B.S. Abdur Rahman Crescent Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2016

Curriculum and Syllabi

(Amendments updated upto December 2020)

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 2016
CURRICULUM AND SYLLABI
(Amendments updated upto December 2020)
(For Students Admitted from the year 2017 to 2019)

B.Sc

BIO TECHNOLOGY

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 Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned Institution
- To empower the youth through quality education and to provide professional leadership
- 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

VISION AND MISSION OFTHE DEPARTMENT OF LIFESCIENCES

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

PROGRAMME OUTCOMES:

- Graduates of the course will have strong background in the interface of modern biology and skill based courses and be 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 environments.
- Graduates of the course will have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
- Graduates of the course will function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary 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 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.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE & TECHNOLOGY,

REGULATIONS -2016

FOR

BACHELOR OF ARTS (B.A.) / BACHELOR OF BUSINESS ADMINISTRATION (BBA) / BACHELOR OF COMMERCE (B.Com.) / BACHELOR OF COMPUTER APPLICATIONS (BCA) / BACHELOR OF SCIENCE (B.Sc.)

DEGREE PROGRAMME (Semester Pattern)

(For Candidates admitted from the academic year 2016-2017 onwards)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means Under Graduate Degree Programme (B.A./BBA/BCA/B.Com./B.Sc.).

ii) **"Course"** means a theory or practical subject that is normally studied in a semester.

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

iv) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology.

v) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology.

vi) **"Controller of Examinations"** means the Controller of Examination of B.S. Abdur Rahman Crescent Institute of Science & Technology, who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMME OFFERED, DURATION AND ELIGIBILITY CRITERIA

2.1 U.G. Programmes Offered

Degree	Mode of Study
B.A.	Full Time
BBA	Full Time
B.Com	Full Time
BCA	Full Time
B.Sc.	Full Time

2.2 Duration of the Programme

The duration of the undergraduate program shall be six semesters (three academic years).

2.3 Eligibility Criteria

2.3.1 Students for admission to the first semester of the under graduate degree programme must have passed the Higher Secondary Certificate examination or any other examination of any authority accepted by this Institution 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. Bio Technology	10 +2 (Higher Secondary) with Chemistry as one of the subjects.
4	BBA (Financial Services)	10 +2 (Higher Secondary) with any stream or equivalent
5	BBA (General)	
6	BBA (Entrepreneurship & Family Business)	
7	B.Com. (General)	10 +2 (Higher Secondary) with Mathematics, Physics and Chemistry / Physics, Chemistry, Botany and Zoology /Commerce /Statistics as subjects.
8	B.Com (Accounts and Finance)	
9	B.Com. (Hons.)	
10	B.A. English (Hons.)	10 +2 (Higher Secondary) with any stream or equivalent

2.3.2 Eligibility conditions for admission such as marks obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by this Institution from time to time.

2.4 Streams of Study

Taking into consideration the rapid developments in technology and to cater the needs of the industry, the following programmes are offered

S.No	Program	Streams of Study
1.	**BCA**	i. Specialization in Cloud Technology and Information Security ii. Specialization in Mobile Applications and Information Security iii. Specialization in Data Science iv. Specialization in Multimedia and Web Application Development
2.	**B.Sc.**	i. Computer Science ii. Bio Technology
3.	**BBA**	i. General ii. Financial Services iii. Entrepreneurship & Family Business
4.	**B.Com**	i. General ii. Honors iii. Accounts and Finance
5.	**B.A.**	i. English (Hons.)

3.0 STRUCTURE OF THE PROGRAMME

3.1 The UG Programme consists of the following components as prescribed in the curriculum

- Core Courses
- Allied Courses
- Elective Courses
- Laboratory courses
- Laboratory integrated theory courses
- Value added Courses
- Project Work

3.2 The curricula and syllabi of all UG programmes shall be approved by Board of Studies of the respective department and Academic Council of this Institution.

3.3 Each course is normally assigned certain number of credits :

- One credit for one lecture period per week.
- One credit for one tutorial period per week.
- One credit each for lab sessions/project of two or three periods per week.
- One credit each for value added courses of two or three periods per week.

3.4 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.

3.5 The minimum number of credits to be earned for the successful completion of the program shall be as follows:

S.No.	Programme	Credits
1	BCA	131
2	B.Sc. Computer Science	131
3	B.Sc. Biotechnology	138 - 142
4	BBA (Financial Services)	123 - 132
5	BBA (General)	145 -162
6	BBA (Entrepreneurship & Family Business)	145 -162
7	B.Com. (General)	159
8	B.Com (Accounts and Finance)	165
9	B.Com. (Hons.)	165 -175
10	B.A. English (Hons.)	141

3.6 The students shall normally register all the courses offered by the department in the semester in the respective programme as per the curriculum. However the registration in less number of courses by the students are permitted without affecting the prerequisite conditions after the approval of Head of the Department / Dean of School to give academic flexibility to students.

3.7 Elective courses from the curricula are to be chosen with the approval of the Head of the Department/ Dean of School

4.0 DURATION OF THE PROGRAMME

4.1 The minimum and maximum periods for the completion of the UG programmes are three years (6 semesters) and five years (10 semesters) respectively.

4.2 Each semester shall consist of a minimum of 90 working days.

4.3 Semester end examination will normally follow within a week after the last working day of the semester.

5.0 CLASS ADVISOR AND FACULTY ADVISOR

5.1 Class Advisor

A faculty member will be nominated by the HOD/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.

5.2 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 advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

6.0 COURSE COMMITTEE

Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers 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 of School / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several

departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

7.0 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.

7.1 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
- Faculty members of all 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

7.2 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 nature 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

7.3 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

7.4 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze 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 concerned course coordinator.

8.0 REGISTRATION AND ENROLMENT

8.1 Except for the first semester, every student shall register for the ensuing semester during a specified week before the semester end examination of the ongoing semester. Every student shall submit a completed registration form indicating the list of courses intended to be enrolled during the ensuing semester. Late registration with the approval of the Dean (Academic Affairs) along with a late fee will be permitted up to the last working day of the current semester.

8.2 From the second year onwards, all students shall pay the prescribed fees for the year on or before a specific day at the beginning of the semester confirming the registered courses. Late enrolment along with a late fee will be permitted up to two weeks from the date of commencement of classes. If a student does not enroll, his/her name will be removed from rolls.

8.3 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

8.4 A student should have registered for all preceding semesters before registering for a particular semester.

9.0 COURSE CHANGE/ WITHDRAWAL

9.1 Change of a Course

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

9.2 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first 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.

10.0 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first assessment of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 4.1).If any student is debarred for want of attendance or suspended due to any act of indiscipline, it will not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only.

11.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

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

Type of Assessment	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 Exam	Full course	3 hours	50%

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

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

11.4 Every practical course will have 60% weightage for continuous assessments and 40% for semester end examination. However a student should secure a minimum of 50% of the marks in the semester end practical examination.

11.5 For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical

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

11.6 In the case of Industrial training /Internship, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the Department/ Dean of School. The weightage for report shall be 60% and 40% for Viva Voce examination.

