pH and temperature on Enzyme action, Bisubstrate reactions.

MODULE III IMMOBILIZATION OF ENZYMES 12

Immobilization of enzymes- Introduction, Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages. Applications of Immobilized Enzymes.

MODULE IV ENZYME REACTION MECHANISMS 12

Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of

Serine proteases-Chymotryspin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens), Triose phosphate isomerase.

MODULE V APPLICATIONS OF ENZYMES 12

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.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Buchholz, K., Kasche, V. and Bornscheuer, U., “Biocatalysts and Enzyme Technology”, WILEY–VCH, 2005.
2. L. Lehringer, d.L. Nelson, M.M Cox- “Principle of Biochemistry by Werth publishers, 2000.
3. L. Stryer, J.M. Berge, J.L. Tymoezko- “Biochemistry” W.H. freeman & Co. 2002.
4. Introduction to protein structure by B randen and Tooze (1998): Garland publishing group.
5. Enzyme by Palmer (2001); Horwood publishing series.
6. Fundamental of Enzymology by Price and Stevens (2002): Oxford University Press.
7. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986

COURSE OUTCOMES:

CO1: Develop fundamental understanding of Enzymes & Proteins

CO2: Understand the kinetics and mechanism of enzyme action

CO3: Understand the concepts of enzyme immobilization

CO4: Understand the Purification methods

CO5: Understand the applications of enzymes in industry

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L			L	L	H	L	M	
CO2	H	H	L	L			L	L	H	L	M	
CO3	H	H	L	L			L	L	H	L	M	
CO4	H	H	L	L			L	L	H	L	M	
CO5	H	H	L	L			L	L	H	L	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD2106	ENZYMOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

COB1: understand the fundamental of Enzyme function and the parameters which affects its activity

COB2: know the calculation of kinetic parameters of enzyme activity. such as KM, Vmax, and kcat values of the Michaelis–Menten equation.

COB3: how to process, present and analyze experimental data

COB4: Understand the effect of temperature on enzyme kinetics

COB5: Understand the effect of pH on enzyme kinetics

PRACTICALS

1. Isolation and Screening of amylase producing microorganisms from soil and saliva
2. Construction of Protein standard curve by Folin's Lowry method and calculate the concentration using straight line equation
3. Effect of substrate concentration on Enzyme kinetics and determination of Km and Vmax
4. Effect of temperature on Enzyme kinetics
5. Effect of pH on Enzyme kinetics

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Lab Manual

COURSE OUTCOMES:

CO1: calculation of Km and Vmax from enzyme catalyzed reaction.

CO2: list the factors that can affect the rate of a chemical reaction and enzyme activity

CO3: understand the effect of substrate concentration on enzyme kinetics

CO4: explain why enzymes have an optimal temperature to ensure greatest activity

CO5: : explain why enzymes have an optimal pH to ensure greatest activity

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

GED 2102	APTITUDE AND INTERPERSONAL SKILLS	L	T	P	C
SDG: 8		0	0	2	1

COURSE OBJECTIVES:

COB1: To enhance problem solving skills

COB2: To train the students to face competitive examination

COB3: To recognize communication barriers and act accordingly

COB4: To learn the nuances of Group discussion and basic Etiquettes.

MODULE I GENERAL MENTAL ABILITY 8

Problems on Age - Time & Work – Speed, Distance & Time – Problems on Train - shortcut techniques - Simple & Compound Interest.

MODULE II QUANTITATIVE APTITUDE AND REASONING 7

Percentage - Profit & Loss – Ratios and Proportions –Verbal Reasoning: Direction, Blood relations, Calendar and Clocks

MODULE III COMMUNICATION AND INTERPERSONAL SKILL 7

Communication skill - Effective listening skills – Problem Solving – Positive Attitude – Maintaining Trust.

MODULE IV PERSONALITY DEVELOPMENT 8

Presentation skills - Group Discussion techniques - Grooming Basics – Etiquettes - Body Language.

P – 30 ; TOTAL HOURS - 30

REFERENCES:

1. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
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. KhattarDinesh , The Pearson Guide to Quantitative Aptitude for

Competitive Examinations, 3e, Pearson India , 2016.
7. Bhattacharya. Indrajit, An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi, 2008
8. Swan, Michael, Practical English Usage, Oxford University Press, 2005
9. P.A. Anand , Wiley's Quantitative Aptitude, 1st Edition,Wiley,2015
10. InduSijwali, A New Approach to Reasoning Verbal & Non-Verbal, Arihant Publications India limited, 2018
11. DishaExperts , Shortcuts in Reasoning (Verbal, Non-Verbal, Analytical & Critical) for Competitive Exams 2nd Edition, Disha Publication, 2018
12. Jaikishan, Premkishan, How to Crack Test Of Reasoning, Arihant Publications India limited, 2018.

COURSE OUTCOMES:

CO1: Apply the concept of aptitude in competitive examination

CO2: Identify simple methods and solutions on problem solving

CO3: Break the glass ceiling and the hurdles of communication barriers

CO4: Present them self positively and master the art of Group discussion and basic etiquettes.

Board of Studies (BoS) :
13thBoS of Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1					L				L	
CO2					M					
CO3								M		
CO4								M		

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

SDG No. 8

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

This Course offers the employability and creates decent working environment.

SEMESTER V

LSD 3101	PLANT BIOTECHNOLOGY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

The purpose of the course is to provide

COB1: training in the science behind plant biotechnology,

COB2: an appreciation of the current scope and limits to its industrial application, and

COB3: the implications of modern methods of genetic modification for plant industries

COB4: students will learn about the importance of germ plasm storage

COB5: students will learan the basics of transgenics and methods.

MODULE I INTRODUCTION TO PLANT TISSUE CULTURE 12

Introduction; Scope, History and importance of Plant tissue culture; Laboratory facilities and operations; Sterilization Techniques; Culture media – Components, types and preparation; Types of culture- Organized and Unorganized Culture - Applications, advantages and disadvantages.

MODULE II MICROPROPAGATION AND SECONDARY METABOLITES 12

Micro propagation techniques- Stages of micropropagation, Organogenesis and Embryogenesis, advantages and disadvantages; Cell suspension culture; Secondary metabolite production; Selection of high yielding line.

MODULE III IN VITRO PRODUCTION OF HAPLOIDS, SOMATIC HYBRIDIZATION 12

Haploid plant generation- Anther culture, Ovary culture and Distant Hybridization, significance, method, advantage and disadvantage; Protoplast isolation, purification, viability and culturing; Somatic hybridization- techniques; Methods to screen, Methods of verification/ characterization; Applications, advantage and disadvantage.

MODULE IV SOMACLONAL VARIATION, GERMPLASM STRORAGE, CRYOPRESERVATION 12

Somaclonal variation - method, applications, advantages and disadvantage, causes; Germ plasm storage- in situ and ex situ; Cryopreservation; Slow growth method.

MODULE V TRANSGENICS FOR CROP IMPROVEMENT 12

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; Biosafety and bioethics.

L – 60;TOTAL HOURS – 60

TEXT BOOKS:

1. Chawla, H. S., “Introduction to plant biotechnology”, Enfield, N.H.: Science Publishers, c2000.
2. Satyanarayana, U., “Biotechnology”, Books & Allied (P) Ltd.-Kolkata, 2008.
3. Dubey R C., “A Text Book of Biotechnology”, S.Chand & Co Ltd, New Delhi, 5th Edition, 2014.

COURSE OUTCOMES:

After the completion of course, the students will

CO1: Perform and design method to culture and propagate plant using simple techniques

CO2: Appreciate the significance of plants as a reactor to produce products

CO3: Analyze and judge wisely on the choice of method for hybridization and need of genetic manipulation in plants.

CO4: Be skilled in methods of long-term storage/preservation of germplasm.

COB5: Students will learn the basics of transgenic process in crops

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSC 3102	PLANT BIOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

The course aims to provide the students

COB1: to learn the preliminary methods of preparing media and to culture plants using different techniques

COB2: to learn about the factors affecting tissue culture

COB3: Learn the basics of establishing a plant tissue culture and its commercialization

COB4: to learn the isolation of protoplast and plant genomic DNA

COB5: Students will learn about the regulatory and approval procedures for commercializing the plants raised via tissue culture

PRACTICALS

List of Experiments:

1. Laboratory safety guidelines and setting up a tissue culture lab
2. Callus Induction
3. Micropropagation through seed culture
4. Micropropagation through shoot tip culture
5. Artificial seed synthesis
6. Anther culture
7. Isolation of protoplast
8. Isolation of plant genomic DNA
9. Regulatory and approval procedures for commercializing plants raised via tissue culture.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. C.C. Giri, Archana Giri., “Plant Biotechnology: Practical Manual”. I K International Publishing House, 2007.
2. Lab Manual.

COURSE OUTCOMES:

After the completion of course, the students will

CO1: grow plants through different micropropagation techniques and troubleshooting.

CO2: isolate DNA from plant material

CO3: Understand the intricacies and the opportunities of plant tissue culture laboratory.

CO4: Understand the uses of protoplast and plant genomic DNA

CO5: Understand the process ofregulatory and approval procedures for commercializing the plants raised via tissue culture.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSC 3103	ANIMAL BIOTECHNOLOGY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

The course aims to provide the students

COB1: To familiarize the students with fundamentals of different culturing and propagation techniques of animals.

COB2: To highlight the applications and potential benefits of biotechnology in enhancing human lives.

COB3: Students will explore the immunodioagnostics and methods to produce vaccines

COB4: Students will learn the basics of transgenics

COB5: Students will learn theapplications of animal biotechnology in medicine.

MODULE I INTRODUCTION TO ANIMAL CELL CULTURE 12

Historical perspective- early experiments- Scope of animal cell culture; Layout and basic requirements for cell culture laboratory; Sterilization and preparation for cell culture; Culture media –Natural and synthetic; Importance of serum and growth factors in cell culture.

MODULE II PROPAGATION OF CELLS 12

Basic Techniques of mammalian cell culture; Disaggregation of animal tissue; Types of animal cell culture – Primary and secondary- Development of primary culture (chicken embryo fibroblast); Maintenance of cell culture, Types of cell lines and its Characterization, Subculture, Immortalization of Cell lines, Evolution of cell line; Cryopreservation. Polymeric matrix construction-Organ culture, Embryo culture.

MODULE III IMMUNODIAGNOSTICS AND VACCINE TECHNOLOGY 12

Introduction to immunodiagnostics-Monoclonal antibodies, hybridoma technology, Introduction to vaccines, Types of vaccines Killed V/s Attenuated vaccines; Modern methods of vaccine generation, Stem cell technology, Cell banking.

MODULE IV TRANSGENIC ANIMALS 12

Gene Transfer methods and transfection methods; Transgenic animals- in vitro fertilization; Technique of embryo transfer; Super ovulation and embryo culture

in farm animals; Animal cloning- importance and scope.

MODULE V **APPLICATIONS OF ANIMAL BIOTECHNOLOGY IN MEDICINE** **12**

Introduction to fermentation Technology, Bioreactors for large scale production of animal cells Production of hormones and special secondary metabolites-insulin, growth hormone and interferon, Principles of gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, Social ethical issues.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Satyanarayana. U, “Biotechnology”, Books and Allied (p) Ltd., 2008.
2. Sudha Gangal., “Animal Tissue culture”, Second edition - University Press (India) Pvt Ltd. Hyderabad.
3. Ranga M,. “Animal Biotechnology”, Studam publishers, 2006.
4. Sasidhara. R., “Animal Biotechnology”, MJP Publishers, 2006.
5. Walker. J. M. & Gingold. E. B., “Molecular biology and Biotechnology”, 3rd edition – Panima publishing corporation, 1999.
6. Nigel Jenkins (Ed), “Animal cell Biotechnology: Methods and protocols”, Humana press, New Jersy, 1999.
7. Watson. J. S., Gillman. M., Witknowski. J. and Zoller. M., “Recombinant DNA”, 2nd edition - Scientific American Books, NY, 1992.
8. Dubey R. C. “A Text Book of Biotechnology”, S. Chand & Co Ltd, New Delhi.

COURSE OUTCOMES:

After the completion of course, the students will

CO1: master concepts in cell culturing and transgenics generation.

CO2: understand the broad area of biotechnology and its potential applications in animal husbandry

CO3: understand the procedures involved in transgenics

CO4: undertand the applications of animal biotechnology in medicine

CO5: critically understand the pros and cons of generating genetically modified organisms and the associated ethical issues.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSC 3104	ANIMAL BIOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

The course aims to provide the students

COB1: With the necessary skills for the isolation of animal cells for in vitro studies

COB2: Maintenance of cell culture and

COB3: The basic techniques in animal cell culture.

COB4: to learn how ro freeze the cell lines

COB5: To learn the contaminants of cell lines

PRACTICALS

List of Experiments:

1. Sterilization techniques
2. Preparation of cell culture media
3. Isolation and culture of Peripheral Blood Mononuclear Cell (PBMC)
4. Resuscitation of Frozen Cell Lines
5. Subculture of Adherent Cell Lines
6. Subculture of Suspension Cell Lines
7. Cell Viability Test
8. Cryopreservation of Cell lines
9. Testing for Bacteria and Fungi
10. Detection of Mycoplasma by Culture

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1.Animal Biotechnology Lab Manual

REFERENCES:

1. “Fundamental Techniques in Cell Culture”, 2nd Edition – European Collection of Cell Culture.

COURSE OUTCOMES:

After the completion of course, the students will have

CO1: Practical knowledge of sterilization techniques

CO2: Working knowledge of different types of media

CO3: Knowledge of cell lines

CO4: Isolation of different cell types

CO5: Identify contaminants of cell lines

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

SEMESTER VI

LSD 3201	**IMMUNOTECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1: Understand the basic concept of human defense system

COB2: familiar with the basic units of immune system *i.e.* immune cells and organs

COB3: Different types of immune response

COB4: Mechanism of various immune dysfunction

COB5: principle and properties of various immunotechniques

MODULE I INTRODUCTION TO IMMUNOLOGY 12

Introduction and History; Properties of immune response, active and passive immunization; Innate and acquired immunity; humoral and cell mediated immunity; cells & Tissues of Immune System.

MODULE II ANTIGEN AND ANTIBODY 12

Antigen and immunogen; antigenicity vs immunogenecity; s: Different characteristics of antigens, mitogens, Hapten, Immunogen, Adjuvants; Molecular structure of antibody; antigen-antibody interaction; Hybridoma technology .

MODULE III MOLECULAR IMMUNOLOGY 09

MHC molecule- types, structure and functions; MHC self restriction, antigen processing and presentation, inflammation pathway and compliment pathways.

MODULE IV CLINICAL IMMUNOLOGY 12

Immune system and human health; Microbial immunology, autoimmunity, hypersensitivity, transplantation immunology; Cancer immunity

MODULE V IMMUNOLOGICAL TECHNIQUES 12

Precipitation, agglutination, Immuno diffusion, immunoelectrophoresis, ELISA, RIA, western blot, immunoprecipitation. fluorescence activated cell sorter.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York,

1988.

REFERENCES:

1. Kuby- Immunology (4th Edition) by R. A. Goldsby, T.J. Kindt, B.A. Osborne.

2. Essentials of Immunology (6th Edition): Ivan Riot- Blakswell Scientific Publications, Oxford, 1988.

2. Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold spring harbor laboratory.

COURSE OUTCOMES:

CO1: To develop and extend the knowledge of cellular and molecular components of the human immune system.

CO2: Understanding the mechanisms involved in immune system development and responsiveness.

CO3: To give you the opportunity to gain laboratory skills by using methods to recognize, isolate and culture leukocytes and study their functions and to use antibodies for quantification in laboratory practical classes

CO4: To allow you to develop and practice a range of transferable skills during the practical's, including teamwork, software applications and data analysis.

CO5: To understand about how immunologists think and work.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing

inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 3202	IMMUNOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn the blood group mapping

COB2: To learn agglutination reactions

COB3: To learn immunodiffusion assays

COB4: To learn the basics of ummunoelectrophoresis

COB5: To learn the basics of ELISA

PRACTICALS

List of Experiments:

1. Blood group mapping
2. Slide and tube agglutination reaction
3. Single radial immunodiffusion assay
4. Double radial immunodiffusion assay
5. Immunoelectrophoresis
6. Dot ELISA
7. PBMCs culture

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Laboratory manual

REFERENCES:

1. Kuby- Immunology (4th Edition) by R. A. Goldsby, T.J. Kindt, B.A. Osborne.
2. Essentials of Immunology (6th Edition): Ivan Riot- Blakswell Scientific Publications, Oxford, 1988.
3. Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold spring harbor laboratory.

COURSE OUTCOMES:

The students will understand the concepts of

CO1:various types bold gropus

CO2:concept of agglutination reaction

CO3:concept of immunodiffusion assay

CO4: Understand the concept of immunoelectrophoresis

CO5:understand the concept of ELISA

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 3203	GENOMICS AND PROTEOMICS	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1: To provide information about genomics and proteomics.

COB2: To offer basic knowledge of genome sequencing methods

COB3: To provide information on functional genomics

COB4: To provide introduction to proteomics and tools to analyze proteome

COB5: To understand the application of proteomics

MODULE I INTRODUCTION TO GENOMICS 12

Introduction to genome-Genomes of prokaryotes and eukaryotes, molecular structure of the gene; Human Genome Project- history, goals, findings, applications, HUGO, HapMap Project, Genomes of model organisms- Viral, bacterial, worm, fruit fly, plant.

MODULE II DNA SEQUENCING METHODS 12

Maps-Linkage maps, Physical mapping methods-Banding patterns, Restriction maps, STS content; DNA sequencing- Sanger‘s dideoxy method, automated DNA sequencing method; High-throughput sequencing-Roche 454, Helicos, Illumina, SOLiD, Nanopore.

MODULE III FUNCTIONAL GENOMICS 12

Northern blotting, Subtractive hybridization, Differential Display Reverse Transcription, Representational Difference Analysis (RDA), Serial Analysis Gene Expression (SAGE), Microarray technology.

MODULE IV INTRODUCTION TO PROTEOMICS 12

Introduction to proteome- protein families, 1D and 2D PAGE, Isoelectric focussing, liquid chromatography-HPLC, Tandem LC; Protein Digestion Techniques; Mass Spectrometers- MALDI-TOF MS, ESI Tandem MS, Q-TOF and Fourier Transform Ion Cyclotron Resonance MS; Peptide Mass Fingerprintin.

MODULE V APPLICATIONS OF PROTEOMICS 12

Proteome mining; Protein Expression Profiling; Identifying Protein–Protein Interactions-IP ad Co-IP, Bait and reverse bait; Mapping Protein Modifications; Phospho and Glycoproeteomics.

L – 60; TOTAL HOURS - 60

TEXT BOOKS:

1. Nachimuthu Saraswathy and Ponnusamy Ramalingam (2011). Concepts and Techniques in Genomics and Proteomics. Biohealthcare Publishing (Oxford) Limited.

REFERENCES:

1.Arthur M. Lesk (2012). Introduction to Genomics. 2nd Ed. Oxford University Press.Daniel C. Liebler (2002). Introduction to Proteomics: Tools for the New Biology. Humana Press Inc. Totowa, NJ.

COURSE OUTCOMES:

At the end of the course students will be

CO1: able to get a better understanding of the basics of the genome structure, organization, different databases etc.