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

11.8 Assessment of seminars and comprehension will be carried out by a committee of faculty members constituted by the Head of the Department/ Dean of School.

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

12.0 SUBSTITUTE EXAMINATIONS

12.1 A student who has missed, for genuine reasons, a maximum of one of the two continuous assessments of a course may be permitted to write a substitute examination paying the prescribed substitute examination fees. However, permission to write 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 Dean of School for that purpose. However there is no Substitute Examination for Semester End examination.

12.2 A student who misses any continuous assessment test in a course shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of missed assessment test. However the Substitute Examination will be conducted after the last working day of the semester and before Semester End Examination.

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% (for genuine reasons such as medical grounds or representing the Institution in approved events etc.) 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. For the courses in which "I" grade is awarded, the student shall register and repeat the course when it is offered next.

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

13.3 A student who has obtained 'I' grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall repeat all the courses of the semester in the subsequent academic year.

13.4 A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" 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 School.

13.5 A student who is awarded "U" grade in a course will have the option either to

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 during the redo classes shall be considered for grading along with the marks scored in the semester-end (redo) examination. If any student obtained "U" grade in the redo course, the marks scored in the continuous assessment test (redo) for that course will be considered as internal mark for further appearance of arrear examination.

13.6 If a student with "U" grade, who prefers to redo the course, fails to earn the minimum 75% attendance while redoing that course, then he / she will not be 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 two redo courses per semester in the evening after regular college hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters.

14.2 The Head of the Department, with the approval of Dean Academic Affairs, may arrange for the conduct of a few courses during the evening, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

14.3 The number of contact hours and the assessment procedure for any redo course will be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

15.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course will be made on absolute marks basis. The Class Committee, without the student members, shall meet within 5 days after the semester-end examination and analyze the marks of students in all assessments of a course and award suitable letter grades. 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	0
I	0
AB	0

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from semester-end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester-end examination.

15.2 A student who earns a minimum of five grade points 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 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of Schools and the results shall be declared by the Controller of Examinations.

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 Controller of Examination. Subsequently the Head of the Department/ Dean of 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 member of faculty knowledgeable in that course. 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

will contain the following details:

- credits for each course registered for that semester.
- performance in each course by the letter grade obtained.
- total credits earned in that semester.
- Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

If Ci, is the number of credits assigned for the i^{th} course and GPi is the Grade Point in the i^{th} course, GPA will be calculated according to the formula

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

Where n = number of courses

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

"I" and "W" grades will be excluded for calculating GPA.

"U", "I", "AB" and **"W"** grades will be 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 will be awarded 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 6 semesters.
First Class	6.50 and above, having completed within a period of 8 semesters.
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained 'U' or 'I' grade in any course during his/her study and should have completed the U.G. programme within 6 semesters (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within 8 semesters reckoned from his/her

commencement of study. For this purpose, the authorized break of study will not be counted. The successful students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

16.0 ELECTIVE CHOICE:

16.1 Apart from the various elective courses listed in the curriculum for each programme, the student can choose a maximum of two electives from any stream of the same program during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

16.2 Online / Self Study Courses

Students are permitted to undergo department approved online/ self study courses not exceeding a total of six credits 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. In case of credits earned through online mode ratified by the respective Board of Studies, the credits may be transferred following the due approval procedures. The students shall undergo self study courses on their own with the mentoring of a member of the faculty. The online/ self study courses can be considered in lieu of elective courses.

17.0 SUPPLEMENTARY EXAMINATION

Final Year 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.

18.0 PERSONALITY AND CHARACTER DEVELOPMENT

18.1 All students shall enroll, on admission, in any of the personality and character development programmes, NCC / NSS / NSO / YRC / Rotaract and undergo

practical training.

- **National Cadet Corps (NCC)** will have to undergo specified number of parades.
- **National Service Scheme (NSS)** will have social service activities in and around Chennai.
- **National Sports Organization (NSO)** will have sports, games, drills and physical exercises.
- **Youth Red Cross (YRC)** will have social service activities in and around Chennai.
- **Rotaract** will have social service activities in and around Chennai.

19.0 DISCIPLINE

19.1 Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to affect the prestige of the Institution.

19.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean will be referred to a Discipline and Welfare Committee nominated by the Vice-Chancellor, for taking appropriate action.

20.0 ELIGIBILITY FOR THE AWARD OF DEGREE

20.1 A student shall be declared to be eligible for the award of 3 year Bachelor provided the student has:

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 10 semesters. from the date of admission, including break of study

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him/her.

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

21.0 POWER TO MODIFY

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

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

B.Sc Bio Technology

CURRICULUM & SYLLABUS, REGULATIONS 2016

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1	AEC	LNC 1184	Tamil – I	4	1	0	4	
2	AEC	ENC 1182	General English – I	4	1	0	4	
3	PC	LSC 1101	Cell Biology	4	0	0	4	
4	PC	LSC 1102	Cell Biology Lab	0	0	3	2	
5	PC	LSC 1103	Microbiology	4	0	0	4	
6	PC	LSC 1104	Microbiology Lab	0	0	3	2	
7	PC	CHB 1182	Chemistry	3	0	0	3	
8	AEC	ENC 1183	Communication Skills	2	0	0	2	**25**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1	AEC	ENC 1283	English - II	4	1	0	4	
2	AEC	LNC 1284	Tamil – II	4	1	0	4	
3	PC	LSC 1201	Molecular Biology	4	0	0	4	
4	PC	LSC 1202	Molecular Biology Lab	0	0	3	2	
5	PC	LSC 1203	Bioinstrumentation	4	0	0	4	
6	PC	LSC 1204	Bioinstrumentation Lab	0	0	3	2	
7	AC	LSC 1205	Basics of Computers	4	0	0	4	
8	AEC	LSC 1206	Confidence building behavioural skills	2	0	0	2	**26**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1	PC	LSC 2101	Biochemistry	3	2	0	4	
2	PC	LSC 2102	Biochemistry Lab	0	0	3	2	
3	PC	LSC 2103	Basics of Genetics	4	0	0	4	
4	PC	LSC 2104	Basics of Genetics Lab	0	0	3	2	
5	AC	LSC 2105	Biostatistics	3	2	0	4	
6	GE		Skill Based Electives - I	3	0	0	3	
7	PE		Open Elective -I	4	0	0	4	
8	AEC	LSC 2106	Quantitative Aptitude & Reasoning -I	2	0	0	2	**25**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1	PC	LSC 2201	Bioprocess Technology	3	2	0	4	
2	PC	LSC 2202	Enzymology	3	2	0	4	
3	PC	LSC 2203	Bioprocess Technology Lab	0	0	3	2	
4	PC	LSC 2204	Enzymology Lab	0	0	3	2	
5	AC	LSC 2205	Biophysics	3	2	0	4	
6	GE		Skill Based Electives - II	3	0	0	3	
7	PE		Open Elective -II	4	0	0	4	
8	AEC	LSC2206	Quantitative Aptitude & Reasoning -II	2	0	0	2	**23**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1	PC	LSC 3101	Plant Biotechnology	4	1	0	4	
2	PC	LSC 3102	Animal Biotechnology	4	1	0	4	
3	PC	LSC 3103	Plant Biotechnology Lab	0	0	3	2	
4	PC	LSC 3104	Animal Biotechnology Lab	0	0	3	2	
5	PE		Core Elective -I	4	1	0	4	
6	PE		Core Elective -II	4	1	0	4	
7	GE	LSC3105	Environmental Science	3	0	0	3	**23**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1	PC	LSC 3201	Immunotechnology	4	1	0	4	
2	PC	LSC 3202	Genomics and Proteomics	4	1	0	4	
3	PC	LSC 3203	Immunology Lab	0	0	3	2	
4	PC	LSC 3204	Genomics and Proteomics lab	0	0	3	2	
5	PE		Core Elective -III	4	1	0	4	
6	PE		Core Elective -IV	4	0	0	4	
7		LSC 3205	Mini Project (Review/Research)	0	0	5	3	**23**

Total Credits: 145 Credits

LIST OF PROGRAMME ELECTIVES

SKILL BASED ELECTIVES (ODD SEM)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	GE	LSCX 102	Cytogenetics	3	0	0	3
2.	GE	LSCX 103	Biofertilizer Technology	3	0	0	3

SKILL BASED ELECTIVES (EVEN SEM)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	GE	LSCX 201	Agricultural Biotechnology	3	0	0	3
2.	GE	LSCX 202	Herbal Technology	3	0	0	3
3.	GE	LSCX 203	Disease Management	3	0	0	3

CORE ELECTIVES (ODD SEM)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	LSCX 111	Human physiology	4	0	0	4
2.	PE	LSCX 112	Medical Biotechnology	4	0	0	4
3.	PE	LSCX 113	Bioinformatics	4	0	0	4
4.	PE	LSCX 114	Bioethics, IPR and Biosafety	4	0	0	4
5.	PE	LSCX 115	Environmental Biotechnology	4	0	0	4

CORE ELECTIVES (EVEN SEM)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	LSCX 211	Nanobiotechonology	4	0	0	4
2.	PE	LSCX 212	Cancer Biology	4	0	0	4
3.	PE	LSCX 213	Pharmacology	4	0	0	4
4.	PE	LSCX 214	Regenerative Medicine	4	0	0	4
5.	PE	LSCX 215	rDNA Technology	4	0	0	4

OPEN ELECTIVES (ODD SEM)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OE	LSCX 121	Industrial Biotechnology	3	0	0	3
2.	OE	LSCX 122	Pharmaceutical Biotechnology	3	0	0	3

OPEN ELECTIVES (EVEN SEM)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	OE	LSCX 221	Fermentation Technology	3	0	0	3
2	OE	LSCX 222	Healthcare Biotechnology	3	0	0	3
3	OE	LSCX 223	Drug Design and Development	3	0	0	3
4	OE	LSCX 224	Food Biotechnology	3	0	0	3

SEMESTER I

LNC 1184	பொதுத் தமிழ் I / GENERAL TAMIL I	L	T	P	C
		3	1	0	3

OBJECTIVES:

- சமூக மாற்றச் சிந்தனைகளை உள்ளடக்கிய தற்கால இலக்கியங்களை அறிமுகம் செய்தல்
- புதுக்கவிதை, சிறுகதை, உரைநடை ஆகிய இலக்கியங்களின் நயம் பாராட்டுதல்
- சந்திப் பிழையின்றி எழுத மாணவர்களைப் பயிற்றுவித்தல்

MODULE I	இருபதாம் நூற்றாண்டு மரபுக்கவிதைகள்	8

மனோன்மணியம் சுந்தரனார் - தமிழ்த்தாய் வாழ்த்து, பாரதியார் - யோக சித்தி, பாரதிதாசன் - நீங்களே சொல்லுங்கள், கண்ணதாசன் - காலக்கணிதம்

MODULE II	புதுக்கவிதைகள்	8

இன்குலாப் - போராட்டம், அப்துல் ரகுமான் - முதுமை, வைரமுத்து - அந்தி, நா.காமராசன் - அலிகள், தாமரை - ஒரு கதவும் கொஞ்சம் கள்ளிப்பாலும், மேத்தா – தேசப்பிதாவுக்கு ஒரு தெருப்பாடகன் அஞ்சலி, ஹைக்கூ கவிதைகள்

MODULE III	சிறுகதைகள்	8

பி.எஸ்.ராமையா - பணம் பிழைத்தது, ஜெயகாந்தன் - பால்வடியும் முகம், கி.இராஜநாராயணன் - நாற்காலி, சு.சமுத்திரம் - காகித உறவு, மாதவிக்குட்டி - நெய்ப்பாயாசம், தி.ஜானகிராமன் - முள்முடி

MODULE IV	மொழிப்பயிற்சி	7

கலைச்சொல்லாக்கம், பிழை திருத்தம் (ஒருமை, பன்மை, ல-ள-ழகர, ர-றகர, ண-ந-னகர வேறுபாடுகள்), அயற்சொற்களைதல்

MODULE V	இலக்கிய வரலாறு	7

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

MODULE VI	படைப்பிலக்கியம்	7

கவிதை எழுதுதல், சிறுகதை வரைதல்

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:

1. பொதுத்தமிழ் - செய்யுள்திரட்டு - தமிழ்த்துறை வெளியீடு
2. தமிழ் இலக்கிய வரலாறு - சோம. இளவரசு
3. சிறுகதைத் தொகுப்பு (கட்டுரைக்களஞ்சியம்)

OUTCOMES:

1. மாணவர்கள் சமூக மாற்றச் சிந்தனைகளை அறிந்துகொள்வர்
2. சந்திப்பிழைகளை நீக்கி எழுதும் திறன் பெறுவர்
3. புத்திலக்கியங்களைப் படைக்கும் திறனையும் திறனாய்வு செய்யும் திறனையும் பெறுவர்

ENC1181	GENERAL ENGLISH – I	L	T	P	C
		4	1	0	4

OBJECTIVES:

- To help the students acquire efficiency in Spoken English through role plays.
- To enable them to make Presentation effectively.
- To develop reading skills among students through extensive readers.
- To orient them in writing letters.
- To train them in appreciating and interpreting English literature.