CO2: able to learn different tools for genome sequencing

CO3: able to learn concept and different tools of functional genomics

CO4: able to learn concept and different tools of proteomics

CO5: able to learn basics of the proteomics and its different applications

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of

biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSD 3204	GENOMICS AND PROTEOMICS LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn the about the various genome databases

COB2: To learn about the genome analysis tools

COB3: Tolearn the basics of proteome analysis

COB4: To gain knowledge on peptide mass fingerprinting

COB5: To obtain basic knowledge on protein modifications and protein-protein interaction predictions

PRACTICALS

List of Experiments:

1. Exploring Genome Databases
2. Retrieving Genome sequences from NCBI using SRA toolkit
3. Using different types of BLAST program
4. Genome annotation: DNA prediction methods
5. Exploring Galaxy server for genome analysis
6. Cancer Genome analysis using cBioportal
7. Protein Digestion analysis
8. Analysis of mass spec data for peptide mass fingerprinting
9. Prediction of protein glycosylation
10. Protein-Protein Interaction Prediction

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Lab Manual

COURSE OUTCOMES:

Students shall be able to

CO1: use different tools for genomic analysis

CO2: use Online tools to analyze proteomic data

CO3: design genomic analysis experimental workflow

CO4: design proteomic analysis experimental workflow

CO5: apply genomics and proteomics tool for research problems

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	L	L			H	H	M	
CO2	H	H	M	M	L	L			H	H	M	
CO3	H	H	M	M	L	L			H	H	M	
CO4	H	H	M	M	L	L			H	H	M	
CO5	H	H	M	M	L	L			H	H	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

GENERAL ELECTIVES

LSDX 001	BASICS OF COMPUTERS	L	T	P	C
		3	1	0	4

SDG: 9

COURSE OBJECTIVES:

COB1: To learn the basic components of the computer system.

COB2: To study how the data are stored in the memory devices.

COB3: To explore the different number system and its usage in computer.

COB4: To understand the different menus used for preparing documents and worksheets.

COB5: To know the various tools used for preparing slides.

MODULE I INTRODUCTION TO COMPUTER 12

Evolution – Basic Components – Input Devices – Output Devices - Hardware and Software Components – Classification of Computers - Application of Computers – Advantages and Disadvantages of Computer.

MODULE II STORAGE DEVICES 12

Primary Storage Devices – Secondary Storage Devices – Cache Memory - Memory Hierarchy – Memory Unit – Memory Size Calculation – Operating System - Introduction.

MODULE III NUMBER SYSTEM 12

Decimal Number System - Binary Number System - Octal Number System - Hexadecimal Number System - Number System Conversion – BCD – ASCII – ISCII – Unicode – EBCDIC.

MODULE IV DOCUMENT AND WORKBOOK 12

Bio-Data Creation – Formatting Documents – Text, Table, Symbols, Formula, Drawing, Page Layout – Borders - Watermarking - Mail Merge – Creating Hyperlink – Header and Footer – Page Numbers – Worksheet – Data Sorting and Filtering -Applying Formulas – Charts.

MODULE V PRESENTATION 12

Slide Creation – Transition – Animation and Multimedia– ClipArt – Insert – Tables, Pictures, Audio Clip, Video Clip – Hyperlink Creation.

L – 45, T - 15 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Michael Miller, "Computer Basics, Absolute Beginners Guide", 9th Edition, Pearson Education, 2019, ISBN : 9780136498902, 0136498906.

REFERENCES:

1. Inderjeet Singh, " Learn to Use Computer, MS Word, Powerpoint and Excel",1st Edition, Packt Publishers, 2019, ISBN:9781088636855.
2. Reema Thareja, "Fundamentals of Computers", 2nd Edition, Oxford University Press, 2019, ISBN: 9780199499274.

\

COURSE OUTCOMES: Students who complete this course will be able to

CO1: bridge the fundamental concepts of computers with different components of the system.

CO2: distinguish the various types of storage devices.

CO3: represent the input using different number system for digital encoding.

CO4: create documents and workbooks for real time applications.

CO5: prepare presentations slides with multimedia effects.

Board of Studies (BoS) : 19thBoS of CSE held on 20.11.2021

Academic Council: Mention Number and date

	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					L										H
CO2															
CO3		H						M						M	
CO4															
CO5										H					

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

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

Statement : Interact with decision makers to improve the uptake of sustainable infrastructure

LSDX 002	**BASICS OF COMPUTER LABORATORY**	**L**	**T**	**P**	**C**
SDG: 9		**0**	**0**	**4**	**2**

COURSE OBJECTIVES:

COB1: To impart basic computer knowledge.

COB2: To study the different components of the computer system.

COB3: To get familiarized with documentation tools and its different menus.

COB4: To explore the different methods of analyzing the created data.

COB5: To understand the presentation and visualization tools.

PRACTICALS

LIST OF EXPERIMENTS:

Study of various components of computer.
Document Creation
Bio-Data
Content Writing with Equations, Hyperlink, Page layout and Watermark
Time Table Creation
Flowchart
Mail Merge
Workbook Creation
Filter and sort the Data
Apply formulas for the data using Formula Editor.
Graphical analysis of data using chart.
Presentation
Create presentation slide.
Slide show with animation and transition effects
Slide show with multimedia effects.
Insert hyper link to word and workbook.
HARDWARE AND SOFTWARE REQUIREMENT:
Windows/Ubuntu
1 GHz or faster processor
1 GB (32-bit) or 2 GB (64-bit) of RAM
16 GB of free hard disk space,

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Lab Manual

COURSE OUTCOMES: Students who complete this course will be able to

CO1: identify the different components of the computer and configure the system.

CO2: create and format documents with professional proficiency.

CO3: prepare worksheet and perform accounting operations.

CO4: apply visualization tools for data analysis.

CO5: design presentation slides with multimedia effects and linking of documents.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th 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					L										H
CO2															
CO3		H						M						M	
CO4															
CO5										H					

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

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

Statement : Interact with decision makers to improve the uptake of sustainable infrastructure

LSDX 003	ARTIFICIAL INTELLIGENCE IN MEDICINE	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: provide basic knowledge about computational models of intelligence

COB2: critically assess the quality of data and models

COB3: gain expertise in the identification and application of appropriate intelligent system models

COB4: make the student to understand the models of artificial intelligence

COB5: provide the ability to analyze the performance of specific AI models and justify their use and limitations.

MODULE INTRODUCTION TO ARTIFICIAL INTELLIGENCE 12

Computational models of intelligence, supervised, semi-supervised, unsupervised, active, and transfer learning, History and status quo of intelligent and expert systems in medicine.

MODULE II CLINICAL DECISION-MAKING AND INTELLIGENT SYSTEMS 12

Risk stratification, patient outcome prediction, disease progression modelling, Validation and implementation of imaging biomarkers, smartphone apps in data-driven clinical decision-making.

MODULE III TOOLS AND TECHNOLOGIES FOR IMPLEMENTING AI METHODS 12

Artificial neural networks for pediatric patient management, deep learning and machine learning in biomedical imaging, Model evaluation and performance metrics, cross-validation, model interpretability, PyTorch, TensorFlow.

MODULE IV ARTIFICIAL INTELLIGENCE IN MEDICAL IMAGING 12

Quality and curation of medical images, Machine learning tasks in Radiology, Diabetic retinopathy detection using retinal fundus imaging, Artificial intelligence in cardiovascular imaging.

MODULE V REGULATORY, ETHICAL, LEGAL AND SOCIAL ISSUES OF AI IN MEDICINE 12

FDA-approved AI algorithms, Privacy-preserving collaborative deep learning methods, multi-institutional training without sharing patient data, Bias,

fairness, accountability, and transparency in machine learning.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Artificial Intelligence in Medical Imaging, Erik R. Ranschaert, Sergey Morozov. Springer, 2019
2. Artificial intelligence in Medicine, Lei Xing, Maryellen L.Giger, Academic Press, 2020.

COURSE OUTCOMES:

CO1: Comprehend a collection of machine learning models, and their applications in medicine

CO2: Identify and apply appropriate intelligent system models and computational tools to specific problems in biomedicine and healthcare

CO3: Analyze the performance of specific models as applied to biomedical problems, and justify their use and limitations

CO4: Understand the use of AI in medical imaging

CO5: Undestand the concepts of ethical, legal and social issues of ai in medicine.

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	H	H	H	H	H	L	H	H	H	H	H
CO2	L	H	H	H	H	H	L	H	H	H	H	H
CO3	L	H	H	H	H	H	L	H	H	H	H	H
CO4	L	H	H	H	H	H	L	H	H	H	H	H
CO5	L	H	H	H	H	H	L	H	H	H	H	H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 004	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: provide basic knowledge about computational models of intelligence

COB2: critically assess the quality of data and models

COB3: gain expertise in the identification and application of appropriate intelligent system models

COB4: make the student to understand the models of artificial intelligence

COB5: provide the ability to analyze the performance of specific AI models and justify their use and limitations.

PRACTICALS

1. Measure liver iron concentration using Patient MRI with confirmed systemic iron overload.
2. Detection of diabetic retinopathy using AI model
3. De-noise CT datasets to increase image quality at reduced dose levels
4. Perform ML test to aid diagnosis of difficult-to-diagnose tumors using formalin-fixed, paraffin-embedded samples
5. Diagnosis of sleep disorders using automated algorithm
6. X-ray wrist fracture diagnosis using deep learning
7. Predict blood glucose changes using AI
8. Process radiology images using deep neural network-based algorithm
9. Acute intracranial hemorrhage triage algorithm
10. Pulmonary CT image reconstruction using deep learning

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Lab Manual

COURSE OUTCOMES:

CO1: Comprehend a collection of machine learning models, and their applications in medicine

CO2: Identify and apply appropriate intelligent system models and computational tools to specific problems in biomedicine and healthcare

CO3: Analyze the performance of specific models as applied to biomedical problems, and justify their use and limitations

CO4: Understand to predict blood glucose changes using AI
CO5:understand the Acute intracranial hemorrhage triage algorithm

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	H	H	H	H	H	L	H	H	H	H	H
CO2	L	H	H	H	H	H	L	H	H	H	H	H
CO3	L	H	H	H	H	H	L	H	H	H	H	H
CO4	L	H	H	H	H	H	L	H	H	H	H	H
CO5	L	H	H	H	H	H	L	H	H	H	H	H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 005	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
SDG: 9		4	0	0	4

COURSE OBJECTIVES:

COB1: To introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.

COB2: To disseminate knowledge on patents, patent regime in India and abroad and registration aspects

COB3: To disseminate knowledge on copyrights, trademarks and its related rights and registration aspects

COB4: To disseminate knowledge on IPR in biotechnology and aware about current trends in IPR and Govt. steps in fostering IPR.

MODULE I OVERVIEW OF INTELLECTUAL PROPERTY 12

Introduction and the need for intellectual property right (IPR); Types of Intellectual Property; Rationale for protection of IPR; Impact of IPR on development, health, agriculture and genetic resources; IPR in India – Genesis and development; IPR in abroad; International organizations, agencies and treaties.

MODULE II PATENTS 12

Definition; Elements of Patentability; Legal requirements for patents; Registration Procedure, Rights and Duties of Patentee; Management of IP assets and IP portfolio - Assignment and license; Restoration of lapsed Patents; Surrender and Revocation of Patents; Infringement, Remedies & Penalties; Patent office and Appellate Board; Different layers of the International patent system – National, International and regional options.

MODULE III COPYRIGHTS 12

Nature of Copyright – rights and protection covered (Law of Copyrights); Fundamentals of Copyright law; Originality of materials; Rights of reproduction; Rights to perform the work publicly; Ownership of copyright; Registration procedure; Notice of copyright; Assignment and license of copyright - Infringement, Remedies & Penalties; Related Rights - Distinction between related rights and copyrights.

MODULE IV TRADEMARKS 12

Concept of Trademarks- Rights, purpose and functions of trademark; Different kinds of marks - Brand names, Logos, Signatures, Symbols, Well known marks, Certification marks and Service marks; Non Registrable Trademarks; Registration of Trademarks; Rights of holder; Assignment and licensing of marks; Infringement, Remedies & Penalties; Trademarks registry and appellate board.

MODULE V DIFFERENT FORMS OF IP AND ROLE OF INTELLECTUAL PROPERTY IN BIOTECHNOLOGY 12

Geographical Indication (GI) – Types; Why and how GI need protection and GI laws; Difference between GI and trademarks; Procedure for registration; Effect of registration; Indian GI act; Industrial design - meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection;

Biotechnology – Adoption and dissemination; Need for protection; Existing Protection; New Plant Varieties; Laws; Benefits; Case Studies of Biotechnology; Patenting of Microorganisms – An overview; Govt. of India step towards promoting IP; IP in current scenario with case studies.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Nithyananda, K V. “Intellectual Property Rights: Protection and Management. India”, IN: Cengage Learning India Private Limited, 2019.
2. Neeraj, P., & Khusdeep, D.“Intellectual Property Rights. India”, IN: PHI learning Private Limited, 2014.

REFERENCES:

1. Intellectual Property Rights – NPTEL Resources

COURSE OUTCOMES:

After the completion of course, the students will

CO1: Get an adequate knowledge on patent for their innovative research works

CO2: Have information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provides a further way for developing their ideas or innovations.

CO3: Understand the importance of copyrights

CO4: Understand the importance of trademarks

CO5: Understand the role of IPR in biotechnology

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M						L				H
CO2	L	M						L				H
CO3	L	M						L				H
CO4	L	M						L				H
CO5	L	M						L				H

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

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to innovate and methods to protect their innovation

LSDX 006	PATENT DRAFTING AND	L	T	P	C
SDG: 9	APPLICATION LABORATORY	0	0	4	2

COURSE OBJECTIVES:

COB1: Understand importance of patent writing

COB2: Understand the art of writing patent

COB3: Understand the procedure to file patent

COB4: Understand the role of patent agents

COB5: Understand post grant procedures

PRACTICALS

1. Introduction to patent, Importance of patent writing, Contents of patent writing, Different forms and fee's structure
2. Contents for writing
    a. Title
    b. Field of invention
    c. Background of the invention/Prior art
    d. Objects of invention
    e. Summary of the invention
    f. Brief description of drawing
    g. Detailed description of the invention
    h. Description of an invention is required to be furnished with sufficient claims
3. Procedure for filing of patent applications
4. Examination, grant, pre-grant and post grant oppositions.
5. cover the post-grant procedures such as maintenance of patent, appeal, revocation, compulsory licensing and use of patents for the purpose of Government
6. Patent agents, offences and penalties, general powers of Controller, general services, scientific advisors and miscellaneous provisions.
7.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Manual of patent office practice and procedure version 3.0, march 1, 2019, published by: the office of controller general of patents, designs & trademarks, Boudhik Sampada Bhawan, S. M. Road, Antop hill, Mumbai (India)

COURSE OUTCOMES:

CO1: Understand importance of patent writing

CO2: Understand the art of writing patent

CO3: Understand the procedure to file patent

CO4: Understand the role of patent agents

CO5: Understand post grant procedures

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M						L				H
CO2	L	M						L				H
CO3	L	M						L				H
CO4	L	M						L				H
CO5	L	M						L				H

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

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to innovate and methods to protect their innovation

LSDX 007	BIOSTATISTICS	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To introduce basic terminologies used in biostatistics, collect and represent different types of data

COB2: To gain insights on the concept of central tendency and its application

COB3: To provide an introduction to probability and probability distribution

COB4: To introduce the concept of correlation and regression and its significance

COB5: To generate hypotheses and test them.

MODULE I DATA, DATA TYPES AND DISPLAY 12

Population vs. Sample, Data- Types and collection and sampling method, ExamplesMedical Study Designs, Representation of data- Graphical Displays: Dotplots, Stem & leaf plots, Histograms

MODULE II DESCRIPTIVE STATISTICS 12

Mean, Medium, Mode and their simple properties(without derivation) and calculation of median by graphs: range, mean deviation,Standard deviation, Coefficient of variation.

MODULE III PROBABILITY and PROBABILITY DISTRIBUTION 12

Random distributions, events-exhaustive, mutually exclusive and equally likely, definition of probability (with simple exercises), definition of binomial, Poisson and normal distributions and their inter-relations.

MODULE IV CORRELATION AND REGRESSION 12

Bivariate data – simple correlation and regression coefficients and their relation, Limits of correlation coefficient, Effect of change of origin and scale on correlation coefficient, Linear regression and equations of line of regression.

MODULE V STATISTICAL INFERENCE AND HyPOTHESIS TESTING 12

Population Distribution, Sampling Distribution, Confidence Interval, P-Value, Null And Alternate Hypothesis, Level Of Significance, Types Of Test- T-Test, Z-Test, Chi-Squared Test And ANOVA

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Biostatistcs- The Bare essentials, Geoffrey R Norman and David L Streiner
2. Fundamentals of Biostatistics by VB Rastogi
3. Fundamentals of Biostatistics, Bernard Roser 8th Edition

REFERENCES:

COURSE OUTCOMES:

After completion of the course, the student will be able to:

CO1: Conduct a simple survey and represent the data collected

CO2: Determine the central tendency of a population

CO3: Identify the outcomes of an event and categorise an experiment into different probability distributions

CO4: Investigate the relationship between two variables

CO5: Design a hypothesis and test it.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M	H		H			L		H		H
CO2	L	M	H		H			L		H		H
CO3	L	M	H		H			L		H		H
CO4	L	M	H		H			L		H		H
CO5	L	M	H		H			L		H		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 008	BIOSTATISTICS AND EXPERIMENTAL	L	T	P	C
SDG: 3	DESIGNING LABORATORY	0	0	4	2

COURSE OBJECTIVES:

This course teaches, including frequently used statistical tests and analyses.

COB1:participants basic principles of biostatistics

COB2: To learn the comparing the groups & catagorial group

COB3: To learn multiple and logistic regression

COB4: To learn the types of survival curves

COB5: To learn to practice student “t” test and one way ANOVA

PRACTICALS

List of Experiments:

1. Introduction; descriptive statistics.
2. Principles of statistical testing.
3. Comparing groups: continuous data.
4. Comparing groups: categorical data.
5. Correlation and linear regression.
6. Multiple regression.
7. Logistic regression.
8. Survival analysis: Kaplan-Meier curves and log-rank tests.
9. Survival analysis: Cox proportional hazards regression.
10. Practice Student “t” test
11. Practice one-way ANOVA

P – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Biostatistcs- The Bare essentials, Geoffrey R Norman and David L Streiner
2. Fundamentals of Biostatistics by VB Rastogi
3. Fundamentals of Biostatistics, Bernard Roser 8th Edition.

REFERENCES:

1. Statistical Package for the Social Sciences (SPSS), software package version 16.0

COURSE OUTCOMES: On successful completion, participants will be able to understand the requirements and assumptions for,

CO1:statistical tests and analytical procedures commonly used in clinical research

CO2: Students understand to compare groups: continuous data.

CO3: Understand the Multiple regression and Logistic regression.

CO4: Understand to use the student 't' test and one way ANOVA

CO5:to perform these procedures in SPSS or R and to interpret the results.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M	H		H			L		H		H
CO2	L	M	H		H			L		H		H
CO3	L	M	H		H			L		H		H
CO4	L	M	H		H			L		H		H
CO5	L	M	H		H			L		H		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 009	BIOINSTRUMENTATION	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: The students will be exposed to basic concepts spectroscopic techniques

COB2: The students will be exposed to Centrifugation and Microscopic Techniques

COB3: The students will be exposed to Electrophoretic techniques

COB4: The students will be exposed to radioisotope techniques

COB5: The students will be exposed to chromatographic techniques

MODULE I COLORIMETRY AND SPECTROSCOPY 12

Principle and application of colorimeter, ultraviolet spectroscopy, Infra-red, Nuclear magnetic resonance spectroscopy and Mass Spectroscopy (GCMS, LCMS & MSMS).

MODULE II CENTRIFUGATION AND MICROSCOPY 12

General principle, support media. Agarose gels, polyacrylamide gels. SDS PAGE, 2D PAGE Pulsed field gel electrophoresis Iso-electric focusing Capillary electrophoresis.