MODULE I **8**

Oral and Written Communication – implications in real life and workplace situations Essential English Grammar - 1-6 units

MODULE II **8**

One–minute Presentations (JAM) on concrete and abstract topics that test their creative thinking (ii) Prepared p and extempore presentations
Short Story; O Henry - “Robe of Peace” (Extensive Reading)

MODULE III **8**

Role-Play – establishing a point of view - convincing someone on social issues such as preservation of water, fuel, protection of environment, gender discrimination.
Poetry: William Shakespeare - “All the World’s a Stage”

MODULE IV **7**

Letter Writing- Letter of Invitation & Permission Developing story from hints- Short Story: John Galsworthy - “Quality” (Extensive Reading)

MODULE V **14**

Précis Writing- Writing instructions and recommendations Reading Comprehension: Short Story**--**Rudyard Kipling – “The Miracle of Puran Bhagat”(Extensive Reading) Written correspondence - - e-mail writing Prose : Education, Employment, Unemployment

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:

1. Anderson, Kenneth & et.al. “Study Speaking : A Course in Spoken English for Academic Purposes” (Second Edition). Cambridge University Press, UK. 2004.
2. Sharma, R.C. & Krishna Mohan, “Business Correspondence and Report

Writing".
3. Tata MacGraw – Hill Publishing Company Limited, New Delhi. 2002
4. Hurlock, B. Elizabeth "Personality Development". Tata McGraw Hill, New York, 2004.
5. Krishnaswamy. N, Sriraman T. Current English for Colleges. Hyderabad: Macmillan Indian Ltd, 2006.
6. Dahiya SPS. Ed. Vision in Verse- An Anthology of Poems. New Delhi: Oxford University Press, 2002
7. Murphy, Raymond. Essential English Grammar. New Delhi: Cambridge University Press, 2009.
8. Seshadri, K G Ed. Stories for Colleges. Chennai: Macmillan India Ltd, 2003.

OUTCOMES:

Students would be able to

- Actively take part in role plays
- Make effective presentation s
- Read and comprehend various texts.
- Write letters without making mistakes.
- Analyse literary texts.

LSC 1101	CELL BIOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To get overview of classes of cells and structural and function aspects of membrane structure and functions.
- To develop a detailed knowledge of cell organelle.
- To develop skill to understand Cell division.
- To understand tissue organization and stem cells.

MODULE I INTRODUCTION TO CELL **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 SIGNALLING **12**

Principles of cell signaling, cell surface receptors, ion channel coupled receptors, G-protein coupled receptors, GPCRs, cAMP signaling pathway, Calcium signaling 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 non

disjunction.

TOTAL HOURS – 60

REFERENCES:

1. Essential Cell Biology by Albert et.al. John Wiley & Sons, 4Ed, 2015
2. The Cell by Cooper. ASM Press, 4Ed, 2007
3. Cell and Molecular Biology by Karp. John Wiley & Sons, 7Ed, 2013

OUTCOMES:

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

- Define components of a cell
- Understand cellular structure and functions
- Understand the mechanisms of Cell cycle control and cell division

LSC 1102	CELL BIOLOGY LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

The students should be able to

1. Understand explicitly the concepts
2. Develop their skills in the preparation and identification of cell structures and their functions

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

TOTAL HOURS - 45

REFERENCES:

Laboratory Manual

OUTCOMES:

Students will learn about

- Basic methods in cell biology
- Characterization and structure of cell isolated from various sources

LSC 1103	MICROBIOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To offer a sense of the history of microbial science, its methodology and its many contributions to humanity
- To ensures the students to understand about the microbiology and diseases.

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.

TOTAL HOURS – 60

REFERENCES:

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

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

OUTCOMES:

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

• 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

• demonstrate proficiency in a set of core microbiological and molecular biologicaltechnical methods, including both an understanding of the principles of the methods and their utilisation in laboratory settings

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

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

• communicate microbiological principles and information effectively to diverse audiences, using a variety of formats

LSC 1104	MICROBIOLOGY LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner. The students should be able to

• Understand explicitly the concepts

• Develop their skills in the preparation, identification and quantification of Microorganisms

LIST OF EXPRIMENTS

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

TOTAL HOURS – 45

REFERENCES:

Laboratory Manual

OUTCOMES:

Students will learn about

Basic methods in microbiology

Characterization and isolation of bacteria isolated from various sources

Growth kinetics of Bacteria

CHB 1182	CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water used for domestic and industrial purpose and treatment process involved.
- the synthesis, properties and applications of nanomaterials.
- the importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean and their limitations.
- the basic analytical techniques like UV-Visible, FT-IR, NMR, AAS, AES, Circular Dichroism and XRD etc.
- photochemistry concepts related to physical processes and chemical reactions induced by photon absorption and their applications.
- basic principles of electrochemistry, cell construction and evaluation and to understand general methodologies for construction & design of electrochemical cell

MODULE I WATER TECHNOLOGY **8**

Impurities present in water, hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment method: – lime soda and zeolite process (principle only), Ion exchange process – Internal treatment : colloidal, carbonate, phosphate and calgon methods – drinking water: standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration, disinfection }– desalination: electrodialysis, reverse osmosis.

MODULE II NANOCHEMISTRY **8**

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis (top-down and bottom-up approach} : sol-gel, thermolysis (hydrothermal and solvothermal), electrodeposition, chemical vapour deposition, laser ablation – properties and applications (electronic, magnetic and catalytic) – risk factors and future perspectives.

MODULE III ENERGY SOURCES **8**

Energy: past, today, and future – a brief history of energy consumption – present energy scenario of conventional and renewable energy sources – renewable energy : needs of renewable energy, advantages and limitations of renewable energy – solar energy: basics, solar energy in the past , photovoltaic, advantages and disadvantages – bioenergy: conversion, bio degradation, biogas generation, biomass gasifier, factors affecting biogas

generation, advantages and disadvantages – geothermal energy: geothermal resources (hot dry rock and magma resources, natural and artificial), advantages and disadvantages – wind energy: wind resources, wind turbines, advantages and disadvantages – ocean energy: wave energy, wave energy conversion devices, ocean thermal energy, advantages and disadvantages.

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission, chromophores, auxochromes – laws of photochemistry : Grotthus-Draper law, Stark Einstein law – quantum yield (problems) – photo physical processes : fluorescence and phosphorescence - Jablonski diagram (electronic states and transitions) – quenching, annihilation – photosensitization: principle and applications – chemiluminescence, bioluminescence.

MODULE V ELECTROCHEMISTRY 7

Electrochemistry - types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode and fluoride ion selective electrode) – Electrolytic and galvanic cells, construction of cell, EMF measurement and applications (problems), standard cell (Weston-cadmium), reversible and irreversible cell, concentration cell. Determination of fluoride ion using fluoride ion selective electrode – Chemically modified electrodes (CMEs) : concept, approaches and applications.

TOTAL HOURS – 45

REFERENCES:

1. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India Ltd., New Delhi, 2011.
2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi, 2014.
5. G.D.Rai, “Non conventional energy sources,” Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, “Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES:

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and

describe the treatment processes.

- classify nanomaterials and apply the nanochemistry approach to synthesize the nanomaterials.
- explain the principle and enumerate the advantages and disadvantages of various renewable energy sources.
- state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- construct a electrochemical cell and describe the various types of electrodes and determine the fluoride content.

ENC 1183	COMMUNICATION SKILLS	L	T	P	C
		2	0	0	2

OBJECTIVES:

• To help the students acquire efficiency in Spoken English with due importance to Stress, Accent and Pronunciation

• To enable them to make Presentation effectively

• To prepare them for Interviews and Group Discussions

• To train them in writing official letters , resume'writing and reports.

MODULE I **8**

Theory: Oral and Written Communication – implications in real life and workplace situations

Lab: Listening to ESL Podcast- Viewing Multimedia- Listening to BBC News- Received Pronunciation (RP/VOA/NDTV) – exposure to paralinguistic features.