MODULE III ELECTROPHORETIC TECHNIQUES 12

Study of radioisotopes in biological samples, autoradiography- GM counter, scintillation counters, radio –immunoassay.

MODULE IV RADIOISOTOPE TECHNIQUES 12

Study of radioisotopes in biological samples, autoradiography- GM counter, scintillation counters, radio –immunoassay.

MODULE V CHROMATOGRAPHIC TECHNIQUES 12

Introduction: Chromatography theory and practice. Paper chromatography, Thin layer chromatography. Ion exchange chromatography. Affinity chromatography, Partition chromatography. Adsorption chromatography. Introduction to gas chromatography and HPLC.

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Wilson, K. and Walker, J. Principles and Techniques of Practical Biochemistry. 5th Edition, Cambridge Press, 1975
2. L. Veerakumari. Bioinstrumentation. Mjp Publishers; 1st edition, Chennai, India, 2011
3. Reilly M J. Bioinstrumentation. CBS HB (1 January 2016)

REFERENCES:

1. Pierre C. ORD and CD in chemistry and biochemistry: An Introduction. Academic Press, 1972.
2. 2. Paddock S. W. Confocal Microscopy methods & protocols.1st Ed., Human Press, 1999.
3. 3. Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st Ed,Wiley-Liss, 2001.

COURSE OUTCOMES:

CO1: After the completion of the module students will have a detailed understanding of spectroscopic techniques

CO2: Students will understand the principles and techniques of centrifugation and Microscopy

CO3: Students will understand the basics of electrophoresis and its instrumentation

CO4: Students will understand the principles and techniques of Radioisotopes

CO5: Students will understand the principles, techniques and applications of chromatographic techniques

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L			L	L	H	L	M	
CO2	H	H	L	L			L	L	H	L	M	
CO3	H	H	L	L			L	L	H	L	M	
CO4	H	H	L	L			L	L	H	L	M	
CO5	H	H	L	L			L	L	H	L	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 010	BIOINSTRUMENTATION LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: Students will be exposed to prepare the buffers for various assays

COB2: Students will be exposed to spectroscopic analysis

COB3: Students will be exposed to basic qualitative anlaysis

COB4: Students will be exposed to Chromatographic techniques such as Paper, Thin layer and Gel filtration chromatography

COB5: Students will be exposed to separate proteins by electrophoresis.

PRACTICALS

List of Experiments:

1. Preparation of Acetate, Tris and Phosphate Buffer systems and validation of Henderson-Hasselbach equation.
2. Reactions of amino acids – Ninhydrin, Pthaldehyde, Dansyl chloride –
3. measurement using colorimetric and fluorimetric methods.
4. Differential estimations of carbohydrates – reducing vs non-reducing,
5. polymeric vs oligomeric, hexose vs pentose
6. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect
7. Separation of Lipids by Thin Layer Chromatography
8. Separation of amino acids by paper chromatography
9. Gel filtration – Size based separation of proteins
10. Separation of proteins by SDS-PAGE Gel Electrophoresis

P – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Alfred Pingoud, Claus Urbanke, Jim Hoggett, Biochemical Methods: A Concise Guide for Students and Researchers, John Wiley & Sons Publishers, Inc, 2002.

REFERENCES:

1. Irwin H. Segel. Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Edition, 1976 John Wiley & Sons Publishers, Inc,
2. Wilson, K. and Walker, J. Principles and Techniques of Practical Biochemistry. 5th Edition, Cambridge Press, 1975.

3. U. K. LAEMMLI. leavage of Structural Proteins during the Assembly of the Head of Bacteriophage T4. Nature volume 227, pages680–685 (1970).

COURSE OUTCOMES:

CO1: After the completion of the experiment's student, have clear understanding of preparation of buffers

CO2: Students will be exposed to spectroscopic analysis

CO3: Students understand the basic qualitative analysis of carbohydrates

CO4: Students understand the Chromatographic techniques such as Paper, Thin layer and Gel filtration chromatography

CO5: Students understand to separate proteins by SDS-PAGE electrophoresis

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 011	HERBAL TECHNOLOGY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1: To provide an overview of the importance of herbal medicines in Siddha and Ayurveda practices

COB2: To explain the medicinal uses of common Indian herbs as examples

COB3: To introduce methods of extraction and characterization of phytocompounds

COB4: To highlight futuristic applications of herbal technology

COB5: To learn the aspects of herbal technology

MODULE INTRODUCTION OF HERBAL MEDICINES 12

History and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of herbs.

MODULE II PHARMACOGNOSY 12

Pharmacognosy - systematic position - medicinal uses of the following herbs in curing various ailments-Tulsi, Turmeric, Fenugreek, Indian Goose berry and Ashoka.

MODULE III PHYTOCHEMISTRY 12

Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs-*Catharanthus roseus* (cardiotonic), Withaniasomnifera (drugs acting on nervous system), *Clerodendronphlomoides* (antirheumatic) and *Centella asiatica* (memory booster).

MODULE IV ANALYTICAL PHARMACOGNOSY 12

Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

MODULE V ASPECTS OF HERBAL TECHNOLOGY 12

Medicinal plant banks - micro propagation of important species - Withaniasomnifera, neem and tulsi- Herbal neutraceuticals-future of pharmacognosy

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1.Pharmacognosy, Dr.C.K.Kokate et al. 1999. NiraliPrakashan
2. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
3. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

REFERENCES:

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book -Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH -publishing Co.5.

COURSE OUTCOMES:

After the completion of this course the students will be able to:

CO1: To appreciate the importance of Indian herbs in medicinal uses

CO2: To design experiments to analyse the phytochemical compounds of herbal plants and its parts

CO3: To innovate new applications of common herbs in food and medicine

CO4: Understand the concept of analytical pharmacology

CO5: Understand the concept of medicial plant banks

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 012	HERBAL TECHNOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

COB1: learn the various extraction methods of herbals

COB2: To learn to quantify the phytochemicals such as phenol and alkaloid

COB3: To learn preparing and standardizing the herbal lotion

COB4: To learn the methods to prepare churna mixture and tablet

COB5: To learnthe methods to prepare syrup and shampoo from herbals

PRACTICALS

List of Experiments:

1. Preliminary phytochemical screening of aqueous extract of Azadirachta indica (NEEM)
2. Evaluation of Excipients of Natural Origins 1 Tragacanth 2 Acacia 3 starch 4 Honey
3. Determination of phenol content
4. Determination of Total Alkaloids
5. Preparation and Standardization of Herbal Lotion
6. Preparation and Evaluation of Turmeric Cream
7. Preparation and Evaluation of Churna Mixture
8. Preparation and Evaluation of Tablet
9. Preparation and Evaluation of Orange Syrup
10. Preparation and Standardization of Methi-Shikakai Shampoo

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Busi- ness Horizons Publishers, New Delhi,

India, 2002.

COURSE OUTCOMES:

CO1: Students understand to prepare the various herbal extraction methods

CO2: Understand toquantify the phytochemicals such as phenol and alkaloid

CO3: Understand the importance of preparing and standardizing the herbal lotion

CO4: Understand the methods to prepare churna mixture and tablet

CO5: Understandthe methods to prepare syrup and shampoo from herbals

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 013	BIO-ENTREPRENUERSHIP	L	T	P	C
SDG: 1		4	0	0	4

COURSE OBJECTIVES:

COB1: To understand concepts and process involved with bio entrepreneurship

COB2: Plan the procedure for preparing various microbial products and analyze

COB3: Formulate the strategy to apply the industrially important products in society.

COB4: Explain the skills and the role of various institutional support for an entrepreneur.

COB5: To make the students aware of the importance of entrepreneurship opportunities available in the society for the entrepreneur.

MODULE I INTRODUCTION TO ENTREPRENEUR 12

Evolution of the concept of entrepreneur – Entrepreneurship; Definitions- concept of Entrepreneurship, development- need- role of resource, talent and spirits – process of Entrepreneurship to socio- economic gains.

MODULE II SCHEMES FOR ENTREPRENEUR 12

Institution and schemes of government of India- scheme and programmes, department of science and technology schemes, nationalized banks – other financial institution- SIDBI- NSIC- NABARD- IDBI- IFCI and ICICI.

MODULE III NEGOTIATIONS/STRATEGY 12

With financiers, bankers etc.; with government/law enforcement authorities; with companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes;Crisis/ Avoiding/Managing; Broader vision–Global thinking.

MODULE IV MICROBIAL PRODUCTS 12

Bread baking bread – leavening- baking process- idli- dosa, fermented products, mushroom cultivation and composting, preparation of compost, filling tray beds – spawing, maintaining optimum temperature, casing, watering, harvesting, storage. Biofertilizer – historical background, chemical fertilizer versus biofertilizer, organic farming, *Rhizobium sp, Azospirullumsp, Azotobactersp* as biofertilizer.

MODULE V ROLE OF KNOWLEDGE CENTRE AND R&D 12

Support mechanism for entrepreneurship in India; Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology

Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies.

L – 60; TOTAL HOURS –60

REFRENCES:

1. Mohanty, S.K., ―Fundamentals of Entrepreneurship‖, Sixth Edition, Prentice Hall India Private Limited, New Delhi, 2005.
2. Saxena, S., ―Applied Microbiology‖, Springer, New York, 2015.
3. Bhatia, B.S. and Batra, G.S., ―Entrepreneurship and small business management‖, Deep & Deep Publications, New Delhi, 2003.
4. Hisrich, D.R., ―Entrepreneurship‖, Sixth Edition, Tata McGraw Hill Private Limited, New Delhi, 2008.
5. Khanka, S.S., ―Entrepreneurial Development‖, Fourth Edition, S. Chand & Company Limited, New Delhi, 2019.
6. Nagendra, S., ―Entrepreneurship and Management‖, Sanguine technical Publishers, New Delhi, 2008.
7. Okafor, N., ―Modern Industrial Microbiology and Biotechnology‖, Second Edition, Science Publishers, New Hampshire, 2007.
8. Shimasaki, C., ―Biotechnology Entrepreneurship: Leading, Managing and commercializing innovative Technologies‖, Second Edition, Academic Press, London, 2020.
9. Suman, B.C. and Sharma, V.P. ―Mushroom cultivation in India‖, Daya Publishing house, New Delhi, 2007. Dr. v. B. Angadi, Dr. H. S. Cheema & Dr. M. R. Das Entrepreneurship, Growth, and Economic Integration A linkage, Himalaya 2009.

COURSE OUTCOMES:

CO1: Understand skills and the role of various institutional support for an entrepreneur

CO2: Understand the procedure for preparing various microbial products

CO3: Acquire knowledge and analyze the applications of microbial products for human well being

CO4: Retain knowledge of microbiology in entrepreneur development

CO5: Understand formulate the strategy to apply the industrially important products in society

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 1 : No Poverty

Statement: End poverty in all its forms everywhere. This course is focused on the importance of eliminating the poverty.

LSDX 014	BIO-ENTREPRENUERSHIP LABORATORY	L	T	P	C
SDG: 1		0	0	4	2

COURSE OBJECTIVES:

COB1: To understand concepts and process involved with bio entrepreneurship

COB2: Plan the procedure for preparing various microbial products and analyze

COB3: Formulate the strategy to apply the industrially important products in society

COB4: Explain the skills and the role of various institutional support for an entrepreneur

COB5: To make the students aware of the importance of entrepreneurship opportunities available in the society for the entrepreneur.

PRACTICALS

List of Experiments:

- Preparation of Proposal with novel idea
- Preparation of SWOT analysis of the proposed idea
- Preparation of a comprehensive report on the funding sources in India
- Preparation of a comprehensive report on the funding sources in abroad
- Preparation of documents needed for Grand-Aid/Extramural/Seed grant requirements from various agencies
- Identification of novel products from Bacteria
- Identification of novel products from Fungi
- Identification of novel products from Plants
- Development of product and analysis the strategy
- Preparation of patent application with five claims

P – 60; TOTAL HOURS – 60

REFERENCES:

1. Mohanty, S.K., ―Fundamentals of Entrepreneurship‖, Sixth Edition, Prentice Hall India Private Limited, New Delhi, 2005.
2. Saxena, S., ―Applied Microbiology‖, Springer, New York, 2015.
3. Bhatia, B.S. and Batra, G.S., ―Entrepreneurship and small business management‖, Deep & Deep Publications, New Delhi, 2003.
4. Hisrich, D.R., ―Entrepreneurship‖, Sixth Edition, Tata McGraw Hill Private Limited, New Delhi, 2008.
5. Khanka, S.S., ―Entrepreneurial Development‖, Fourth Edition, S. Chand & Company Limited, New Delhi, 2019.

6. Nagendra, S., ―Entrepreneurship and Management‖, Sanguine technical Publishers, New Delhi, 2008.
7. Okafor, N., ―Modern Industrial Microbiology and Biotechnology‖, Second Edition, Science Publishers, New Hampshire, 2007.
8. Shimasaki, C., ―Biotechnology Entrepreneurship: Leading, Managing and commercializing innovative Technologies‖, Second Edition, Academic Press, London, 2020.
9. Suman, B.C. and Sharma, V.P. ―Mushroom cultivation in India‖, Daya Publishing house, New Delhi, 2007. Dr. v. B. Angadi, Dr. H. S. Cheema & Dr. M. R. Das Entrepreneurship, Growth, and Economic Integration A linkage, Himalaya 2009.

COURSE OUTCOMES:

CO1: Understand skills and the role of various institutional support for an entrepreneur

CO2: Understand the procedure for preparing various microbial products

CO3: Acquire knowledge and analyze the applications of microbial products for human well being

CO4: Retain knowledge of microbiology in entrepreneur development

CO5: Understand formulate the strategy to apply the industrially important products in society

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L	H				H
CO2	M	L	H	H	L		L	H				H
CO3	M	L	H	H	L		L	H				H
CO4	H	L	H	H	L		L	H				H
CO5	H	L	H	H	L		L	H				H

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

SDG 1 : No Poverty

Statement: End poverty in all its forms everywhere. This course is focused on the importance of eliminating the poverty.

LSDX 015	WASTE MANAGEMENT	L	T	P	C
		4	0	0	4

SDG: 12

COURSE OBJECTIVES:

COB1: To impart knowledge and skills in the collection, storage, transport for waste materials.

COB2: To gain the skills in the treatment for waste materials

COB3: To obtain the knowledge of disposal and recycling options for solid wastes

COB4: To develop the knowledge to design criteria, methods and equipments for waste management.

COB5: To learn about waste disposing disposal technologies.

MODULE I ECOSYSTEM AND ECOTECHNOLOGY 15

Aim, scope and applications of ecology – Development and evolution of ecosystems – Principles and concepts pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems –productivity in ecosystems.

MODULE II SOURCES, CLASSIFICATION AND WASTE CHARACTERIZATION 10

Type of sources of solid, liquid and hazardous wastes-Salient features of municipal solid waste, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes, plastics and fly ash - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics –waste sampling and characterization.

MODULE III STORAGE, COLLECTION AND TRANSPORT OF WASTES 12

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

MODULE IV WASTE PROCESSING TECHNOLOGIES 13

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes -

treatment of biomedical wastes.

MODULE V WASTE DISPOSAL 10

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods –design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate– landfill closure and environmental monitoring.

L –60; TOTAL HOURS – 60

TEXT BOOKS:

1. Paul T Williams, Waste Treatment and Disposal, Wiley, 2005

REFERENCES:

1. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
2. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
3. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.

COURSE OUTCOMES:

CO1: Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation

CO2: Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste

CO3: Understand the role and response to the waste and apply the basic scientific principles for solving practical waste management challenges

CO4: Understand the waste disposing technologies

CO5: Understand the ways to dispose the wastes

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	M	H	H		H	H			H
CO2	H	H	L	M	H	H		H	H			H
CO3	H	H	L	M	H	H		H	H			H
CO4	H	H	L	M	H	H		H	H			H
CO5	H	H	L	M	H	H		H	H			H

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

SDG 12: Responsible consumption and production

Statement: Ensure sustainable consumption and production patterns. Studying this course will help the student to understand the responsibilities of consuming products and disposing the products with care. They also learn to produce the things in a proper way.

LSDX 016	WASTE MANAGEMENT LABORATORY	L	T	P	C
SDG: 12		0	0	4	2

COURSE OBJECTIVES:

COB1: To make students learn principles and design of experiments.

COB2: To investigate the performance of various Soils

COB3: To learn to analyze the BOD and COD

COB4: To analyze the Alkalinty, acidity and pH

COB5: To analyze the cholorides and sulphates

PRACTICALS

List of Experiments:

1. Determination of Total Solids in wastewater
2. Determination of suspended solids
3. Determination of volatile solids
4. Determination of Dissolved Oxygen.
5. Determination of BOD
6. Determination of COD.
7. Determination of Alkalinity, Acidity and pH.
8. Determination of Fats, oils and greases.
9. Determination of Chlorides
10. Determination of Sulphates.

P – 60; TOTAL HOURS - 60

TEXT BOOKS:

1. Manual of Water and Wastewater Analysis – NEERI Publication.
2. Standard Methods for Examination of Water and Wastewater, American Publication.

REFERENCES:

1.BIS Standards: 2490-1974, 3360-1974, 3307-1974.

2.Chemistry for Environment Engineering. Sawyer and Mc Carty.

COURSE OUTCOMES:

CO1: Achieve Knowledge of Design and development of experimental skills.

CO2: Understand the principles of design of experiments.

CO3: Understand the methods to analyze the BOD and COD

CO4: Understand the methods to analyzethe Alkalinty, acidity and pH

CO5: Students will successfully understand to analyzethe cholorides and sulphates

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	M	H	H		H	H			H
CO2	H	H	L	M	H	H		H	H			H
CO3	H	H	L	M	H	H		H	H			H
CO4	H	H	L	M	H	H		H	H			H
CO5	H	H	L	M	H	H		H	H			H

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

SDG 12: Responsible consumption and production

Statement: Ensure sustainable consumption and production patterns. Studying this course will help the student to understand the responsibilities of consuming products and disposing the products with care. They also learn to produce the things in a proper way.

LSDX 017	PHYTOCHEMISTRY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

COB1:upon completion of courses the student will be able to know the different classes of phytoconstituents**.**

COB2: upon completion of courses the student will be able to know about the biosynthetic pathways and their properties

COB3: upon completion of courses the student will be able to know about the genera; process of natural product drug discovery.

COB4: upon completion of courses the student will be able to know the phytochemical fingerprinting

COB5: upon completion of courses the student will be able to know about the structure elucidation of phytoconstituents.

MODULE I PHYTOCHEMICAL STUDIES 12

Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and Methods of fractionation. Separation of phytoconstituents by latest CCCET, SCFE techniques including prep and Flash column chromatography.

MODULE II PRIMARY METABOLITES 12

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primarymetabolites: Carbohydrates: Acacia, Agar, Tragacanth, Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin), Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat,

MODULE III PHYTOCHEMICAL FINGERPRINTING 12

Applications in the characterization of herbal extracts, structure elucidation of phytoconstituents, and some compounds: carvone, citral, menthol, luteolin, kaempferol, nicotine, caffeine, phytochemical fingerprinting. HPLC and LC-MS and GCMS

MODULE IV DRUG DISCOVERY 12

Drug discovery and development: History of herbs as source of drugs and drug discovery. Sourcing and archiving Natural products for discovery.

Evaluating natural products for therapeutic properties, identifying the biologically active Natural products, the lead structure selection process and structure development with suitable examples from the following source: artemesin, andrographolides.

MODULE V QUALITY CONTROL OF DRUGS OF NATURAL ORIGIN 12

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf-constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Wilson and Gisvoids text book of organic medicinal and pharmateutical chemistry by Deorge.
2. Medicinal Natural of Plant Analysis-A biosynthetic approach Dewick PM, John Wiley and Sons, Toronto, 1998.