MODULE II **8**

Theory:

(i) One–minute Presentations (JAM) on concrete and abstract topics that test their creative thinking

(ii) Prepared presentations and extempore presentations

Lab: viewing Presentation Tips, Interviews Skills

(iii) Group project – presentation on any social issue. The group will have to research on the history of the problem, its cause, impact and outcome hoped for and then make a presentation

MODULE III **8**

Theory: Developing persuasive skills – establishing a point of view – convincing some one on social issues such as preservation of water, fuel, protection of environment, gender discrimination.

Lab: Negotiating Skills, Expressing Opinion

MODULE IV **8**

Theory: Brainstorming – Think, pair and share activity – Discussion etiquette

63 – Assigning different roles in a GD (Note-taker, Manager, Leader and Reporter)

Lab: Viewing Group Discussion

MODULE V **13**

Theory: Written correspondence - Letter of Application and CV - e-mail writing - writing instructions and recommendations – Lab reports

Lab: Resume' writing – viewing different types – Functional, Chronological- Writing one's resume using wiki, viewing e-mail etiquette, format and style.

Theory: Technical Writing –Writing a technical Proposal – format- cover page, executive summary, time line chart, budget estimate, drafting, conclusion.

TOTAL HOURS – 45

REFERENCES:

1. Anderson, Kenneth & et.al. "Study Speaking : A Course in Spoken English for Academic Purposes" (Second Edition). Cambridge University Press, UK. 2004.

2. Sharma, R.C. & Krishna Mohan, "Business Correspondence and Report Writing". Tata MacGraw – Hill Publishing Company Limited, New Delhi. 2002.

3. Hurlock, B. Elizabeth. "Personality Development". Tata McGraw Hill, New York. 2004.

4. M. Ashraf Rizvi 'Effective Technical Communication". Tata McGraw – Hill Education, 2005.

5. 6.Gerson, Sharon & Steven M. Gerson, " Technical Writing : Process and Product" Pearson Education, New Delhi, 2004.

6. Riordan & Pauley. 'Report Writing Today'. 9th Edition. Wadsworth Cengage Learning, USA. 2005.

OUTCOMES:

On completion of the course, the students will have the ability to speak effectively and write official letters, reports and proposals.

SEMESTER II

ENC 1282	**GENERAL ENGLISH II**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**3**

OBJECTIVES:

- To prepare students for Interviews and Group Discussions
- To train them in writing official letters , resume' writing and reports.
- To train them in analysing different genre of literature.

MODULE 1 **7**

Filling Money Order Challan and Bank Challan Short Story :G.K.Chesterton – The Hammer of God (Extensive Reading) Essential English Grammar – 7-12 units

MODULE 2 **8**

Brainstorming – Think, pair and share activity Poetry : Walt Whitman- I Celebrate Myself

MODULE 3 **8**

Dialogue Writing- Discussion etiquette -Assigning different roles in a GD (Note-taker, Manager, Leader and Reporter) Prose: Environment

MODULE 4 **8**

Interview skills- SWOT Analysis Letter Writing- Letter to the Editor- Letter of Application and CV

MODULE 5 **8**

Report Writing- feasibility report and survey report Short Story : Katherine Mansfield—A Cup of Tea (Extensive Reading)

MODULE 6 **6**

Technical reports –Writing a technical report – format and content

TOTAL HOURS – 45

1. M. Ashraf Rizvi ‘Effective Technical Communication”. Tata McGraw – Hill Education, 2005. Gerson, Sharon & Steven M. Gerson, “ Technical Writing : Process and Product”
2. Pearson Education, New Delhi, 2004. 6. Riordan & Pauley. ‘Report Writing Today’. 9th Edition. Wadsworth Cengage Learning, USA. 2005.
3. Krishnaswamy. N, Sriraman T. Current English for Colleges. Hyderabad: Macmillan Indian Ltd, 2006.
4. Dahiya SPS. Ed. Vision in Verse- An Anthology of Poems. New Delhi: Oxford University Press, 2002.
5. Murphy, Raymond. Essential English Grammar. New Delhi: Cambridge University Press, 2009.
6. Seshadri, K G Ed. Stories for Colleges. Chennai: Macmillan India Ltd, 2003.

OUTCOMES:

After completing the course the students would be able to

- Take part in group discussions and interviews with confidence.
- Write official letters, their application letter with CV and reports.
- Analyse various genre of literature.

LNC 1284	TAMIL II	L	T	P	C
		3	1	0	3

OBJECTIVES:

- r%f khw;wr; rpe;jidfis cs;slf;fpa jw;fhy ,yf;fpaq;fis mwpKfk; nra;jy;
- GJf;ftpij> rpWfij> ciueil Mfpa ,yf;fpaq;fspd; eak; ghuhl;Ljy;
- re;jpg; gpioapd;wp vOj khzth;fisg; gapw;Wtpj;jy;

MODULE I **mw ,yf;fpaq;fs**; **8**

jpUf;Fws; - nrhy;td;ik (65Mk; mjpfhuk;)> ehybahh; - mitawpjy; (5 ghly;fs; -32Mk; mjpfhuk;)> gonkhop ehD}W - ,d;dh nra;ahik (5 ghly;fs;)> ,dpait ehw;gJ - Kjiye;J ghly;fs;

MODULE II **gf;jp ,yf;fpaq;fs**; **8**

Njthuk; - %th; Njthuk; (15 ghly;fs;) mg;gh; Njthuk;> jpUQhdrk;ge;jh; Njthuk;> Re;juh; Njthuk; (xt;nthd;wpypUe;Jk; Ie;J ghly;fs;)> fhiuf;fhyk;ikahh; - %d;W ghly;fs; (mw;Gjj; jpUte;jhjp)> khzpf;f thrfh; - jpUntk;ghit (Njh;e;njLf;fg;ngw;w 5 ghly;fs;)> Mz;lhs; - jpUg;ghit (Njh;e;njLf;fg;ngw;w 5 ghly;fs;)> FyNrfuho;thh; - jpUNtq;flj;jpy; gpwj;jYk; ,Uj;jYk; NghJnkdy; (11 ghRuk;)

MODULE III **fhg;gpaq;fs;** **8**

kzpNkfiy - Mjpiu gpr;irapl;l fhij (20 mbfs; kl;Lk;)> fk;guhkhazk; - ghyfhz;lk;> ehl;Lg;glyfk; (10 ghly;fs; kl;Lk;)> ,ul;rzpa ahj;hpfk; - rpYitg;ghL (10 ghly;fs;)> rPwh Guhzk; - khDf;Fg; gpizepd;w glyk; (6 ghly;fs;)

MODULE IV **fl;Liufs**; **7**

c.Nt.rhkpehijah;-jkpo;ehl;L tzpfh;. t.,uhkrhkp Iaq;fhh;-%jwpQh; ,uh[Nfhghyhr;rhhpahh;> kh.,uhrkhzpf;fdhh;-rpj;jd;dthry; Xtpaq;fs;> gp.vy;.rhkp-rq;f ,yf;fpaj;jpy; mwptay; fiy> f.ifyhrgjp - ghujpAk; Nkdhl;Lf; ftpQUk;> njh. gukrptd; - nrhy;Yk; nghUSk;.

MODULE V **,yf;fpa tuyhW** **7**

mw ,yf;fpaq;fspd; Njhw;wKk; tsh;r;rpAk;> irt itzt ,yf;fpaq;fs; Njhw;wKk; tsh;r;rpAk;> fhg;gpaq;fs; Njhw;wKk; tsh;r;rpAk;> ciueil Njhw;wKk; tsh;r;rpAk;

MODULE VI nkhopg;gapw;rp 7

,yf;fzf; FWpg;Gj; jUjy;> ty;ypdk; kpFkplq;fSk;> kpfhtplq;fSk;> nkhopngah;g;G (Mq;fpyj;jpypUe;J jkpopy; ngah;j;jy;)> fbjq;fSk; tiffSk;

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:

1. nghJj;jkpo; - nra;As;jpul;L - jkpo;j;Jiw ntspaPL
2. jkpo; ,yf;fpa tuyhW - Nrhk. ,stuR
3. rpWfijj; njhFg;G (fl;Liuf;fsQ;rpak;)

OUTCOMES:

- khzth;fs; r%f khw;wr; rpe;jidfis mwpe;Jnfhs;th;
- re;jpg;gpiofis ePf;fp vOJk; jpwd; ngWth;
- Gj;jpyf;fpaq;fisg; gilf;Fk; jpwidAk; jpwdha;T nra;Ak; jpwidAk; ngWth;

LSC 1201	MOLECULAR BIOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations

MODULE I DNA REPLICATION **12**

Semiconservative mode of replication, Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA replication

MODULE II DNA DAMAGE AND REPAIR **12**

Chemical modifications of DNA, Ionizing radiations and DNA damage, DNA double strand breaks, DNA damage repair, 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.

MODULE IV TRANSCRIPTION MODIFICATIONS IN RNA **12**

5'-cap formation, transcription termination, 3 '-end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA and mRNA stability.

MODULE V TRANSLATION **12**

Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation

TOTAL HOURS –60

REFERENCES:

1. Molecular Biology of the Gene. James D Watson, 7Ed. Cold Spring Harbor Laboratory Press. 2014
2. Molecular Biology. Robert F Weaver, 5Ed, McGraw Hill, 2013
3. Molecular Biotechnology. Glick and Pasternak, 4Ed, ASM Press, 2010.

OUTCOMES:

Through completion of this course, the student will achieve,

- A basic understanding of the central dogma of molecular biology
- An exposure to the modern day techniques employed to study DNA and hence gene functions

LSC 1202	MOLECULAR BIOLOGY LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

- To learn basic techniques in molecular biology
- To study and to differentiated the electrochemical properties of nucleic acids

LIST OF EXPERIMENTS

1. Agarose gel electrophoresis of chromosomal & plasmid DNA
2. Extraction of genomic DNA from bacteria
3. Extraction of plasmid DNA from bacteria
4. Isolation of RNA from bacteria
5. Isolation of DNA fragment from agarose gel

TOTAL HOURS –45

REFERENCES:

1. Michel R. G and Sambrook J. Molecular Coning- A laboratory manual. Cold spring harbor laboratory press, 2012.

OUTCOMES:

On the completion of the above experiments students will be able to handle DNA samples and also to isolate, purify and visualize nucleic acid.

LSC 1203 BIOINSTRUMENTATION

L	T	P	C
4	0	0	4

OBJECTIVES:

The students will be exposed to basic concepts related with techniques and instrumentation widely used in Biotechnology.

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**

Principle of centrifugation, rotors, different types of centrifuges, preparative and analytical centrifugation, ultra centrifugation. Optical microscopy, Bright field, Dark field, phase contrast and fluorescence microscopy. Electron microscopy: Transmission and scanning electron microscopy, Atomic force microscopy.

MODULE III ELECTROPHORESIS **12**

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

MODULE IV RADIOISOTOPE TECHNIQUES **12**

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

MODULE V CHROMATOGRAPHY **9**

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. Permeation.

TOTAL HOURS – 60

REFERENCES:

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

OUTCOMES:

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in instrumentation used in Biotechnology.

LSC 1204	BIOINSTRUMENTATION LABORATORY	L	T	P	C
		0	0	3	2

OBJECTIVES:

- Provides an opportunity to experimentally verify the theoretical concepts of bioenergetics and protein engineering already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

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 – measurement using colorimetric and fluorimetric methods.
3. Differential estimations of carbohydrates – reducing vs non-reducing, polymeric vs oligomeric, hexose vs pentose
4. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect
5. Separation of lipids by TLC.
6. Enzyme Kinetics: Direct and indirect assays – determination of K_m, V_{max} and
7. Restriction enzyme – Enrichment and Module calculation
8. Ion-exchange Chromatagraphy – Purification of IgG and Albumin
9. Gel filtration – Size based separation of proteins
10. SDS-PAGE Gel Electrophoresis

TOTAL HOURS – 45

REFERENCES:

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

2. Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Edition, Irwin H. Segel, 1976 John Wiley & Sons Publishers, Inc,

3. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.

OUTCOMES:

On the completion of the above objectives student will be able to perform biochemical assays, electrochemical techniques, spectrophotometry and chromatography.

LSC 1205 BASICS OF COMPUTERS

L	T	P	C
3	1	0	4

OBJECTIVES:

To know about computer and to operate the computer.
To familiarize the office suite.

MODULE I INTRODUCTION TO COMPUTER **12**

What is Computer – Evolution – Basic Components – Memory – Software Components - Input / Output Devices - External Storage Devices – Personal Computer – Work Station - Mainframes.

MODULE II MS - WORD **12**

Introduction – User Interface – Themes and Quick Styles - Server Components Word Basics: Parts of Word Window – Formatting Features – Menus, Commands, Toolbars and their Icons – MS Word menus in focus - Word Exercise I – Word Exercise II.

MODULE III MS-EXCEL **12**

Introduction – Entering and Editing Text - Menus, Commands and Toolbars – MS Excel Menus in Focus - Excel Exercise-I – Alternate method - Entering formulas – Formatting Cells, Date Range – Inserting Headers & Footers – Saving a file and opening a file.

MODULE IV MS-POWER POINT **12**

Creating a new presentation and new slide– Opening a presentation – Deleting a slide, Copying a slide – Numbering the Slides – Saving a presentation – Changing the default directory – Printing a presentation – Working with Power Point – MS Power Point Menus in focus – Formatting in Power Point.

MODULE V MS-ACCESS **12**

Parts of an Access Window – MS Access Menus in Focus – Starting Microsoft Access – Creating a New Database – Creating Table using Table Wizard – Saving the Database - Creating Tables in design view – Query – Forms – Reports.