REFERENCES:

1. Pharmacognosy & Phytochemistry of medicinal plants by Jean Brunton.
2. Chemistry of Natural Products by S. V. Bhat, B. A. Nagasampagi, M. Sivakumar
3. Jenkins Quantitative pharmaceutical chemistry by AN Kenwell

COURSE OUTCOMES:

CO1: Students will acquire knowledge on various types of phytoconstituents present in the plants.

CO2: Students will acquire knowledge on different types of drug and its nature.

CO3: Students will acquire knowledge about different metabolites and its importance.

CO4: Students will acquire idea about different technique use in phytochemical studies.

CO5: On the completion of course, student will know about the different types of phytochemicals and its nature.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 018	PHYTOCHEMISTRY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: Learn the basic principles of genetic variation in treatment response

COB2: Learn the molecular and cellular biology to explain the genetic basis of variability in drug response

COB3: Understand the concept of pharmacogenomics in different therapeutic areas.

COB4: To identify important sources and reliable databases with pharmacogenomics knowledge base.

COB5: to learn the techniques of drug analysis of HPLC and LCMS.

PRACTICALS

List of Experiments:

1. Quantification of total genomic DNA.
2. Metabolic profiling using NMR.
3. Identification of different lipids from different sources using proteolytic enzymes.
4. Phytochemical fingerprinting of herbal extract from different sources.
5. Evaluation of natural products for therapeutics properties.
6. Qualitative analysis of different adulteration of drugs
7. Drug analysis using HPLC
8. Drug analysis using LCMS

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Sample:

1. Martin D. W, Mayer P. A. and Rodwell V. W. Harper's Review of Biochemistry 30th Ed., Maruzen Asian Lange Med.,2010.
2. Dixon M, Webb E. C,Thorne C.J.R and Tipton K.F.Enzymes. 3rd Ed., Longmans, Green & Co.,Academic Press, New York, 1979.

REFERENCES:

1. McLeod, et. al (eds.) (2009). Pharmacogenomics: Applications to Patient Care, 2nd Ed. American Association of Colleges of Pharmacy.

COURSE OUTCOMES:

CO1: On the completion of the above objective's student will be able to understand the concepts to a drug therapy.

CO2: On the completion of the course students will knowledge of genetic testing and the resultant individualization of drug therapy.

CO3: Student will understand how variability in genes encoding drug metabolizing enzymes.

CO4: student will get the knowledge of drug testing.

CO5: Understand the drug analysis of HPLC and LCMS**.**

Board of Studies (BoS):
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 019	PHARMACOLOGY	L	T	P	C
SDG: 3, 15		4	0	0	4

COURSE OBJECTIVES:

The purpose of this course is:

COB1: To provide an Understanding of the basic concepts of Drugs and specified recptor mechanism

COB2: To gain expertise on therapuetic intervention against severe diseases

COB3: To provide a framework of the professional disciplines such as medicine, pharmacology in working with the biotechnology area

COB4: To develop the students' ability to analyze and solve problems

COB5: To provide a framework of the drug design and its development process.

MODULE I GENERAL PHARMACOLOGY 12

Pharmacokinetics: The kinetics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors.

MODULE II CNS PHARMACOLOGY 12

Local and General anesthetics, sedatives and hypnotics, drugs used to treat anxiety, depression, psychosis,mania, epilepsy and neurodegenerative diseases,Narcotic and non-narcotic analgesics, anti-inflammatory agents.

MODULE III REGULATORY PERSPECTIVES OF CLINICAL TRIALS 12

Origin and principles of international conference on harmonization-Good clinical practice (ICH-GCP) guidelines. Ethical committee, institutional review board, ethical guidelines for biomedical research and human participant, schedule Y, ICMR.

MODULE IV PHARMACOLOGICAL SCREENING METHODS 12

Common lab animals: Description, handling and applications of different species and strains of animals, transgenic animals. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. Limitations of animal experimentation and alternate animal experiments. Extrapolation of *in vitro* data to preclinical and preclinical to humans.

MODULE V CELLULAR AND MOLECULAR PHARMACOLOGY 12

Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; Isolation of cells, sub-culture, cryopreservation, characterization of cells and their application, Principles and applications of cell viability assays, glucose uptake assay. Principles and applications of flow cytometry.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Cooper G.M., Hausman R.E., The Cell: A Molecular Approach, Sinauer Publisher, USA, 2004
2. Ausubel F.M., Current Protocols in Molecular Biology, Vol-I toVI, Wiley, New Jersey. 1998
3. Dickenson J., Freeman F., Molecular Pharmacology: From DNA to Drug Discovery, Wiley, Colorado, 2001
4. Hardman J.G., Le L., Molinoss P.B., Ruddon R.W. and Gil A.G., Goodman and Gilman, The Pharmacological Basis of Therapeutics, Pergamon Press, Oxford., 1987.

REFERENCES:

1. Currie GM. Pharmacology, Part 1: Introduction to Pharmacology and Pharmacodynamics, 2018, Journal of Nulcear Medicine and Technology, Volume 46, Issue 2, Page number 81-86.
2. Fan J, de Lannoy IA.Pharmacokinetics, 2014, Biochemistry and Pharmacology, Voumne 87, Issue 1, Page number 93-120.

COURSE OUTCOMES:

The students would be more confident and able to:

CO1: explain the therapeutic mode of action on neurological system.

CO2: design the drug formulation for targeted chronic disease.

CO3: enquire quality assurance in protecting the public, workers, and the environment.

CO4: consider excellent research model for drug development in preclinical studies

CO5: understand the regualatory bodies for clinical trial of a drug.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 020	PHARMACOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

The objectives for the lab is to:

COB1: understand explicilty the formulations of drugs and/or medicines

COB2: develop the experimental skills, accuracy and precession of analysis

COB3: expose and build the students more confident working with biological samples

COB4: provide better expertise for drug designing and development in lab.

COB5: screen and enquire drug targets in disease prevention

PRACTICALS

List of Experiments:

1. Calculation for conversion of drug dose
2. Determination of ED50, LD50 and TD50 value
3. Determination of blood sugar and hemoglobin level in blood sample.
4. Cell viability assay
5. Isolation and identification of DNA from Goat liver.
6. Isolation and identification of Mitochondria from Goat liver.
7. Protocol design for clinical trial
8. To study the effects of various drugs on isolated tissue preparations.
9. Estimation of proteins by Branford/Lowry's in biological samples.
10. Apoptosis determination by fluorescent imaging studies

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Shivsharan B. Dhadde, Handbook of Experimental Pharmacology, 2019, Edition: 1Publisher: Studium Press (India) Pvt. Ltd.ISBN: ISBN 93-85046-63-92

REFERENCES:

1. Ausubel F.M., Current Protocols in Molecular Pharmacology, Volume 1-6, Wiley, New Jersey, USA, 2004.

COURSE OUTCOMES:

The students will be able to:

CO1: understand the fundamentals of Pharmacolgy lab.

CO2: More confident working with biological samples.

CO3: perform diagnostic experiments in clinical research

CO4: Shed a light on novel medicine formulation against severe disease

CO5: explain the pharmacological implications and understanding the structural considerations different episodes of drug mechansims.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	H	L	H	H	L		L		L	L		
CO5	H	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 021	BIOPHARMACEUTICS AND PHARMACOKINETICS	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To provide an Understanding of the basic concepts of pharmacokinetics and biopharmaceutics

COB2: To provide better understanding for toxicology, pharmaceutics, comparative medicine, bioengineering, occupational and environmental health.

COB3: To help students grasp the basic theories and basic skills of biopharmaceutics and pharmacokinetics

COB4: To develop the students' ability to analyze and solve problems

COB5: To provide a framework of the drug development process and its regulation.

MODULE I INTRODUCTION TO BIOPHARMACEUTICALS 12

Biopharmaceuticals: current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals. Discovery of protein or peptide-based therapeutics: In-silico, pharmaco-informatics. Pre-clinical toxicity assessment, Clinical trial phases and design, clinical data management, concept of Pharmacovigilance.

MODULE II PHARMACOKINETICS OF BIOPHARMACEUTICALS 12

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 BIOPHARMACEUTICAL PRODUCTS AND THEIR CONTROL 12

Therapeutic categories - Vitamins, laxatives, analgesics, nonsteroidal contraceptives - External antiseptics - Antacids and others, antibiotics, biological hormones - Quality management and control.

MODULE IV REGULATORY AGENCIES & BIOPHARMACEUTICAL 12

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, Benzdizapines, CNS stimulant Drugs, Drug designing against apoptotic mediated disease, narco-drug testing, narco-analysis process, drug doping control procedures.

MODULE V RESEARCH MODELS AND BIOPHARMACEUTICALS 12

Introduction of Research Models, Primary cell culture, Secondary cell culture, role of pharmaceutical companies in drug testing procedures, Cancer, Diabetes, Ageing and neurodegenerative animal models, role of biopharmacueticals in vaccine development.

L – 60 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues, 4th edition, CRC Press, USA, 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, 9th edition, USA, 1978.

REFERENCES:

1. de Campos ML, Padilha EC, Peccinini RG. A review of pharmacokinetic parameters of metabolites and prodrugs, 2014, Drug Metabolism Letters, Volume 7, Issue 2, Page number 105-116.
2. Fan J, de Lannoy IA.Pharmacokinetics, 2014, Biochemistry and Pharmacology, Voumne 87, Issue 1, Page number 93-120.

COURSE OUTCOMES:

The students would be more confident and able to:

CO1: explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agent.

CO2: outline the drug manufacturing process including the role of quality control.

CO3: enquire quality assurance in protecting the public, workers, and the environment.

CO4: 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: understand the pharmacokinetic basis of prolonged release medications.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	M	L	H	H	L		L		L	L		
CO5	M	L	H	H	L		L		L	L		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 022	**BIOPHARMACEUTICS AND PHARMACOKINETICS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 3		**0**	**0**	**4**	**2**

COURSE OBJECTIVES:

The objectives for the lab are to:

COB1: understand explicilty the formulations of drugs and/or medicines

COB2: develop the experimental skills, accuracy and precession of analysis

COB3: identify the different study designs applied in bioequivalence studies

COB4:recognize the disease related factors that can cause pharmacokinetic variability.

COB5: evaluate the in vitro-in vivo correlation for different drug products

PRACTICALS

List of Experiments:

1. Various routes of drug administration
2. Evaluation of analgesic and anti-inflammatory activity.
3. Protocol design for clinical trial.
4. Estimation of cytotoxicity of drugs
5. Isolation and identification of DNA from Goat liver.
6. Isolation and identification of Mitochondria from Goat liver.
7. Histopathology of liver isolated from experimental models.
8. Estimation of proteins by Branford/Lowry's in biological samples.
9. Live or Dead cell determination by fluorescent imaging studies.
10. Conversion of preclinical dose to clinical.
11.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues, 4th edition, CRC Press, USA, 2006.

REFERENCES:

1. de Campos ML, Padilha EC, Peccinini RG. A review of pharmacokinetic parameters of metabolites and prodrugs, 2014, Drug Metabolism Letters, Volume 7, Issue 2, Page number 105-116.

COURSE OUTCOMES:

The students will be able to:

CO1: understand the fundamentals of Biopharmaceutics and Pharmacokinetics in the lab.

CO2: More confident working with biological samples.

CO3: perform diagnostic experiments in clinical research

CO4: Shed a light on novel medicine formulation against severe disease

CO5: explain the pharmacological implications and understanding the structural considerations different episodes of drug mechanisms.

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PS O1	PS O2	PS O3	PS O4
CO1	M	L	H	H	L		L		L	L		
CO2	M	L	H	H	L		L		L	L		
CO3	M	L	H	H	L		L		L	L		
CO4	M	L	H	H	L		L		L	L		
CO5	M	L	H	H	L		L		L	L		

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

		L	T	P	C
LSDX 023	**BASIC BIOMEDICAL INSTRUMENTATION**	**4**	**0**	**0**	**4**
SDG: 3					

COURSE OBJECTIVES:

COB1: To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration.

COB2: To introduce the student to the various sensing and components of devices of electrical origin.

COB3: To provide the latest ideas on devices of Electrical/non-electrical devices.

COB4: To bring out the important and modern methods of imaging techniques.

COB5: To provide latest knowledge of medical assistance / techniques and therapeutic equipment.

MODULE I PHYSIOLOGICAL SYSTEM 12

Cell and its structure – Nervous system- Functional organization of the nervous system – Central and Peripheral nervous system-Brain and spinal cord-neurons - synapse –transmitters and neural communication – Resting and Action Potential -Cardiovascular system –Systemic circulation and respiratory circulation- respiratory system – organs of respiratory system-Gas exchange in alveoli.

MODULE II ELCTRODES AND AMPLIFIERS OF BIOMEDICAL ISNTRUMENTS 12

Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers. Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier.

MODULE III ELECTRO/NON-ELECTRICAL PHYSIOLOGICAL MEASUREMENTS – 12

Components and functions of Instruments-Electrocardiography (ECG)-Electroencephalography (EEG)- Electromyography (EMG)-Electroretinography (ERG).

Pulmonary function measurements – spirometer Blood Gas analysers : pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter – Erythrocyte sedimentation rate (ESR) measurements.

MODULE IV MEDICAL IMAGING 12

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 12

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Audio meters – Dialysers – Lithotripsy.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. K. Sembulingam and Prema Sembulingam. Essentials of Medical Physiology. Jaypee Brothers Medical Publishers, 2019
2. R.S. Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.

REFERENCES:

1. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', IInd edition, Pearson Education, 2002 / PHI. n dialyzers.

COURSE OUTCOMES:

CO1: The 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: Students will understand the basic components of Biomedical instruments such as Electrodes and amplifiers

CO3: Students will gain knowledge about the functions of electrical and non-electrical instruments

CO4: Students will get the knowledge on medical imaging techniques

CO5: Students understand the difference between diagnostic and therapeutic instruments such as dialysers, pacemakers and lithotripters.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H		M	H	M				H		H	
CO2	H		M	H	M				H		H	
CO3	H		M	H	M				H		H	
CO4	H		M	H	M				H		H	
CO5	H		M	H	M				H		H	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to innovate and methods to protect their innovation.

LSDX 024	BASIC BIOMEDICAL	L	T	P	C
SDG: 3, 9	INSTRUMENTATION LABORATORY	0	0	4	2

COURSE OBJECTIVES:

COB1: Students will be exposed to basic blood pressure by sphygmomanometer and ECG pattern

COB2: Student will be exposed to identify and assess the functions of electrodes and amplifiers

COB3: Student will be exposed to oxygen levels by fingertip oximeter.

COB4: Student will expose to assess the function of hemoglobin by ESR

COB5: Students will be exposed to the therapeutic equipment's such as ventilators and dialysers.

PRACTICALS

List of Experiments:

1. Blood pressure measurement by Sphygmomanometer.
2. Assessment of Electrocardiography and physiological measurement of ECG pattern
3. Identification and assessing the functions of electrodes and amplifiers
4. Assessing the functions and measuring PO_2 levels by Fingertip Oximeter
5. Assessing ventilation of lungs by spirometer.
6. Erythrocyte sedimentation rate – Wintrobe's method
7. Estimation of Haemoglobin content by Sahli's method
8. Estimation blood glucose level by one touch glucometer
9. . Assessing the functions of modern Ventilators
10. Assessing the Urine filtration by modern dialysers
11. Protype preparation of Endoscopy by students

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Laboratory manual

REFERENCES:

1. https://www.electronicsandcommunications.com/2017/12/spirometer-working-principle.html
2. https://medlineplus.gov/lab-tests/erythrocyte-sedimentation-rate-esr/

COURSE OUTCOMES:

CO1: By completing the laboratory course student's expertise in handling sphygmomanometer and ECG

CO2: Students understand to assess the functions of electrodes and amplifiers

CO3: Student understand to measure oxygen levels by fingertip oximeter

CO4: Student understand the function of hemoglobin and get the technical exposure to ESR

CO5: Students understand the therapeutic equipments such as ventilators and dialysers.

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H		M	H	M				H		H	
CO2	H		M	H	M				H		H	
CO3	H		M	H	M				H		H	
CO4	H		M	H	M				H		H	
CO5	H		M	H	M				H		H	

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

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to innovate and methods to protect their innovation

LSDX 024	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
SDG: 6		4	0	0	4

COURSE OBJECTIVES:

COB1: To learn the environment protection Act and Law related to environmental biotechnology

COB2: To give basic idea on environmental sample analysis

COB3: To understand the basic principles involved in waste water management

COB4: To get the information on usage of Bioremediation-biotechnology

COB5: To inform students about Biooxidation & microbial leaching

MODULE I INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY 15h

Water, Soil and Air: their sources and effects. Removal of Specific Pollutants: Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption & detoxification mechanisms. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics.

MODULE II ENVIRONMENTAL SAMPLE ANALYSIS 10h

Physicochemical and bacteriological analysis of soil and water, Problems associated with soil alkali soils, sodic soils, and solid waste, Fate of insecticides fungicides, pesticides in soil, use of genetically modified (insect- , pest- and pathogen resistant) plants. Ecotoxicology of soil pollutants, Municipal solid waste treatment strategies.

MODULE III WASTE WATER MANAGEMENT 15h

Waste water constituents, Analysis and selection of flow rates and loadings, Process Selection, Physical unit operations, Chemical unit operations, Fundamentals of biological treatment, Role of biotechnology in water purification systems. Types and kinetics of biological treatment, Advanced waste water treatment, Biological Processes for Industrial and domestic effluent, Treatment, Aerobic Biological Treatment, Anaerobic Biological Treatment.

MODULE IV BIOREMEDIATION-BIOTECHNOLOGY 10h

Bioremediation-Biotechnology for clean environment, Biomaterials as

substitutes for non-degradable materials, Metal microbe interactions: Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance Bioindicators and biosensors for detection of pollution. Biotechnology for Hazardous Waste Management, Persistent organic pollutants, Xenobiotics, Biological Detoxification of PAH, Biotechniques for Air Pollution Control. Solid Waste Management.

MODULE V BIOOXIDATION & MICROBIAL LEACHING 10h

Biooxidation – Direct and Indirect Mechanisms. Bacterial oxidation of Sphalerite, Chalcopyrite and Pyrite. Recovery of metals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.

L – 60; TOTAL HOURS - 60

TEXT BOOKS:

1. Amann, R.I. Stromley, J. Stahl : Applied & Environmental Microbiology
2. Environmental Microbiology, W.D. Grant & P.E. Long, Blakie, Glassgow and London.

REFERENCES:

1.Biotreatment Systems, Vol. 22, D. L. Wise (Ed.), CRC Press, INC.
2.Standard Methods for the Examination of Water and Waste Water (14 th Education), 1985. American Public health Association

COURSE OUTCOMES:

CO1: The concepts, types and factors affecting natural processes

CO2: Of applications, specific advantages and disadvantages of specific bioremediation technologies, analysis of water samples, etc

CO3: Of molecular techniques in used in waste water management

CO4: Bioremediation of nuclear waste

CO5: Bioremediation of heavy metals and oil

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	M	H	H		H	H			H
CO2	H	H	L	M	H	H		H	H			H
CO3	H	H	L	M	H	H		H	H			H
CO4	H	H	L	M	H	H		H	H			H
CO5	H	H	L	M	H	H		H	H			H

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

SDG 6: Clean water and sanitation.

Sustainable management of water resources and access to safe water and sanitation are essential for unlocking economic growth and productivity, and provide significant leverage for existing investments in health and education.

LSDX 025	ENVIRONMENTAL BIOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 6		0	0	4	2

COURSE OBJECTIVES:

COB1: To make students learn principles and design of experiments.