TOTAL HOURS – 60

REFERENCES:

1. Sanjay Saxena, “MS Office for Everyone”, Vikas Publishing House Pvt. Ltd., New Delhi, 2010, Reprinted 2010,.
2. Sinha P.K., “Computer Fundamentals”, BPB Publications, 6th Edition, New

Delhi, 2004.

OUTCOMES:

On the completion of the above objectives student will be able to operate the computer.

LSC1206	CONFIDENCE BUILDING BEHAVIOURAL SKILLS	L	T	P	C
		2	0	0	2

OBJECTIVES:

To enable the students to develop communication skills for verbal communication in the work place.

MODULE I **8**

This course is practical oriented one and exercises will be given to the students group users /individually depending upon the aspect considered. The following aspect will form the broad outline content of the syllabi. The exercises will be designed by the faculty member and coordinated by the overall course coordinator.

LAB ACTIVITIES:

- Introduction: Soft skills definition, examples
- Verbal communication: Case study, communication and discussion
- Prepared speech
- Impromptu speech
- Debate: Case studies - Attitude and Behavior: role play and exploration
- Ability to ask for help – communication and team work
- Manners and etiquette
- Organization and Planning
- Time keeping
- Conduct in workplace
- Conscientiousness
- Work output
- Professionalism
- Motivation
- Ownership of tasks
- Adaptability/flexibility

ASSESSMENT:

The assessment will be continuous and portfolio based. The students must produce the record of the work done through the course of the semester in the individual classes. The portfolio may consist of a) the individual task outline and activities, b) worked out activities c) Pre-designed sheets which may be provided by the Faculty member. The portfolio will be used by the Faculty member for

assessment. The course coordinator in consultation with the course committee shall decide at the beginning of the semester, the number of exercises, method of assessment of each and the weightage for the end semester assessment.

TOTAL HOURS – 45

OUTCOMES:

The students should be able to:

- develop verbal communication skills
- debate with other students confidently
- communicate effectively their ideas

SEMESTER III

LSC2101	BIOCHEMISTRY	L	T	P	C
		3	2	0	3

OBJECTIVES:

The course aims to

- provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis,
- enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.
- Help students to understand concepts related to metabolism
- Provide knowledge to the defects related to metabolic disorders

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 FUNCTION OF CARBOHYDRATES AND PROTEINS 12

Classification, structure, function, chemical and physical properties of mono di and polysaccharides. Primary, secondary and tertiary structure of proteins, Ramachandran plot, Function of proteins.

MODULE III CARBOHYDRATE METABOLISM 12

Carbohydrate metabolism: Embden-Meyerhof pathway , regulation of glycolysis, fermentation, anaerobic fate of pyruvate, pentose phosphate pathway, citric acid cycle, regulation of citric acid cycle, gluconeogenic pathway, control of gluconeogenesis, glycogen metabolism (glycogenolysis and glycogenesis), regulation of glycogen metabolism, electron transport chain system

MODULE IV AMINO ACIDS AND PROTEIN METABOLISM 12

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 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY, 9th Edition, 2019
2. Biochemistry by Lehninger. McMillan publishers, 7th Edition, 2017

Biochemistry by Zubey. Wm. C. Brown publishers, 3rd Edition, 1993

OUTCOMES:

At the end of the course students will be able to

- 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
- demonstrate knowledge of key facets of modern biochemistry including: proteins and structural biology, bioinformatics, advanced molecular biology, cell organisation, signal transduction and its role in diseases such as cancer; and the identification of drug targets
- demonstrate proficiency in core biochemical laboratory techniques, understanding both the principles and applications of these methods within the molecular biosciences
- demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment
- collect, organise, analyse, evaluate and interpret biochemical data using appropriate quantitative, technological and critical thinking skills

LSC 2102	BIOCHEMISTRY LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

- 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. The students should be able to understand and develop their skills in
- Accuracy and Precession of analysis
- Qualitative testing of Carbohydrates
- Identification of amino acids and proteins
- Quantitative analysis of nucleic acids and enzymes.

LIST OF EXPERIMENTS

1. Introductory class for biochemistry lab instrumentations.
2. pH measurements and preparation of buffers.
3. Qualitative tests for Carbohydrates.
4. Estimation of sugars.
5. Estimation of proteins by Lowry's method / Biuret method.
6. Estimation of cholesterol by Zak's method.
7. Determination of saponification number of lipids.
8. Separation of amino acids - Thin layer chromatography.
9. Separation of sugars - Paper chromatography
10. Biochemical estimation of DNA /RNA using Spectrophotometer

L – 00; P – 45; TOTAL HOURS – 45

REFERENCES:

Laboratory Manual

OUTCOMES:

Students will learn

- about the biomolecules,
- estimation of biomolecules and
- analytical techniques including spectrophotometer and chromatography

LSC 2103	BASICS OF GENETICS	L	T	P	C
		4	0	0	4

OBJECTIVES:

1. Introduction to the subject and few fundamental works on genetics
2. Interactions and structural organization of genes and chromosome
3. Significance of mutation and repetitive sequences
4. Genetic linkage analysis, sex determination and mapping techniques
5. Population genetics and evolutionary genetics

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

MODULE IV SEX DETERMINATION AND SEX LINKAGE 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 extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). 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.

OUTCOMES:

Students will be able to understand

- basic concept of genetics and fundamental work of Mendel
- how variation in traits appear and basic and higher order structural organization of gene
- the importance of repetitive sequence, mutation and mechanistic detail of gene expression
- mechanism of sex determination and chromosome mapping and linkage analysis
- basic mechanism of inheritance, evolution and population genetics

LSC 2104	BASICS OF GENETICS LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

Hands on experimentation on

- different cell division,
- Barr-body translocation,
- Karyotyping and
- Pedigree analysis

LIST OF EXPERIMENTS

i. Permanent and temporary mount of mitosis.
ii. Permanent and temporary mount of meiosis.
iii. Mendelian deviations in dihybrid crosses
iv. Demonstration of - Barr Body translocation.
v. Karyotyping with the help of photographs
vi. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
vii. Study of polyploidy in onion root tip by colchicine treatment.
viii. Staining based karyotyping analysis of cancer cells
ix. Genotyping

L – 00; P – 45; TOTAL HOURS – 45

REFERENCES:

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

OUTCOMES:

1. Students will have a clear idea on how mitosis and occurs
2. Students will understand how chromosomes look like
3. Students will have a clear idea on ploidy level of plant and human cells

LSC 2105 BIO-STATISTICS

L	T	P	C
3	2	0	4

OBJECTIVES:

- To introduce basic terminologies used in biostatistics, collect and represent different types of data
- To gain insights on the concept of central tendency and its application
- To provide an introduction to probability and probability distribution
- To introduce the concept of correlation and regression and its significance
- To generate hypotheses and test them.

MODULE I DATA, DATA TYPES AND DISPLAY 12

Population vs. Sample, Data- Types and collection and sampling method, Examples-Medical 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; P – 00; TOTAL HOURS – 60

REFERENCES:

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

OUTCOMES:

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

- Conduct a simple survey and represent the data collected
- Determine the central tendency of a population
- Identify the outcomes of an event and categorise an experiment into different probability distributions
- Investigate the relationship between two variables
- Design an hypothesis and test it.