COB2: To investigate the performance of various Soils, waters and industrial wastes.

COB3: To learn to estimate theBiological Oxygen Demand and Chemical Oxygen Demand

COB4: To learn to detectColiforms in water Sample

COB5: To learn to identifybacteria from air by Open plate method.

PRACTICALS

1. Determination of pH of water
2. Determination of Acidity of water
3. Determination of Alkalinity of water
4. Determination of Total Hardness
5. Determination of Dissolved Oxygen (DO)
6. Determination of Biological Oxygen Demand (BOD)
7. Determination of Chemical Oxygen Demand (COD)
8. Determination of Chloride content in the water sample
9. Determination of Manganese of water
10. Determination of Sodium content of water
11. Presumptive test for Coliforms presents in water Sample
12. Enumeration of bacteria from air by Open plate method.

P – 60 ; TOTAL HOURS- 60

TEXT BOOKS:

1. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. "Wastewater Treatment Concepts and Design Approach", Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi.

REFERENCES:

1. Nemerow N.N., (1971) – "Liquid Waste of industry theories, "Practices and Treatment. Addison Willey New York.

COURSE OUTCOMES:

CO1: Achieve Knowledge of Design and development of experimental skills.
CO2: Understand the principles of design of experiments.
CO3: Understand the importance of BOD and COD
CO4: Understand the importance of detecting the coliform in the water
CO5: Understand the open plate method to detect bacteria from air

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	M	H	H		H	H			H
CO2	H	H	L	M	H	H		H	H			H
CO3	H	H	L	M	H	H		H	H			H
CO4	H	H	L	M	H	H		H	H			H
CO5	H	H	L	M	H	H		H	H			H

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

SDG 6: Clean water and sanitation.

Statement: Sustainable management of water resources and access to safe water and sanitation are essential for unlocking economic growth and productivity, and provide significant leverage for existing investments in health and education.

DISIPLINE SPECIFIC ELECTIVES

LSDX 051	**DISEASE MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 3		**4**	**0**	**0**	**4**

COURSE OBJECTIVES:

COB1: To strengthen the concept of disease and disease transmission

COB2: To provide insight on the study designs used to understand a disease

COB3: To introduce the factors that causes chronic diseases

COB4: To emphasise the factors considered for a reliable prognostic and diagnostic test

COB5: To acquaint the students with knowledge regarding epidemiology, prevention, control & management of diseases of public health.

MODULE I INTRODUCTION TO EPIDEMIOLOGY 12

Definition and aims, Epidemiological approach, Measuring disease Frequency – Prevalence, incidence, morbidity rates, attack rates etc., Types of Epidemiological studies, Uses of Epidemiology, Infectious disease Epidemiology, Endemic, epidemic and pandemic diseases.

MODULE II HEALTH AND DISEASES 12

Concept of disease, sources and modes of disease transmission, acute and chronic diseases, major stages in disease progress, zoonosis and carriers of infectious diseases. Concepts of wellbeing, Spectrum of Health, Determinants and Indicators of health – Mortality, Morbidity, Disability, Health care system.

MODULE III DESCRIPTIVE AND ANALYTICAL EPIDEMIOLOGY 12

Definition, descriptive study designs, types of data for descriptive epidemiology, ratios, proportions and rates, method of age-adjustments, observational and experimental analytic epidemiologic studies, case-control and cohort studies, bias in case control studies.

MODULE IV CHRONIC DISEASE EPIDEMIOLOGY 12

Chronic and acute diseases, Natural history of diseases – Epidemiological triad; Risk factors, Environmental factors – physical stress, chemicals,

biologic agents, social factors, Behavioural factors – smoking, diet, obesity, hereditary factors.

MODULE V CLINICAL EPIDEMIOLOGY 12

Introduction, screening and diagnosis, validity, reliability and yield, prognosis, prognostic indicator, biases in disease prognosis, health outcomes research, prevention of diseases and control measures, Modes of interventions, Levels of preventive health services (urban & rural), Health Management.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Kenrad E. Nelson & Carolyn Masters Williams. Infectious Disease Epidemiology: Theory and Practice. Second Edition. Jones and Bartlett Publishers, 2006.

REFERENCES:

1. Ray M Merrill, Introduction to Epidemiology, Jones and Barlett Learning.
2. Leon Gordis, Epidemiology, Saunders, Elsevier.

COURSE OUTCOMES:

Students will be able to

CO1: understand the factors that causes chronic diseases

CO2: measure disease prevalence and to identify the cause-effect of a disease

CO3: learnthe factors considered for a reliable prognostic and diagnostic test

CO4: predict the nature of a disease and design preventive measures

CO5: acquaint methods to strategize health management

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M	M		L				M	M		
CO2	L	M	M		L				M	M		
CO3	L	M	M		L				M	M		
CO4	L	M	M		L				M	M		
CO5	L	M	M						M			

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 052	DISEASE MANAGEMENT LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To familiarize students on science and methods of epidemiology

COB2: To understand the applications of epidemiology in public health decision making

COB3: To introduce students to quantitative research methods in public health

COB4: To train students in the method of data analysis and report writing

COB5: The information from this course will be subsequently used for planning health interventions

PRACTICALS

1. Survey methods and their application to public health research.
2. Data collection - Construction of questionnaire.
3. Interpretation of epidemiological data.
4. Measuring disease frequency and excess risk.
5. Outbreak Investigation.
6. Designing a randomized control trial.
7. Epidemiological study designs - Cohort Studies.
8. Epidemiological study designs - Case Control Studies.
9. Demonstration of disease surveillance methods.
10. Report writing.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Kenrad E. Nelson & Carolyn Masters Williams. Infectious Disease Epidemiology: Theory and Practice. Second Edition. Jones and Bartlett Publishers, 2006.
2. Lab manual.

REFERENCES:

1. Health Research Methodology: A guide for training in research methods. Second Edition. WHO, 2001.
2. Dona Schneider and David E. Lilienfeld. Lilienfeld's Foundations of Epidemiology, Fourth Edition, Oxford University Press, USA, 2015.
3. Barkar, D.J.P., Practical Epidemiology: Churchill pub, Livingstone,

1991.

COURSE OUTCOMES:

Students will be able to

CO1: identify surveillance data needs.

CO2: collect and analyze epidemiological data.

CO3: design surveillance for a public health issue.

CO4: measure frequency of a disease and associated risk.

CO5: design different types of epidemiological studies.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M	M		L				M	M		
CO2	L	M	M		L				M	M		
CO3	L	M	M		L				M	M		
CO4	L	M	M		L				M	M		
CO5												

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 053	CYTOGENETICS	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: Understand Mendelian genetics

COB2: Understand the basics of mutation

COB3: Understand the structural organisation of genes

COB4: Understand the basics of cell cycle

COB5: Understand the techniques employed in the field

MODULE I INTRODUCTION TO GENETICS 12

Mendelian principles in haploid organisms (Chlamydomonas and Neurospora), Tetrad analysis, Dominance relationships (Incomplete dominance, Codominance, Overdominance), Allelic variations and gene function (Lethal genes, Conditional lethals), Gene concept: Concept of allelism (Factors, alleles, multiple alleles, pseudoalleles)

MODULE II MUTATION 12

Types of mutations (Sponteneous, Induced, Base substitutions and frameshifts - Transitions, Transversions, gain in function, loss in function, Neutral mutations), Molecular mechanism of mutations (Base analogs, alkylating agents); Detection of mutations: Dominant lethal test, Sex-linked recessive lethal test, II-III translocations, Ames test, P-mediated mutagenesis, Cytogenetic effects of ionizing and nonionizing radiations.

MODULE III STRUCTURE AND FUNCTION OF CHROMOSOME 12

Structure and function of chromosomes. - chemical composition, telomeres, centromeres and kinetochores, nucleolar organizers, chromomeres, euchromatin and heterochromatin, unique and repetitive DNA, chromosome, structure throughout the cell cycle, banded chromosomes, lamp brush chromosomes, polytene chromosomes, B chromosomes.

MODULE IV CELL DIVISION 12

Molecular mechanism of cell division: Amitosis, Endomitosis and Mitosis, Ultra structure and organization of centrosome, centromere, Kinetochore, Endomitosis and polyteny, molecular mechanism of crossing over, chromosomal evidence of crossing over, environmental and genetic factors which affect the frequency of crossing over, Linkage and construction of

genetic maps: Cytogenetic and linkage maps, Two and threepoint cross in Drosophila, RFLP mapping genetic control of meiosis, Karyotyping and its importance.

MODULE V TECHNIQUES 12

karyotyping, spectral keryotping, FISH, multicolor FISH, locus specific FISH, comparative genomic hybridisation, Flow cytometry, application of cytogenetics.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Brooker R.J Genetics: Analysis and Principles. Benjamin/Cummings, Longman Inc, 1999.
2. Gardner EJ, Simmons M.J and D. P. Snustad Principles of Genetics. John Wiley and Sons. Inc. N.Y, 1991
3. Griffiths A.J. F, Miller J.H, Suzuki D. T, Lewontin R.C and W. M. Gelbart. An introduction to genetic analysis. W.H.Freeman and Company, N.Y, 1996.
4. Gersen, Steven L., Keagle, Martha B. The Principles of Clinical Cytogenetics Springer Nature, Singapore, 2005.

COURSE OUTCOMES:

CO1: Understand Mendelian genetics

CO2: Understand the basics of mutation

CO3: Understand the structural organisation of genes

CO4: Understand the basics of cell cycle

CO5: Understand the techniques employed in the field

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M		L				H	M		
CO2	L	H	M	M					H	M		
CO3	L	H	M	M	L				H	M		
CO4	L	H	M	M					H	M		
CO5	L	H	M	M	L				H	M		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 054	CYTOGENETICS LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: Understand Mendelian genetics

COB2: Understand the basics of mutation

COB3: Understand the structural organisation of genes

COB4: Understand the basics of cell cycle

COB5: Understand the techniques employed in the field

PRACTICALS

1. Introduction to different types of microscopes
2. Subcellular fractionation
3. Observation of mitosis in onion root tip
4. Observation of mitosis in human peripheral blood
5. Observation of meiosis in pollen grains
6. Observation of meiosis in grasshopper testis
7. Observation of polytene chromosome
8. Barr body identification from buccal smear
9. Observation of budding and binary fission in yeast
10. Karyotyping
11.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Arsham. M., Lawce H and Barch M. “The AGT Cytogenetic Laboratory Manual”, Wiley-Blackwell, 2016.

COURSE OUTCOMES:

CO1: Understand Mendelian genetics

CO2: Understand the basics of mutation

CO3: Understand the structural organisation of genes

CO4: Understand the basics of cell cycle

CO5: Understand the techniques employed in the field

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M		L				H	M		
CO2	L	H	M	M					H	M		
CO3	L	H	M	M	L				H	M		
CO4	L	H	M	M					H	M		
CO5	L	H	M	M	L				H	M		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 055	AGRICULTURAL BIOTECHNOLOGY	L	T	P	C
SDG: 2, 12		4	0	0	4

COURSE OBJECTIVES:

COB1: The students will be introduced to basic concepts in the field

COB2: The students will be introduced to gene transfer protocols

COB3: The students will be introduced to basic concepts in nitrogen fixation

COB4: The students will be introduced to basic concepts to abiotic stress

COB5: The students will be introduced to applications of GM foods

MODULE I INTRODUCTION 12

Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation. Study of biopesticides used in agriculture (neem as example). integrated pest management.

MODULE II GENE TRANSFER METHODS 12

Organelle DNA, Satellite-and repetitive DNAs. DNA repair. Regulation of gene expression. Recombinant DNA technology-cloning vectors, restriction enzymes, gene cloning. Methods of gene transfer in plants. Achievements and recent developments of genetic engineering in agriculture. Ribozfore Technology microarray, bioethics, terminator technology, nanotechnology, DNA finger printing, gene silencing.

MODULE III NITROGEN METABOLISM 12

Mechanism of biological nitrogen fixation process. study of NIF, NOD and HUP genes in nitrogen fixation process. Production of biofertilizers and applications of rhizobium, azotobacter, azolla and mycorrhiza. Use of plant growth regulators in agriculture and horticulture.

MODULE IV ABIOTIC STRESS RESPONSE 12

Biochemical basis of abiotic stresses namely osmotic (drought, salinity), temperature, heavy metals, air and water pollutants, synthesis and functions of proline and glycine betaine in stress tolerance interaction between biotic and abiotic stresses; stress adaptation. Reactive calcium, nitric oxide and salicylic acid in plant development. Molecular strategies for

imparting tolerance against biotic and abiotic stress. Development of transgenic for biotic & abiotic stress tolerance.

MODULE V APPLICATIONS 12

Classification, chemical composition and nutritional values of food grains (cereals including millets, legumes and pulses). Anti-nutritional factors-chemistry and methods of their removal. Importance and scope of food preservation and storage. Food spoilages- causes and effects. Food preservation and processing of food crops, Bakery and confectionary, other processing techniques- Fermentation, malting, brewing, puffing, flaking, pearling, sprouting, roasting. Enrichments- Methods, need and fortification. Genetic engineering for value addition from economic point of view as well as nutritional composition- Transgenes for altered composition of oil/ starch/ amino acid/vitamins/antinutrients with their sources. Golden rice, high quality protein maize, hypoallergenic rice, wheat gluten modification. Biosol concept. Spheroplast fusion technology. Biocatalysts and worldwide food industry market

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Salisbury, F.B. and Ross, C.W.: Plant Physiology, Hartmann, H.T & Kester, D.E. Plant Propagation – Principles and Practices. Prentice Hall of India Hudsont: Plant propagation principles and practices, 1989
2. Principles of Gene Manipulation and Genomics – 7th Edition – Sandy B. Primrose, Richard Twyman – Blackwell Publishing, 2000
3. Gene Cloning and DNA Analysis: An Introduction - 6th Edition - T. A. Brown - John Wiley & Sons, 2001
4. An Introduction to Genetic Engineering - 3rd Edition - Desmond S. T. Nicholl – Cambridge University Press, 2003
5. Molecular Biotechnology: Principles and Applications of Recombinant DNA- 4th Edition - Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten - ASM Press, 2014
6. Food processing: Biotechnological Applications by Marwaha & Arora, Asiatech Publishers N.D., 2000
7. Postharvest physiology and storage of tropical and subtropical Fruits, CABI Publishing, 2005
8. Postharvest by Wills, Mcglasson, CABI, 2007
9. Essentials of Food Science by Vaclavik, Plenum,NY, 2003
10. Fruit & Vegetable Biotechnology by Valpuestav, 2005

COURSE OUTCOMES:

CO1: The students will be introduced to basic concepts in the field

CO2: The students will be introduced to gene transfer protocols

CO3: The students will be introduced to basic concepts in nitrogen fixation

CO4: The students will be introduced to basic concepts to abiotic stress

CO5: The students will be introduced to applications of GM foods

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M	M	L	H				H	H		
CO2	L	M	M	L	H				H	H		
CO3	L	M	M	L	H				H	H		
CO4	L	M	M	L	H				H	H		
CO5	L	M	M	L	H				H	H		

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

SDG 2: Zero Hunger

Statement: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. Studying this course will help the students to understand the important of food to every individual in the earth.

SDG 12: Responsible consumption and production

Statement: Ensure sustainable consumption and production patterns. Studying this course will help the student to understand the responsibilities of consuming products and disposing the products with care. They also learn to produce the things in a proper way.

LSDX 056	AGRICULTURAL	L	T	P	C
SDG: 2, 12	BIOTECHNOLOGY LABORATORY	0	0	4	2

COURSE OBJECTIVES:

COB1: The students will be introduced to basic concepts in the field

COB2: The students will be introduced to gene transfer protocols

COB3: The students will be introduced to basic concepts in nitrogen fixation

COB4: The students will be introduced to basic concepts to abiotic stress

COB5: The students will be introduced to applications of GM foods

PRACTICALS

1. Isolation of soil microorganisms- rhizobium, azotobacter and mycorrhiza.
2. Isolation of rhizobium from root nodules.
3. Isolation of DNA from Plant sample and bacteria.
4. Isolation of RNA from plant sample.
5. Restriction analysis of the plant DNA and bacterial DNA.
6. Separation of DNA by Gel Electrophoresis methods
7. Application of Polymerase Chain reaction.
8. Genetic transformation through Agro-bacterium.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Biotechnology Vol I and VII by Rehm HJ and Reed G. Verlg Chemic Weinheim, USA, 1997

2. Elements of Biotechnology by Gupta PK 1999. Rastogi Publication, Meerut, India., 1999.

3. Biotechnology by Singh BD. Kalyani publishers, New Delhi., 2000

4. Introduction to Plant Biotechnology by H.S. Chawala, Oxford IBH, 2002.

COURSE OUTCOMES:

CO1: The students will be introduced to basic concepts in the field

CO2: The students will be introduced to gene transfer protocols

CO3: The students will be introduced to basic concepts in nitrogen fixation

CO4: The students will be introduced to basic concepts to abiotic stress

CO5: The students will be introduced to applications of GM foods

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	M	M	L	H				H	H		
CO2	L	M	M	L	H				H	H		
CO3	L	M	M	L	H				H	H		
CO4	L	M	M	L	H				H	H		
CO5	L	M	M	L	H				H	H		

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

SDG 2: Zero Hunger

Statement: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. Studying this course will help the students to understand the important of food to every individual in the earth.

SDG 12: Responsible consumption and production

Statement: Ensure sustainable consumption and production patterns. Studying this course will help the student to understand the responsibilities of consuming products and disposing the products with care. They also learn to produce the things in a proper way.

LSDX 057	NANOBIOTECHNOLOGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of Nanoscience relevant to the field of engineering.

COB2: To provide an exposure about the importance of various synthesis method

COB3: To enrich the knowledge of students in various characterisation techniques

COB4: To make them to understand nanomaterials synthesis methods

COB5: To enrich the knowledge of students in various applications of nanomaterials

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS **12**

Definition - Origin of nanotechnology - Difference between bulk and nanomaterialsTop-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures.

MODULE II TYPES OF NANOMATERIALS **12**

Metal oxides and metal nanoparticles - Ceramic nanoparticles - Semiconducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES **12**

Sol-gel, hydrothermal, solvothermal, Solution plasma, Plasma Arcing, Electro deposition, RF

sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS **12**

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofiber, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS **12**

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 12

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Hari Singh Nalwa, ―Handbook of Nanostructured Materials and Nanotechnology‖, Academic Press, 2000.
2. Guozhong Cao, ―Nanostructures and Nano materials-Synthesis, Properties and Applications‖, Imperial College Press (2011).
3. Zhong Lin Wang, ―Handbook of Nanophase and Nanomaterials (Vol 1 and II)‖, Springer, 2002.
4. Mick Wilson, KamaliKannangara, Geoff smith, ―Nanotechnology: Basic Science and Emerging Technologies‖, Overseas press, 2005.

REFERENCES:

1. A. Nabok, ―Organic and Inorganic Nanostructures‖, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: ―Nanotechnologies and Nanophysics‖, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, KamaliKannangara, Michells Simmons and Burkhard Raguse, ―Nano Technology – Basic Science and Emerging Technologies‖, 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, ―Nanoscience and Nanotechnology: Fundamentals to Frontiers‖, Wiley, 2013.

COURSE OUTCOMES:

CO1: Apply the knowledge of different types of nanomaterials for various engineering applications.

CO2: Acquire the knowledge of various methods of production of nanomaterials.

CO3: Familiarize students with various characterization techniques.

CO4: Familiarize students with various synthesis of nanomaterials

CO5: Familiarize students with various applications of nanomaterials

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	M			H		H		H
CO2	H	H	M	H	M			H		H		H
CO3	H	H	M	H	M			H		H		H
CO4	H	H	M	H	M			H		H		H
CO5	H	H	M	H	M			H		H		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 058	NANOBIOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of Nanoscience relevant to the field of engineering.

COB2: To provide an exposure about the importance of various synthesis method

COB3: To enrich the knowledge of students in various characterisation techniques

COB4: To make them to understand nanomaterials synthesis methods

COB5: To enrich the knowledge of students in various applications of nanomaterials

PRACTICALS

List of Experiments:

1. Nanoparticle synthesis by chemical reduction method
2. Nanoparticle synthesis using bioreduction method
3. Encapsulation of nanomaterials
4. Preparation of nanobiocomposites
5. Characterization of nanoparticles using UV-Vis Spectroscopy
6. Characterization of nanoparticles using XRD
7. Characterization of nanoparticles using SEM
8. Characterization of nanoparticles using TEM
9. Characterization of nanoparticles using AFM
10. Photoluminescence property of nanomaterials

P – 60; TOTAL HOURS – 60

REFERENCES:

1. A. Nabok, ―Organic and Inorganic Nanostructures‖, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: ―Nanotechnologies and Nanophysics‖, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, KamaliKannangara, Michells Simmons and Burkhard Raguse, ―Nano Technology – Basic Science and Emerging Technologies, 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, ―Nanoscience and Nanotechnology: Fundamentals to Frontiers‖, Wiley, 2013.

COURSE OUTCOMES:

CO1: Apply the knowledge of different types of nanomaterials for various engineering applications.

CO2: Acquire the knowledge of various methods of production of nanomaterials.

CO3: Familiarize with various characterization techniques.

CO4: Familiarize with various synthesis of nanomaterials

CO5: Familiarize with various applications of nanomaterials

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	M			H		H		H
CO2	H	H	M	H	M			H		H		H
CO3	H	H	M	H	M			H		H		H
CO4	H	H	M	H	M			H		H		H
CO5	H	H	M	H	M			H		H		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 059	REGENERATIVE MEDICINE	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: Students will learn the concept of cells, tissue and organ

COB2: Students shall learn about cell development and differentiation

COB3: Students shall learn about cell communication

COB4: Students shall learn about laboratory model of stem cells

COB5: Students shall learn about clinical application of stem cells

MODULE I CELLS, TISSUES AND ORGANS 12

Overview of cellular components-cell membrane, nucleus, cytoskeleton; major tissue types: epithelial, connective, muscular, nervous tissues; Integrating cells into tissues: Cell-cell junctions, cell-ECM interactions adhesion molecules, maintaining cell polarity; connective tissues, cardiovascular system, nervous system, Organ homeostasis, Tissue repair, remodeling and regeneration.

MODULE II CELL DEVELOPMENT AND DIFFERENTIATION 12

Fertilization- formation of the zygote; Cleavage and blastocyst formation; Implantation; Embryonic stem cells; Anterior/Posterior axis formation; left and right axis formation; Formation of heart and blood vessels; Formation of liver, pancreas and GI tract; Peri- and post-natal Mesenchymal stromal cells; Hematopoietic, neural stem cells; Induced pluripotency.

MODULE III CELLULAR COMMUNICATION 12

Junctional complexes- Tight, Gap, Adherens; Components of a stem cell niche- soluble, insoluble; Extracellular matrix ECM regulated signaling; Signaling in stem cells niches; Cellular events and Molecular mediators of EMT; EMT and MET in cellular reprogramming; EMT in wound healing and regeneration; EMT in cancer progression and metastasis.

MODULE IV APPLICATIONS OF STEM CELLS-LAB ORIENTED 12

Effects of chemicals and drugs by Embryonic Stem Cell Test (EST); Neurotoxicity testing using stem cell-based screening assay; In vitro models for cardiovascular diseases, neurological diseases; Stem cell models of

genetic disorders; diabetic model; Tissue remodelling in Cancer; High throughput drug screening using cancer stem cells

MODULE V APPLICATIONS OF STEM CELLS-CLINICAL 12

Disorders of endocrine system; Modelling endodermal diseases using stem cells; Animal models of neurodegenerative disorders; Treatment of Parkinson's disease, cerebral stroke, multiple sclerosis and ALS with stem cells; Stem cells for the treatment of motor neuron disease and spinal cord injury; Application of MSCs as an immunomodulator during transplantation; cancer immunotherapy

L –60 ; TOTAL HOURS 60–

TEXT BOOKS:

1. Lanza, R, Atala, A. et al (eds) Principles of Regenerative Medicine, 3rd Edition, Academic Press, 2018.

REFERENCES:

1. Steinhoff, G. (ed). Regenerative Medicine, Springer, 2011

COURSE OUTCOMES:

CO1: Students will know about basics of cells, tissue and organ

CO2: Students will be able to understand cell development and differentiation

CO3: Students will be able to understand cell communication mechanism

CO4: Students will know different laboratory model of stem cells

CO5: Students will know different clinical application of stem cells

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M					H	M		H
CO2	L	L	L	M					H	M		H
CO3	L	L	L	M					H	M		H
CO4	L	L	L	M					H	M		H
CO5	L	L	L	M					H	M		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging

challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 060	REGENERATIVE MEDICINE LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: Students shall learn about cell culture techniques

COB2: Students shall learn to estimate cell viability

COB3: Students shall learn cell cycle analysis

COB4: Students shall learn karyotyping

COB5: Students shall learn chick embryo handling and sectioning

PRACTICALS

List of Experiments:

1. Cell Culture Techniques, Media Preparation
2. Subculture, Freezing, Cell Counting by Trypan blue
3. Viable cell Counting (MTT)
4. Cell cycle analysis
5. Karyotyping
6. Stages of Development- sectioning and tissue specific staining
7. Neural crest cell isolation from chick embryos

P – 60; TOTAL HOURS -60

TEXT BOOKS:

1. Freshney, R. I. (2010) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth Edition. John Wiley and Sons

REFERENCES:

COURSE OUTCOMES:

CO1: Students will be able to culture animal cells

CO2: Students will be able to count viable cells

CO3: Students will be able to do cell cycle analysis

CO4: Students will be able to do karyotyping

CO5: Students will be able to handle tissue sectioning and chick embryo cell isolation

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M					H	M		H
CO2	L	L	L	M					H	M		H
CO3	L	L	L	M					H	M		H
CO4	L	L	L	M					H	M		H
CO5	L	L	L	M					H	M		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 061	CANCER BIOLOGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

This course will cover

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 INTRODUCTION CANCER BIOLOGY 12

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 checkpoints, mutations.

MODULE II CANCER GENETICS 12

Cancer genes, Oncogenes-retroviral oncogenes, approaches to the identification of human oncogenes, Tumor suppressor genes in hereditary cancers.

MODULE III TUMOR MICROENVIRONMENT 12

Malignant cells-aberrant DNA methylation, vascular and stroma, immune mediated cells, extracellular matrix, secreted proteins.

MODULE IV CANCER SIGNALING PATHWAYS 12

Cancergene pathways, The MPAK, PI3K/AKT pathways, The WNT/APC pathways, TGFBeta/SMAD signaling, EMT signaling.

MODULE V CANCER IMMUNOLOGY 12

Historical perspectives, Tumor Antigen, Mechanism to immune response to cancer, role of gene rearrangement in tumor response, Inflammation and cancer, Immunotherapy, Adaptive immunotherapy.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts,Peter Walter. Molecular Biology of the Cell 5Edition, Garland Science; 2008.

2. Robert A. Weinberg. The Biology of Cancer 2nd Edition Garland Science, 2013.

REFERENCES:

1. A Najafi SMA. The Canonical Wnt Signaling (Wnt/β-Catenin Pathway): A Potential Target for Cancer Prevention and Therapy. Iran Biomed J. 2020 Sep;24(5):269-80. doi: 10.29252/ibj.24.5.264.

2. Mukherjee TK, Paul K, Mukhopadhyay S. Cell signaling molecules as drug targets in lung cancer: an overview. Curr Opin Pulm Med. 2011 Jul;17(4):286-91. doi: 10.1097/MCP.0b013e328347bda6.

3. Chiang GG, Abraham RT. Targeting the mTOR signaling network in cancer. Trends Mol Med. 2007 Oct;13(10):433-42. doi: 10.1016/j.molmed.2007.08.001.

COURSE OUTCOMES:

CO1: Differentiate between carcinoma, sarcoma, leukemia, and lymphoma and how these terms are used to name cancer types.

CO2: Summarize why it is important to understand basic biology in the study of cancer.

CO3: Name the six hallmarks of cancer

CO4: Outline how cancer starts and how it spreads

CO5: Understand the signaling patheays that are disregualted in cancer

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M					H	M		H
CO2	L	L	L	M					H	M		H
CO3	L	L	L	M					H	M		H
CO4	L	L	L	M					H	M		H
CO5	L	L	L	M					H	M		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 062	CANCER BIOLOGY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To gain the knowledge of cancer cell lines

COB2: To gain the knowledge on culturing and MTT assay

COB3: To gain knowledge on cancer cell apoptosis and growth curve

COB4: To gain knowledge on cancer cell migration assay

COB5: To gain knowledge on idenfication and designing primers for oncogene/tumor suppressior gene

PRACTICALS

List of Experiments:

1. Identfication of cancer cell line
2. Culturing cancer cell lines
3. MTT assay in cancer cell lines
4. Cancer cell apoptosis assay (Annexin V-FITC)
5. Cancer cell growth curve
6. Kaplan -Meyer plot for survival
7. Cancer cell migration assay
8. Identify the oncogene and tumor suppressor gene
9. Design a primer for oncogene/Tumor suppressor gene
10. KEGG Pathway analysis (Drug development)

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

Lab manual

REFERENCES:

1. Kramer N, Walzl A, Unger C, Rosner M, Krupitza G, Hengstschläger M, Dolznig H. In vitro cell migration and invasion assays. Mutat Res. 2013 Jan-Mar;752(1):10-24.

2. https://www.genome.jp/kegg/pathway.html

3. https://primer3.ut.ee/

COURSE OUTCOMES:

CO1: Students understand the cancer cell lines

CO2: Understand how toculture the cancer cells and MTT assay

CO3: Understand the cancer cell apoptosis and growth curve

CO4: Understand thecancer cell migration assay

CO5: Understand theidenfication and designing primers for oncogene/tumor suppressior gene.

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M					H	M		H
CO2	L	L	L	M					H	M		H
CO3	L	L	L	M					H	M		H
CO4	L	L	L	M					H	M		H
CO5	L	L	L	M					H	M		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 063	DEVELOPMENTAL BIOLOGY	L	T	P	C
LSC: 3, 15		4	0	0	4

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 provide an understanding of post embryonic development and its need

COB5: To impart the application of developmental biology in other fields of life science

MODULE I BASIC CONCEPTS IN DEVELOPMENTAL BIOLOGY **12**

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.

MODULE II ORGANOGENESIS: NEURULATION, SOMITOGENESIS, LIMB DEVELOPMENT, HEART FORMATION **12**

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 formationStages, 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.

MODULE III MODEL ORGANISM IN DEVELOPMENTAL BIOLOGY **12**

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.

MODULE IV MOLCEULAR TECHNIQUES 12

REMI- Random mutagenesis, Reverse Genetics- Knock out, homologous recombination, traditional and conditional knock out. Knock in, Gene Silencing/knock downv- importance and different strategies- RNAi , RNA morpholino.

MODULE V POST EMBRYONIC DEVELOPMENT 12

Different types of post embryonic development- Growth, Metamorphosis, aging and regeneration. Growth- different modes-hyperplasia, hypertrophy and accretionregulation by hormones, Metamorphosis- types of metamorphosis, universal set of events.

L – 60 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Scott Gilbert and Micheal JF Barresi, Developmental Biology, 11th edition.2003
2. Jonathan Slack, Essentials of Developmental Biology, 3rd Edition., 2001.

REFERENCES:

1. Lewis Wolpert, Principles of development, 4th Edition

COURSE OUTCOMES:

The students would be more confident and able to:

CO1: design simple experiments and interpret concepts of embryonic development.

CO2:appreciate and describe the signaling orchestra involved in organogenesis

CO3:make the right choice of model organism for a problem related to development.

CO4: strategize a molecular method to tweeze the intricacies of signalling in development.

CO5:predict the impact of exogenous factors on the development of an organism.

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L			L	L	H	L	M	
CO2	H	H	L	L			L	L	H	L	M	
CO3	H	H	L	L			L	L	H	L	M	
CO4	H	H	L	L			L	L	H	L	M	
CO5	H	H	L	L			L	L	H	L	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 064	DEVELOPMENTAL BIOLOGY LABORATORY	L	T	P	C
SDG: 3, 15		0	0	4	2

COURSE OBJECTIVES:

The objectives for the lab is to:

COB1: understand explicilty developement biology of the embroys

COB2: develop the experimental skills, accuracy and precession of analysis

COB3: expose and build the students more confident working with isolated cells

COB4: provide better expertise animal development in lab.

COB5: impart the knowledge of developmental biology in biological specimens

PRACTICALS

List of Experiments:

1. Animal Cell Culture
2. Isolation of genomic DNA from Cells
3. Isolation of cells from goat liver
4. Isolation of Fibroblast cells from chick embryo
5. Estimation of proteins by Branford/Lowry's in biological samples.
6. Methods of sterilization and preparation of culture media.
7. Staining and fixing of fibroblast cells

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Scott Gilbert and Micheal JF Barresi, Developmental Biology, 11th edition.,2003

2. Jonathan Slack, Essentials of Developmental Biology, 3rd Edition., 2001.

REFERENCES:

1. Sadowska-Bartosz I, Bartosz G.Effect of Antioxidants on the Fibroblast Replicative Lifespan In Vitro, 2020, Oxidative Medicine and Cell Longevity, The application of molecular biology.1999, volume 1, issue 1-2, page number 6325-6478.

COURSE OUTCOMES:

The students will be able to:

CO1: understand the fundamentals of Developmental Biology lab.

CO2: More confident working with biological samples.

CO3: design simple experiments and interpret concepts of embryonic development

CO4: make the right choice of model organism for a problem related to development.

CO5: explain the medical applications and understanding developmental mechanism

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG15: Life on Earth

Statement: Human life depends on the earth as much as the ocean for our sustenance and livelihoods. This course focused on the importance of microbial species and its good as well as its bad sides. Studying this course will help the students to understand the living things and its importance.

LSDX 065	FOOD BIOTECHNOLOGY	L	T	P	C
SDG: 2		4	0	0	4

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 learn the common microbes that affect food.

COB3: To learn the components of food

COB4: To learn the food preservatives and its importances

COB5: To update students' knowledge of new developments in biology of food industry

MODULE I HISTORICAL BACKGROUND 12

Micro-organisms in Food – History- Types of Micro-Organisms –Sources of Microbes- Factors affecting growth of micro-organisms –Microbial growth- Intrinsic and Extrinsic Factors.

MODULE II FOOD MICROBIOLOGY 12

Food Spoilage –Factors – Role of Microbes in Food – Food Infection & Food Intoxication – Food Pathogens – Food Toxins – Bacterial, Fungal & Biological.

MODULE III FOOD COMPONENTS 12

Water- Water activity- Determination of Water Activity – Carbohydrates – Flavour, Colour and Texture Contribution – Role of Fats in Food – Proteins & Enzymes –Food Additives – Colours & Flavours.

MODULE IV FOOD PRESERVATION 12

Principles of Preservation – Factors Affecting Preservation – Commercial Preservation methods –Preservation by High Temperature – Evaporation & Drying – Preservation by Low Temperature – Refrigeration & Freezing.

MODULE V FOOD COMMODITIES 12

Milk & Dairy Products (Yogurt & Cheese) – Fermentation & Fermented Products (Wine, Beer, DisSpirits) – Single Cell Protein-Other Food Products (Extruded Products/Cocoa/Coffee/Tea).

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Food Chemistry. The AVI Publishing Co Inc., Connecticut, MA, USA

REFERENCES:

1. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA. H.-D. Belitz, W. Grosch and P. Schieberle. 2009.
2. Food Chemistry, 4th Ed. Springer-Verlag Berlin Heidelberg. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA. Lillian Hoagland Meyer. 1974.

COURSE OUTCOMES:

CO1: The students will be able to search for, analysis and synthesis of data and information, with the use of the necessary technology
CO2: Undestand the common microbes that affect the food.
CO3: Understand the food preservatives and its importances
CO4: Understand the food preservatives and its importances
CO5: Students can understand the food commodities

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	M		H				H	M	H	
CO2	H	L	M		H				H	M	H	
CO3	H	L	M		H				H	M	H	
CO4	H	L			H						H	
CO5	H	L			H						H	

SDG 2: Zero Hunger

Statement: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. Studying this course will help the students to understand the important of food to every individual in the earth.

LSDX 066	FOOD BIOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 2		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn the basics of food laroatory and equipment usage

COB2: Students learn to analyze the proximate analysis

COB3: Students learn thechemical constituents of foods

COB4: Students will learnMicrobial analysis of food

COB5: Students will learn GMP practices and food preservation techniques

PRACTICALS

List of Experiments:

1. Introduction to food laboratory
2. Laboratory equipment and usage
3. Proximate analysis of food samples (Determination of protein, Determination of carbohydrate, Determination of fat, Determination of moisture content, Determination of ashcontent, Determination of fiber content)
4. Determination of chemical constituents of foods
5. Indirect and Direct Determination of the Casein Content of Milk
6. Microbial analysis of food
7. Good Manufacturing Practices for food
8. Introduction to food processing of various foods including dairy, bakery
9. Food preservation techniques

P – 60 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Food Science- Norman Potter, Springer; 5th ed. 1995 edition (31 July 1999)
2. Biochemistry of Foods - N.A. Michael Eskin, 1990, Academic Press, California
3. Food Chemistry - O. R. Fennema, 4th ed. 2007, CRC press.
4. Kulp K. and Ponte J.G. Jr. (2000). Handbook of Cereal Science and Technology. New York/Basel, Marcel Dekker Inc.
5. Essentials of Food and Nutrition by Swaminathan Vol. I and II

COURSE OUTCOMES:

After completion of the course students,

CO1:understand the basics of food biotechnology lab

CO2:understand the importance ofanalyzing the proximate analysis

CO3:understand to alazye the chemical constitients of food

CO4:understand to analyzeMicrobial analysis of food

CO5:understand the importance ofGMP practices and food preservation techniques

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	M		H				H	M	H	
CO2	H	L	M		H				H	M	H	
CO3	H	L	M		H				H	M	H	
CO4	H	L			H						H	
CO5	H	L			H						H	

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

SDG 2: Zero Hunger

Statement: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. Studying this course will help the students to understand the important of food to every individual in the earth.

LSDX 067	BIOFERTILIZER TECHNOLOGY	L	T	P	C
SDG: 2,3		4	0	0	4

COURSE OBJECTIVES:

COB1: To provide an in-depth knowledge of biofertilizer types and production methods

COB2: To explain the significance of Nitrogen fixation using examples

COB3: To illustrate the role of different microbes in biofertilizer technology

COB4: To introduce the concept of organic farming

COB5: To learn the applications of azolla and its uses

MODULE I INTRODUCTION TO BIOFERTILIZERS 9h

Biofertilizers-Definition and benefits-Types of Biofertilizers-Conventional and liquid biofertilizers-Overview of production methods, types and their benefits-nitrogen fixation-phosphate biofertilizers

MODULE II BACTERIAL BIOFERTILIZERS 9h

Mechanism of nitrogen fixation (free-living and symbiotic) Rhizobium,Azospirillum,Azotobacter - Biochemistry and molecular basis of nitrogen fixation - Phosphate solubilization and mobilization. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

MODULE III ALGAL BIOFERTILIZERS 9h

Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

MODULE IV F**UNGAL BIOFERTILIZERS 9h**

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM –isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

MODULE V ORGANIC FARMING 9h

Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Applicatioons.

L – 60; TOTAL HOURS-60

TEXT BOOKS:

1. Textbook of Agricultural Biotechnology by Dr. Ahindra Nag, PHI Learning Private Ltd., New Delhi, 2009.

REFERENCES:

1. Subba Rao, N. S. (1982). Advances in Agricultural Microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

COURSE OUTCOMES:

CO1: To demonstrate a deep understanding on Biofertilizer production methods

CO2: To analyse and compare the mechanism of Nitrogen fixation and phosphate bacteria as biofertilizers

CO3: To perceive the nuances of fungal biofertilizers

CO4: Students able to understand the importance of azolla and its cultivation methods

CO5: To perceive the nuances of organic farming

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	H	M	M				H	H	L	H
CO2	H	L	H	M	M				H	H	L	H
CO3	H	L	H	M	M				H	H	L	H
CO4	H	L	H	M	M				H	H	L	H
CO5	H	L	H	M	M				H	H	M	H

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

SDG 2: Zero Hunger

Statement: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. Studying this course will help the students to understand the important of food to every individual in the earth.

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 068	BIOFERTILIZER TECHNOLOGY LABORATORY	L	T	P	C
SDG: 2,3		0	0	4	2

COURSE OBJECTIVES:

COB1: To gain the knowledge of bio fertilizer production

COB2: To illustrate the role of different microbes in biofertilizer technology

COB3: To introduce the concept of organic farming

COB4: To learn the concept of biocompost

COB5: To learn theBiofertilizers application and importance in agricultural field

PRACTICALS

List of Experiments:

1. Nitrogen fixing bacteria on root nodules function
2. Production of biofertilizer using microbes.
3. Production of algal biofertilizers
4. Factors influencing algal growth
5. Production of Bio-compost
6. Production of vermin-compost
7. Biofertilizers application and importance in agricultural field

P – 60 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Textbook of Agricultural Biotechnology by Dr. Ahindra Nag, PHI Learning Private Ltd., New Delhi, 2009.

REFERENCES:

1. Subba Rao, N. S. (1982). Advances in Agricultural Microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

COURSE OUTCOMES:

CO1: To demonstrate a deep understanding on Biofertilizer production methods

CO2: To analyse and compare the mechanism of Nitrogen fixation and phosphate bacteria as biofertilizers

CO3: To perceive the nuances of organic farming

CO4: Students understand the concept of biocomposting

CO5: Students understand theBiofertilizers application and importance in agricultural field

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L	M		M	H	M	H	
CO2	H	H	H	H	L	M		M	H	M	H	
CO3	H	H	H	H	L	M		M	H	M	H	
CO4	H	H	H	H	L	M		M	H	M	H	
CO5	H	H	H	H	L	M		M	H	M	H	

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

SDG 2: Zero Hunger

Statement: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. Studying this course will help the students to understand the important of food to every individual in the earth.

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 069	COMPUTER AIDED DRUG DESIGN	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB 1. Role of CADD in drug discovery

COB2: Different CADD techniques and their applications

COB3: Various strategies to design and develop new drug like molecules

COB4: Working with molecular modeling softwares to design new drug molecules

COB5: The in silico virtual screening protocols

MODULE I INTRODUCTION TO DRUG DESIGN 12

Introduction to Computer Aided Drug Design (CADD) History, different technique sand applications Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, disubstituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters

MODULE II QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIPS 12

Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations 3D-QSARapproaches and contour map analysis Statistical methods used in QSAR analysis and importance of statistical parameters

MODULE III MOLECULAR MODELING AND DOCKING 12

Molecular Modeling and Docking A) Molecular and Quantum Mechanics in drug design B) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation C) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-C.

MODULE IV MOLECULAR PROPERTIES AND DRUG DESIGN 12

Molecular Properties and Drug Design: a) Prediction and analysis of ADMET

properties of new molecules and its importance in drug design. b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. c) Homology modeling and generation of 3D-structure of protein.

MODULE V VIRTUAL SCREENING 12

Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.

L –60; TOTAL HOURS –60

TEXT BOOKS:

1. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press, 2000
2. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers, 1999
3. Computational and structural approaches to drug discovery, Robert M Stroud and Janet.F Moore,RCS Publishers, 2006
4. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group, 2000
5. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers, 2008
6. Principles of Drug Design by Smith andWilliams, CRC Press, Taylor & Francis, 2010.

COURSE OUTCOMES:

CO1: Explain the various stages of drug discovery

CO2: Learn the concept of boosterism and drug resistance

CO3: Describe physicochemical Properties and the techniques involved in QSAR

CO4: Learn introduction to Bioinformatics and Cheminformatics

CO5: Explain the various techniques in Virtual Screening

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	H	H	H	H	H	L	H	H	H	H	H
CO2	L	H	H	H	H	H	L	H	H	H	H	H
CO3	L	H	H	H	H	H	L	H	H	H	H	H
CO4	L	H	H	H	H	H	L	H	H	H	H	H
CO5	L	H	H	H	H	H	L	H	H	H	H	H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 070	COMPUTER AIDED DRUG DESIGN LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn various software and tools for computer-aided drug designing.

COB2: To gain the knowledge on sequence-structure alignment of proteins

COB3: To gain knowledge onPrediction of active site in receptor

COB4: To gain knowledge onLigand-based drug designing

COB5: To gain knowledge onStructure based designing. Molecular Docking

PRACTICALS

1. Homology modelling of protein.
2. Conformational analysis: Secondary structure prediction, 3D structure prediction, fold recognition
3. sequence-structure alignment of proteins. Molecular modelling of drug-receptor interaction:
4. Prediction of active site in receptor, building small molecules, ADME Predictions.
5. Ligand-based drug designing: Protein-ligand docking, Protein-protein docking, Combinatorial library generation.
6. Pharmacophore mapping. Molecular shape-based drug designing: Structure based designing. Molecular Docking.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Geert van der Plas, Georges Gielen Willy Sansen, “A Computer-Aided Design and Synthesis Environment for Analog Integrated Circuits”, Kluwert Academic Publishers, United States, 2002. (ISBN: 978-0-7923-7697-2).

REFERENCES:

1. Gore M, Jagtap, Computational Drug Discovery and Design, Humana Press, ISBN: 978-1493977550.
2. http://www.swissadme.ch/

COURSE OUTCOMES:

CO1: Learn and use various tools for in silico drug designing.

CO2: Analyze and provide solutions to new drug discovery by using modern CADD tools.

CO3: AnalyzePrediction of active site in receptor

CO4: To analyze Ligand-based drug designing

CO5: To analyzeStructure based designing. Molecular Docking

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	L	H	H	H	H	H	L	H	H	H	H	H
CO2	L	H	H	H	H	H	L	H	H	H	H	H
CO3	L	H	H	H	H	H	L	H	H	H	H	H
CO4	L	H	H	H	H	H	L	H	H	H	H	H
CO5	L	H	H	H	H	H	L	H	H	H	H	H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 071	BIOMASS AND BIOENERGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.

COB2: To understand the basic need for energy conservation and waste heat recovery

COB3: To explore the possibility of renewable energy production in a green way

COB4: To emphasize the utilization of bio-energy and opportunity in R&D

COB5: To acquaint the students with different methods of bio-energy production

MODULE I INTRODUCTION AND SCOPE OF BIOENERGY 12

Introduction – Need for alternative fuel sources – History of biofuels - Bio resource – origin – biomass types and characteristics- biomass conversion technology - Bioenergetics –Biocatalysis –Kinetics of product formation

MODULE II RENEWABLE BIOENERGY 12

Introduction – Importance – Merit and demerits – Possibilities and opportunities. Biofuel - Bioalcohol – Biodiesel – Biohydrogen – Biomethane – Biokerosine – Biochar (Bio-oil, syngas) – Global scenario of biofuel production – Plant - Microbial macromolecules as biofuel feedstocks. Microbial fuel cells (MFC).

MODULE III BIOENERGY FEEDSTOCKS 12

Microbial feedstocks for biofuels – Microalgae – Cyanobacteria – Diatom – Bacteria – Fungi. Biomass production - Raceway ponds – Photobioreactors (thin film & tubular) – Fermentors. Bioconversion of feedstocks – Saccharification – ABE fermentation - Transesterification – Pyrolysis – Fischer-Tropsch process. Microbial biorefinery.

MODULE IV TECHNOLOGIES IN BIOENERGY PRODUCTION 12

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources. Hydrothermal Liquefaction – Nanotechnology - Nanocatatysis – Condensation – Incineration – rDNA technology.

MODULE V APPLICATIONS AND OPPORTUNITY OF BIOENERGY 12

Pollution control – CO2, NOx, H2S mitigation – wastewater treatment - Properties of B100 – Blended – ASTM- ISO – BIS – EU standard for biofuel quality. Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – Bioenergy policy.

L – 60; TOTAL HOURS –60

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, ―Energy Technology‖, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. 2. O. Callaghn. P.W., ―Design and Management for Energy Conservation‖, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, ―Non Conventional Energy Sources‖, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. ―Principles of Energy Conservation‖, McGraw Hill, 1991.
3. D Patrick and S W Fardo, ―Energy Management and Conservation‖, PHI,1990
4. P. O'Callaghan: ―Energy Management‖, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., ―Energy Conservation in Process Industries‖, Academic Press, 1983.
6. Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986
7. Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986

COURSE OUTCOMES:

CO1: Realize the global and national energy status and need to switch over to renewable energy technology.

CO2: Energy audit and suggest methodologies for energy savings

CO3: Utilize the available resources in an optimal way.

CO4: Concern about the global environmental issues &promote carbon credits.

CO5: Concern about renewable energy and utilization.

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	H	M	L				H	H	L	
CO2	H	L	H	M	L				H	H	L	
CO3	H	L	H	M	L				H	H	L	
CO4	H	L	H	M	L				H	H	L	
CO5	H	L	H	M	L				H	H	L	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 072	BIOMASS AND BIOENERGY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To make the students to explore the basic of bio-energy and its resources

COB2: To understand the importance of renewable energy

COB3: To explore the possibility of renewable energy production in a green way

COB4: To emphasize the utilization of bio-energy and opportunity in R&D

COB5: To acquaint the students with different methods of bio-energy production

PRACTICALS

List of Experiments:

1. Estimation of TOC in bio-resources
2. Production and characterization of FAME
3. Determination of bioconversion of sugar to ethanol
4. Production of biochar
5. Production of electricity using MFC
6. Production and estimation of BD from vegetable oil
7. Preparation of biodiesel through transesterification process
8. Qualitative analysis of BD100 using international standard
9. Determination of viscosity, and cetene number in oil
10. Production biofuel through HTL
11. Determination of biogas production
12. Analysis of catalytic property of nanomaterials for biofuel production
13. Estimation of degradation of chemical polymer
14. Estimation of degradation of biopolymer
15. Identification of PHB producing biosystem

P –60; TOTAL HOURS –60

REFERENCES:

1. Rai G.D,Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
2. Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986
3. Chawla O.P, Advances in Biogas Technology ICAR publication New

Delhi 1986

COURSE OUTCOMES:

CO1: The students will be able to understand the concepts of bio energy sources and its applications.

CO2: Fundamental understanding of the importance of Bio resources, Bio energy and reactors.

CO3: Familiarizing the Energy and Environment

CO4: Understanding of biomass and conservation and utilization

CO5: Understanding of various catalytic reaction for the production of FAME

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L	M		M	H	M	H	
CO2	H	H	H	H	L	M		M	H	M	H	
CO3	H	H	H	H	L	M		M	H	M	H	
CO4	H	H	H	H	L	M		M	H	M	H	
CO5	H	H	H	H	L	M		M	H	M	H	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 073	rDNA TECHNOLOGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To develop knowledge about DNA modifying enzymes

COB2: To understand the gene cloning vectors

COB3: To learn the screening of the cloned DNA

COB4: To understand the gene manipulation methods

COB5: To understand the application of the rDNA technique in different field of biotechnology

MODULE I TOOLS OF GENETIC ENGINEERING 12

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

MODULE II GENE DELIVERY SYSTEMS 12

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 12

Expression vectors, Restriction enzyme analysis, Southern blotting, Northern blotting, Western blotting, In-situ hybridization. Colony and plaque hybridization, positive selection and negative selection.

MODULE IV GENE MANIPULATION TECHNIQUES 12

Site-directed mutagenesis, Insertion & Deletion Mutagenesis, Polymerase Chain reaction (PCR): Basic principles, modifications, applications, gene editing techniques, CRISPR-Cas9.

MODULE V APPLICATION OF rDNA TECHNOLOGY 12

Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. T.A. Brown “Gene Cloning & DNA Analysis: An Introduction” 7th edition Wiley Blackwell Oxford UK, 2016
2. Primrose and Twyman “Principles of Gene Manipulation and Genomics” 7th Edition Blackwell Oxford UK, 2006

COURSE OUTCOMES:

CO1: understand the applications of DNA modifying enzymes

CO2: familiarize with the use of different gene cloning vectors

CO3: screen and express the cloned gene products

CO4: apply the knowledge of gene manipulation techniques

CO5: learn the different applications of genetic engineering

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	H	H				H	M		H
CO2	H	M	M	H	H				H	M		H
CO3	H	M	M	H	H				H	M		H
CO4	H	M		L	H				H	M		H
CO5	H	M		M	H				H	M		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 074	rDNA TECHNOLOGY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To learn the technique of plasmid DNA isolation

COB2: To learn PCR for cloning experiments

COB3: To learn TA cloning

COB4: To learn the screening technique of the cloned DNA

COB5: To learn the screening of bacterial colonies by X-gal and IPTG

PRACTICALS

List of Experiments:

1. Plasmid DNA isolation
2. PCR amplification of gene of interest
3. Restriction digestion of DNA
4. TA cloning
5. Transformation of competent cells by heat shock method
6. Screening Bacterial Colonies Using X-Gal and IPTG

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Green and Sambrook 'Molecular Cloning: A Laboratory Manual' 4th Edition, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York, 2012

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: isolate plasmid DNA for rDNA preparation

CO2: design PCR for cloning purpose

CO3: perform cloning in the TA cloning vector

CO4: screen the cloned DNA in the transformed cells

CO5: Understand the screening methods of bacterial colonies by X-gal and IPTG

Board of Studies (BoS) :	Academic Council:
8th BoS of SLS held on 5.07.2021	17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	H	H				H	M		H
CO2	H	M	M	H	H				H	M		H
CO3	H	M	M	H	H				H	M		H
CO4	H	M		L	H				H	M		H
CO5	H	M		M	H				H	M		H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 075	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
SDG: 3, 9		4	0	0	4

COURSE OBJECTIVES:

COB1: To give students a broad understanding and experience of technological processes.

COB2: To update students' knowledge of new developments in of industrial biology relevance.

COB3: To acquaint students with appropriate academic studies and industrial experience to enable them to contribute to the field of biotechnology.

COB4: To provide students with insights on bioprocess development

COB5: Students learn the applications of industrial biotechnology

MODULE I INTRODUCTION TO INDUSTRIAL BIOPROCESS 12

An introduction to fermentation processes: Microbial biomass, Microbial enzymes, Microbial metabolites, Recombinant products, Transformation processes. The isolation, preservation and improvement of industrially important micro-organisms Screening methods, Storage at reduced temperature, Storage in a dehydrated form, The selection of induced mutants, use of auxotrophs, resistant mutants, revertant mutants, Modification of the permeability, use of recombination systems, protoplast fusion techniques

MODULE II BIOREACTOR TYPES AND OPERATION CONTROL 12

Fermentation systems – Batch culture, Continuous culture, Fed-batch culture, Kinetics of growth and product formation, Design of a fermenter – components of a bioreactor, various types of bioreactors for microbial, animal, plant cell culture – fluidized bed reactor, bubble column, air lift fermenter, packed bed, trickle bed etc. Aseptic operation and containment. Medium formulation, scale up of fermentation processes,

MODULE III DOWNSTREAM PROCESSING 12

Downstream Processes in fermentation and bioprocess technology; Solid and liquid separation – Flocculation and Flotation, filtration and centrifugation. Cell disruption by solid and liquid shear, ultrasonication,

enzyme action and mechanical disruption. Product recovery and purification principle – Precipitation, Crystallization, Liquid-Liquid extraction, Distillation, Evaporation, Chromatographic separation, Adsorption and concentration, Membrane filtration, Lyophilization, spraying, drying and packing.

MODULE IV PRODUCTION OF PRIMARY AND SECONDARY METABOLITES **12**

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, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,) Study of production processes for various classes of secondary metabolites.

MODULE V APPLICATIONS **12**

Introduction to genetic engineering, Production of recombinant proteins having therapeutic and diagnostic applications (insulin, human growth hormone & interferon), Production of recombinant vaccines (hepatitis B vaccine, cholera vaccine & vaccinia vector vaccine), production of monoclonal antibodies, Food processing, Sweeteners, Food wastes, Rapid diagnostics, Bioremediation.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1.Wulf Cruger and Anneliese Cruger, “A Textbook of Industrial Microbiology”,Panima Publishing Corporation.

2.Michael J. Waites, Neil L.Morgan, John.S. Rockey and Grey Higton, “Industrial Microbiology”: An Introduction, Blackwell science publishing house.

REFERENCES:

1. Presscott, Dunn, Industrial Microbiology, Agrobios (India), 2009.
2. Christoph Wittmann, James C. Liao, Industrial Biotechnology: roducts and Processes, Wiley-VCH Verlag GmbH & Co. KGaA, 2017.

COURSE OUTCOMES: Students will be able to acquire knowledge on

CO1: The facts, concepts, principles and theories relevant to the broad area of industrial biotechnology.

CO2: The upstream and downstream processes used for industrial production of various metabolites.

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 industrial biotechnology.

CO5: Processes which facilitate the critical evaluation of research, scholarship and methodologies within the area of biotechnology.

Board of Studies (BoS) : 8th BoS of SLS held on 5.07.2021

Academic Council: 17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	H	M	L				H	H	L	
CO2	H	L	H	M	L				H	H	L	
CO3	H	L	H	M	L				H	H	L	
CO4	H	L	H	M	L				H	H	L	
CO5	H	L	H	M					H	H		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to help the student to understand the industry scale production using biotechnological tools.

LSDX 076	INDUSTRIAL BIOTECHNOLOGY LABORATORY	L	T	P	C
SDG: 3,9		0	0	4	2

COURSE OBJECTIVES:

COB1: To acquaint students with practical knowledge of bioprocess technology.

COB2: To provide information on applicability of biotechnological studies.

COB3: To perform experiments for isolation of microorganisms from various sources.

COB4: To learn theSolvent extraction techniques

COB5: To learn theDetection and isolation of pathogens from spoiled food

PRACTICALS

1. Primary screening of amylase producers by Replica Plate technique.
2. Primary screening of antibiotic producers by crowded plate technique.
3. Production of Amylase - Purification and measuring enzyme activity.
4. Production of alcohol and estimation by colorimetric method.
5. Enzyme immobilized by alginate gel method
6. Hydrolysis of starch by immobilized method
7. Effect of substrate concentration on biomass yield
8. Solvent extraction techniques for product recovery
9. Micropropagation of plant by leaf disc culture
10. Detection and isolation of pathogens from spoiled food.

P – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Lab Manual

REFERENCES:

1. Yadav P. R, Tyagi R. Biotechnology of Animal Tissues. Discovery Publishing House, 2006.
2. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.

COURSE OUTCOMES:

At the end of the syllabus students will be able to

CO1: Understand the fundamentals of bioprocess techniques.

CO2: Carry out enzyme immobilized reaction and microbial culture

CO3: Develop their practical skills in enzyme isolation and purification.

CO4: Apply techniques involved in downstream process.

CO5: Understand the Detection and isolation of pathogens from spoiled food

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L	M		M	H	M	H	
CO2	H	H	H	H	L	M		M	H	M	H	
CO3	H	H	H	H	L	M		M	H	M	H	
CO4	H	H	H	H	L	M		M	H	M	H	
CO5	H	H	H	H	L	M		M	H	M	H	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to help the student to understand the industry scale production using biotechnological tools.

LSDX 077	MOLECULAR FARMING	L	T	P	C
SDG: 3, 9		4	0	0	4

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 make them understand the possibility of utilization of plant sources

COB5: To convey the importance of molecular farming for novel protein recovery

MODULE I INTRODUCTION AND FOREIGN PROTEIN EXPRESSION **12**

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 **14**

Biology of sprouting - Dicotyledonous seeds - Germination, sprout Rubisco synthesis, rubisco promoters- Inhibition of endogenous gene expression - Expression cassette design, sprouting- equipments, 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 **12**

Technical aspects, cereal transformation, expression construct design - Prodigene 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 **11**

Introduction, expression of therapeutic and human proteins in plants. Transgenic chloroplast system. Chloroplast derived human antibodies, biopharmaceuticals. Human Serum Albumin. Human insulin like growth factor1, Human interferon, Anti-microbial 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 **11**

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 – 60; TOTAL HOURS –60

TEXT BOOKS:

1. Molecular Farming, Amita Sarkar, 2019, Discovery Publishing Pvt.Ltd

REFERENCES:

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 1st Edition,Allison R. Kermode, Liwen Jiang 2017.

COURSE OUTCOMES:

CO1: The student will be aware about the basics of molecular farming
CO2: The student will be aware novel sprouting technologies
CO3: The student will be aware vectors used for the expression of foreign proteins
CO4: The student will be aware edible vaccine and nutraceuticals
CO5: The student will be aware on extraction of products from plant systems

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	H					H			H
CO2	H	H	L	H					M			H
CO3	H	H	L	H					M			H
CO4	H	H	L	H					M			H
CO5	H	H	L	H					H			H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging

challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to help the student to understand the industry scale production using biotechnological tools.

LSDX 078	MOLECULAR FARMING LABORATORY	L	T	P	C
SDG: 3, 9		0	0	4	2

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 make them understand the possibility of utilization of plant sources

COB5: To convey the importance of molecular farming for novel protein recovery

PRACTICALS

List of Experiments:

1. Estimation of Protein in leaves and stem in the plant
2. Estimation of Pigments in leaves and stem in the plant
3. Estimation of Protein in leaves and stem in the plant
4. Production of sprouts using grains
5. Estimation of protein content in sprouts
6. Effect of protein level in sprouts under saline stress
7. Effect of protein level in sprouts under nutrients stress
8. Comparative analysis of sprouts of monocot and dicot plants
9. Protoplast fusion
10. Observation of protein level in leaves using CLSM
11. Techno-economic analysis of protein expression in plants

P – 60; TOTAL HOURS –60

REFERENCES:

1. Molecular Farming, Amita Sarkar, 2019, Discovery Publishing Pvt.Ltd
2. Molecular Farming – Plant-made Pharmaceuticals and Technical Proteins, Rainer Fischer and Stefan Schillberg. Wiley.VCH Verlag GmbH and Co. KGaA. 2004
3. Molecular Pharming: Applications, Challenges and Emerging Areas 1st Edition,Allison R. Kermode, Liwen Jiang 2017

COURSE OUTCOMES:

CO1: The student will be aware about the basics of molecular farming

CO2: The student will be aware novel sprouting technologies

CO3: The student will be aware vectors used for the expression of foreign proteins

CO4: The student will be aware edible vaccine and nutraceuticals

CO5: The student will be aware on extraction of products from plant systems

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	H					H			H
CO2	H	H	L	H					M			H
CO3	H	H	L	H					M			H
CO4	H	H	L	H					M			H
CO5	H	H	L	H					H			H

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to help the student to understand the industry scale production using biotechnological tools.

LSDX 079	BIOPHYSICS	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To familiarize students with various molecules of life

COB2: To understand the structural and functional role of carbohydrate and amino acids.

COB3: The course will also acquaint them with the basic knowledge about biochemistry

COB4: To expose themselves about the secondary metabolites in plants and animals.

COB5: To enable the learners about the structural properties of nucleic acids and lipids and their biological role.

MODULE I STRUCTURE OF BIOLOGICAL SYSTEMS 12

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 12

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 Tm values.

MODULE III CONFORMATION OF PROTEINS 12

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.

MODULE IV MEMBRANE BIOLOGY 12

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.

MODULE V BIOCALORIMETRY 12

Thermodynamic parameters, activation energy of reactions, enthalpy, entropy, free energy,Isothermal titration calorimetry, changes in heat capacity by isothermal titration calorimetry, differential scanning calorimetry, equilibrium constant.

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Biochemistry (2015) by Berg, Tymoczko, Gatto, Stryer. Eighth Edition. WH Freeman and Co.
2. Lehninger: Principles of Biochemistry (2017) by Nelson and Cox. Seventh edition. WH Freeman and Co.

REFERENCES:

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.

COURSE OUTCOMES:

CO1: Student will be able to understand the chemistry of the structures of biomolecules.

CO2: Student will be able to have the all-basic information related to the biological structure.

CO3: Student will be able to know about the detail structure elucidation by using the basic techniques.

CO4: Students understand the membrane biology

CO5: Understant the importance of biocalorimentry

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	L			L	L	H	L	M	
CO2	H	H	L	L			L	L	H	L	M	
CO3	H	H	L	L			L	L	H	L	M	
CO4	H	H	L	L			L	L	H	L	M	
CO5	H	H	L	L			L	L	H	L	M	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 080	BIOPHYSICS LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: To explore about the molecular structure.

COB2: To have an idea about the buffer's behaviour and its preparation according to calculation.

COB3: To obtain the knowledge about the analysis of different biomolecules.

COB4: To gain an idea about some basic principles which is important for estimation of biomolecules.

COB5: To learn the interaction of DNA and protein

PRACTICALS

List of Experiments:

1. Effects of protein at different temperatures.
2. Analysis of lipids and its quantitative analysis.
3. Absorption spectral behavior of DNA
4. Absorption spectral behavior of RNA
5. Effect of urea on protein denaturation.
6. Membrane behavior in different tonicity solutions
7. Protein and DNA interaction.

P – 60 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Martin D. W, Mayer P. A. and Rodwell V. W. Harper's Review of Biochemistry 30th Ed., Maruzen Asian Lange Med.,2010.

2. Nelson D. L, Cox M. M. Lehninger's Principle of Biochemistry. 5th Ed.,W. H.Freeman, 2008.

3. Dixon M, Webb E. C,Thorne C.J.R and Tipton K.F.Enzymes. 3rd Ed., Longmans, Green & Co.,Academic Press, New York, 1979.

REFERENCES:

1.Wilson K., Walker J, Practical biochemistry Fifth Edition Cambridge Press.

2.R David Freifelder., Physical biochemistry: Application to biochemistry and Molecular biology

COURSE OUTCOMES:

CO1: On the completion of the above objective's student will be able to explore about the technical knowledge to handle the instrument.

CO2: On the completion of the course students will have an idea about basic principles of estimation technique.

CO3: Student will acquire the knowledge of absorption spectra.

CO4: student will get the idea about the protein behavior in the presence of different factors.

CO5: Students able to understand the DNA & protein interaction

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 081	MOLECULAR DIAGNOSTICS	L	T	P	C
SDG: 3		4	0	0	4

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: Understanding the common procedures used in forensic science

MODULE I INTRODUCTION TO MOLECULAR DIAGNOSTICS 12

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, SOP and ethics in molecular diagnostics.

MODULE II DETECTION AND IDENTIFICATION OF MICROORGANISMS 12

Bacterial Targets of Molecular-Based Tests, Molecular Detection of Bacteria, Detection of Respiratory Tract Pathogens, Molecular Testing for Urogenital Tract Pathogens, Viruses- Human Papillomavirus, HIV-1, Hepatitis C, Dengue,Viral Load Determination.

MODULE III CLINICAL GENETICS 12

Overview of Molecular Genetics, Nucleic Acid Amplification, Molecular Detection of Inherited Diseases, Detection of Genomic Duplications and Deletions, Genetic Testing, Genetic Counseling, Preimplantation Genetic Diagnosis.

MODULE IV IMMUNODIAGNOSTICS 12

Introduction to immunodiagnostics, antigen-antibody reactions, antibody production, antibody markers, CD markers, FACS, Human Leukocyte Antigen (HLA) typing, agglutination (ABO/ Bacterial), immunoprecipitation, immunodiffusion.

MODULE V FORENSIC SCIENCE 12

Introduction to Forensic Science, DNA Polymorphisms and Human Identification-RFLP typing, STR typing by PCR, Y-STR, Linkage analysis, Mitochondrial DNA marker analysis, Molecular diagnostic applications in Forensic Science

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. George P. Patrinos and Wilhelm J. Ansorge (ed.)(2010) Molecular Diagnostics Second Edition, Academic Press
2. Lela Buckingham and Maribeth L. Flaws (2007) Molecular Diagnostics. Fundamentals, Methods, & Clinical Applications. F A Davis Company

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 learn the application of molecular diagnostic techniques in forensic science lab

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	M	L	M			H	H	H	L
CO2	H	M	L	M	L	M			H	H	H	L
CO3	H	M	L	M	L	M			H	H	H	L
CO4	H	M	L	M	L	M			H	H	H	L
CO5	H	M	L	M	L	M			H	H	H	L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 082	MOLECULAR DIAGNOSTICS LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: development of hands on experience of PCR

COB2: ability to process blood sample

COB3: ability to analyze samples using microscope

COB4: developing the skill of cytogenetic analysis

COB5: gaining the knowledge of advanced techniques

PRACTICALS

List of Experiments:

1.Amplification of a gene of interest using PCR

2.Detection of bacteria using 16s rRNA specific primer

3.Blood specimen collection and blood grouping

4.Staining blood sample and cell counting

5.DNA staining of cell sample and characterization under microscope Barr body detection

6.G staining

7.Demonstration of SDS PAGE

8.Demonstration of RT PCR

9.Demonstration of HPLC

P – 60 ; TOTAL HOURS – 60

TEXT BOOKS:

1.Barbara Detrick, Robert G. Hamilton and John L. Schmitz (Eds.) (2016) Manual of Molecular and Clinical Laboratory Immunology. 8t edition, ASM press, ISBN: 1555818714

2.Diana Nicoll, Chuanyi Mark Lu and Stephen J. McPhee (2017) Guide to Diagnostic Tests, Seventh Edition (A & L LANGE SERIES). 7th edition, McGraw Hill, ISBN: 1259640892

REFERENCES:

COURSE OUTCOMES:

CO1: students shall be able to handle PCR and analyze specimens

CO2: students will be familiarized with processing, storing of blood samples and blood grouping

CO3: students will be able to analyze and characterize samples using microscope

CO4: students will learn chromosomal staining

CO5: students will familiarize with operations of advanced instruments

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	L	L				H	M		
CO2	H	M	M	M	L				H	M		
CO3	H	M	M	M	L				H	M		
CO4	H	M	M	L	L				H	M		
CO5	H	M		M	L				H	M		

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 083	DOWNSTREAM PROCESS	L	T	P	C
SDG: 3,9		4	0	0	4

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:learn the drying and polishing of products

MODULE INTRODUCTION TO BIOSEPARATION 12

Definition, Role of bioseparation in Bioprocess technology, challenges in bioseparation, Ideal bioseparation process.

MODULE II REMOVAL OF SOLIDS 12

Principle and types of Filtrations, 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 12

Extraction, Soxhlet extraction, Maceration extraction, Ultrasound assisted extraction, Microwave assisted extraction, supercritical fluid extraction, Aqueoustwo-phase systems, precipitation, selective precipitation, affinity precipitation.

MODULE IV PURIFICATION 12

Adsorption, Mixed mode expanded bed adsorption, adsorbents, Nano-based adsorbents, Chromatography, electrophoresis, crystallization.

MODULE V DRYING AND POLISHING 12

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 – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Industrial Bioseparations: Principles and Practice, Daniel Forciniti, Wiley, 1st Edition, 2008
2. Bioseparations Science and Engineering (2nd ed.), Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, 2008.

REFERENCES:

1. Bioseparations Downstream Processing for Biotechnology-Paul A Belter and E L Cussler
2. Bioseparations Engineering: Principles, Practice, and Economics- Michael R Ladisch.

COURSE OUTCOMES:

CO1: Understand the basics of bioseparation methods

CO2: apply different technologies involved in the reduction of bulk quantity after the large-scale process in bioreactor and to remove specific impurities

CO3:make rational decisions to achieve the product specifications and enrich target products

CO4: Understand the various purification methods

CO5: Understand the varipus drying and polishing methods

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	H	M	L				H	H	L	
CO2	H	L	H	M	L				H	H	L	
CO3	H	L	H	M	L				H	H	L	
CO4	H	L	H	M	L				H	H	L	
CO5	H	L	H	M	L				H	H	L	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing

inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to help the student to understand the industry scale production using biotechnological tools.

LSDX 084	DOWNSTREAM PROCESS LABORATORY	L	T	P	C
SDG: 3, 9		0	0	4	2

COURSE OBJECTIVES:

COB1: To understand the nature of the end product, its concentration, stability and degree of purification required

COB2: To design processes for the recovery and subsequent purification of target biological products.

COB3: To learn the method of Aqueous phase of extraction

COB4: To learnthe method of Ultrasonication based cell distruption

COB5: To learnthe method of osmotic cell lysis

PRACTICALS

1. Density gradient centrifugation
2. Cross flow filtration
3. Fast protein liquid chromatography
4. Ion-exchange chromatography
5. Soxhlet extraction
6. Microwave assisted extraction
7. Aqueous two-phase extraction
8. Ultrasonication based cell disruption
9. French press
10. Osmotic cell lysis
11.

P – 60; TOTAL HOURS – 60

REFERENCES:

1. Lab Manual

COURSE OUTCOMES:

CO1: Acquired knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.

CO2: Learned cell disruption techniques to release intracellular products

CO3: Understand the method of Aqueous phase of extraction

CO4: Understand the method of Ultrasonication based cell distruption

CO5: Understand the method of osmotic cell lysis

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	L	M		M	H	M	H	
CO2	H	H	H	H	L	M		M	H	M	H	
CO3	H	H	H	H	L	M		M	H	M	H	
CO4	H	H	H	H	L	M		M	H	M	H	
CO5	H	H	H	H	L	M		M	H	M	H	

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

SDG 9: Industry, Innovation and Infrastructure

Statement: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. Studying this course to help the student to understand the industry scale production using biotechnological tools

LSDX 085	EPIDIOMOLOGY	L	T	P	C
SDG: 3		4	0	0	4

COURSE OBJECTIVES:

COB1: To learn the basics of epidiomology

COB2: To learn the principles in measurements

COB3: To learn the observational study designs

COB4: To learn the experimental study designs

COB5: To learn qualitative research

MODULE FUNDAMENTALS OF EPIDEMIOLOGY 12

Tools of Epidemiology: measuring disease Frequency (Prevalence, incidence, morbidity rates, attack rates etc. - Historical aspects of Epidemiology and evolution - Definition and understanding - Natural history of disease - Survey methodology including census procedures and Sampling

MODULE II PRINCIPLES OF MEASUREMENTS 12

Types of measures - Reliability - Validity - Accuracy - Questionnaire construction - Index construction and scaling - Observe variation - Diagnostic tests - Measurement issues - Evaluating sources of data.

MODULE III STUDY DESIGNS-OBSERVATIONAL STUDIES 12

Cross Sectional Studies - Descriptive Studies - Cohort Studies - Case Control Studies - Before – after Studies - Historical Prospective Studies - Making international comparisons

MODULE IV STUDY DESIGNS- EXPERIMENTAL STUDIES 12

The Randomized Control trial - Allocation alternative - Maneuver - Measurement including blinding - Compliance, contamination, co intervention - Adverse events - Stopping rules - Analysis- Diagnostic tests- Measurement issues

MODULE V QUALITATIVE RESEARCH 12

Mixed designs- Ecological Studies - Space time cluster studies - Familial aggregation studies

L – 60; TOTAL HOURS – 60

TEXT BOOKS:

1. Marit L. Bovbjerg. Foundations of Epidemiology. Publisher-Oregon State University.

2. Laura Wheeler Poms. Understanding Epidemiology, Concepts, Skills, and Applications. ISBN-13: 978-1516516254

REFERENCES:

1. Frérot M, Lefebvre A, Aho S, Callier P, Astruc K, Aho Glélé LS. What is epidemiology? Changing definitions of epidemiology 1978-2017. PLoS One. 2018 Dec 10;13(12):e0208442.

2. Olshan AF, Diez Roux AV, Hatch M, Klebanoff MA. Epidemiology: Back to the Future. Am J Epidemiol. 2019 May 1;188(5):814-817. doi: 10.1093/aje/kwz045.

3. Wilkinson L. Epidemiology. Lancet. 2005 Apr 2-8;365(9466):1223. doi: 10.1016/S0140-6736(05)74798-X.

COURSE OUTCOMES:

CO1: Understand the basics of bioseparation methods

CO2: apply different technologies involved in the reduction of bulk quantity after the large-scale process in bioreactor and to remove specific impurities

CO3: make rational decisions to achieve the product specifications and enrich target products

CO4: Understand the various purification methods

CO5: Understand the varipus drying and polishing methods

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	L	H	M	L				H	H	L	
CO2	H	L	H	M	L				H	H	L	
CO3	H	L	H	M	L				H	H	L	
CO4	H	L	H	M	L				H	H	L	
CO5	H	L	H	M	L				H	H	L	

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.

LSDX 086	EPIDIOMOLOGY LABORATORY	L	T	P	C
SDG: 3		0	0	4	2

COURSE OBJECTIVES:

COB1: List sources of epidemiologic data and define related measures of morbidity and mortality

COB2: To design disease occurance

COB3: To learn the association and casuality

COB4: To learn the methods in screening disease

COB5: To learn the behavioral epidiomology

PRACTICALS

1. Epidemiology and Data Presentation
2. Descriptive Epidemiology: Patterns of Disease— Person, Place, Time Cross flow filtration
3. Data and Disease Occurrence
4. Association and Causality
5. Analytic Epidemiology: Types of Study Designs
6. Epidemiology and Screening for Disease
7. Infectious Diseases and Outbreak Investigation
8. Social and Behavioral Epidemiology

P – 60; TOTAL HOURS – 60

REFERENCES:

1. Rothman KJ. Epidemiology: An Introduction. New York, NY.
2. Gordis L. Epidemology, 3rd Ed. Philadelphia, PA. Elsevier Saunders: 2004

COURSE OUTCOMES:

CO1: Acquired knowledge for the disease occurance

CO2: Understand the various types of study designs

CO3: Understand the screening for disease

CO4: Understand the infectious diease outbreak

CO5: Understand the Behavioral epidiomology

Board of Studies (BoS) :
8th BoS of SLS held on 5.07.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	L	L				H	M		L
CO2	H	M	M	M	L				H	M		H
CO3	H	M	M	M	L				H	M		H
CO4	H	M	M	L	L				H	M		L
CO5	H	M		M	L				H	M		L

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

SDG 3: Good Health and Well Being

Statement: Good health is essential to sustainable development. The continuing burden of HIV and other infectious diseases, and emerging challenges such as noncommunicable diseases. Universal health coverage will be integral to achieving good health, ending poverty and reducing inequalities. Studying this course is essential to understand the basics of biological and health sciences to pursue research and develop remedies for the diseases.