LSC 2106 QUANTITATIVE APTITUDE & REASONING-1

L	T	P	C
2	0	2	3

OBJECTIVES:

- To learn basics of numbering system and least common multiples and Highest common factor.
- To have knowledge in time and distance, ration and proportion and calculate the percentage
- To learn the blood relations and family tree also sense of directions
- To acquire knowledge of verbal reasoning of synonyms and antonyms

MODULE I Quantitative Aptitude -I **8**

Numbers-Odd number, even number, Prime and composite numbers, Problems on H.C.F and L.C.M, Average

MODULE II Logical reasoning-I **8**

Time and Distance, Probability, Percentage, Ratio and Proportion,

MODULE III Number Series, Cause and Effect, Analogies **7**

Number Series, Cause and Effect, Analogies

MODULE IV Logical reasoning-II **7**

Directions, Blood relations, Syllogism and clock

MODULE V **7**

Closet Test, Synonyms and Antonyms

L – 00; P – 45; TOTAL HOURS – 45

REFERENCES:

1. Quantitative Aptitude – R.S. Aggarwal – Sultan Chand Publication.
2. · Logical Reasoning - R.S. Aggarwal – Sultan Chand Publication.

OUTCOMES:

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

- To solve any problems in the logical reasoning
- To calculate the Time and distance, Percentage and probability
- Learn about Cause & Effect, Blood relations, clock and syllogism

SEMESTER IV

LSC 2201	BIOPROCESS TECHNOLOGY	L	T	P	C
		3	2	0	4

OBJECTIVES:

The course aims to provide the students with

- the theoretical basis Bioprocess principles and
- the integration of biochemistry, microbiology, cell biology and process engineering.
- It aims to exploit the potential of microorganisms and cells by technical means.

MODULE I Introduction to Bioprocess technology 12

Definition, large-scale production of bio-based products using bioreactors, physical variables in Bioprocess, Mass and energy balances, metabolic stoichiometry, biomass yield

MODULE II Bioreactor 12

Types & operation of Bioreactors, physico-chemical standards used in bioreactors, limitations of bioreactors, stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations.

MODULE III Aeration and agitation 12

Sparger and types, development of novel spargers, self-cleaning spargers, Impeller and types, axial and radial flow, baffle installation in bioreactor

MODULE IV Downstream processing 12

Cell disruption- physical, chemical and enzymatic methods. Bioseparation, Chromatography, extraction, drying techniques

MODULE V Industrial production of bio based products 12

Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid, α-amylase, protease penicillin, tetracycline and vitamin B12, with reference to easily available raw materials, Production of herbal drugs.

L – 60; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Bioprocess Engineering - Basic concepts by M. L. Schuler & F. Kargi, Entice Hall 1992.
2. Bioprocess Engineering Principles by Pauline M. Doran, Academic Press 1995.

OUTCOMES:

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

- Understand the basic role of engineering in bio-processing applications
- Obtain a basic understanding of how cells work and become familiar with the environmental conditions (i.e. nutrients, pH, etc.) required for applications of biological components (cells or enzymes) to bio-processing systems
- Understand and model enzyme kinetics and apply the models for analysis of immobilized enzymatic bioreactors. • Utilize material balances to evaluate cell growth and substrate/product utilization in bioreactors.
- Design bioreactors to achieve desired results (i.e. specified cell concentration, production rates, etc.).
- Understand and apply scale-up methods for designing bioreactors.
- Become familiar with principles of recovery and purification techniques of bioprocesses.

LSC 2202	BIOPROCESS TECHNOLOGY LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Enables the student to develop their skills in the field of enzyme isolation, its assay, enzyme kinetics and microbial fermentation.
- Develop their practical skills in enzyme isolation and purification.
- Evaluate enzyme kinetics
- Carry out enzyme immobilized reaction and microbial culture
- Develop practical skill in submerged and solid state fermentation

List of experiments: **12**

1. Estimation of fermented sample using DNS method
2. Bioethanol production from fermentable sugar juice
3. Production of secondary metabolites using fed-batch process
4. Solid state fermentation
5. Optimization of immobilization method for yeast
6. Hydrolysis of starch using immobilized yeast through matrix entrapment method
7. Kinetics of growth in batch cultivation- estimation of Monod kinetic parameters
8. Temperature effect on microbial growth - estimation of Energy of activation and Arrhenius constant for microorganisms
9. Effect of substrate concentration on biomass yield
10. Solvent extraction techniques for product recovery

L – 00; P – 60; TOTAL HOURS – 60

REFERENCES:

1. Lab manual

OUTCOMES:

- At the end of the syllabus students will be able to understand the fundamentals of bioprocess techniques.
- Students will be familiar with techniques involved in downstream process..

LSC 2203 ENZYMOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- To obtain a general knowledge about how enzymes work.
- To understand the kinetics of enzyme action.
- To understand the biotechnological applications of enzymes and their purification methods.

MODULE I Enzymes-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 Michelis – 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 Extraction and Purification of enzymes 12

The extraction of soluble enzymes, Membrane bound Enzymes, nature of extraction medium. Purification of Enzymes by analytical techniques, Criteria of Purity, Determination of Molecular Weight of Enzymes. Enzyme assay- Introduction, Enzyme assay by kinetic determination of catalytic activity, Coupled kinetic assays, Radioimmunoassay (RIA) of enzymes, Investigation of sub-cellular

compartmentation of enzyme, and enzyme histochemistry

MODULE V Applications of 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; P – 00; TOTAL HOURS – 60

REFERENCES:

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

OUTCOMES:

After learning the course the students should be able to:

- Develop fundamental understanding of Enzymes & Proteins
- Understand the kinetics and mechanism of enzyme action
- Understand the Purification methods

LSC 2204	ENZYMOLOGY LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the fundamental of Enzyme function and the parameters which affects its activity
- To know the calculation of kinetic parameters of enzyme activity. such as KM, Vmax, and kcat values of the Michaelis–Menten equation.
- Learn how to process, present and analyze experimental data.

List of Experiments

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 straigh 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

L – 00; P – 60; TOTAL HOURS – 60

REFERENCES:

1. Lab Manual

OUTCOMES:

At the End of Course Students will be able to do

- the calculation of Km and Vmax from enzyme catalyzed reaction.
- list the factors that can affect the rate of a chemical reaction and enzyme activity
- explain why enzymes have an optimal pH and temperature to ensure greatest activity
- explain why the same type of chemical reaction performed at different temperatures revealed different results/enzyme activity

LSC 2205	BIOPHYSICS	L	T	P	C
		3	2	0	4

OBJECTIVES:

This course aims to introduce the theories and concepts of biophysics of bio molecules which are considered important in biotechnology applications. To Learn the structures of biological molecules and to understand the concept of structural analysis.

MODULE I MOLECULAR 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, hydropathy plots

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, hydrophobicity plots.

MODULE V BIOCALORIMETRY **12**

Thermodynamic parameters, activation energy of reactions, enthalpy, entropy, free

enrgy, Isothermal titration calorimetry, changes in heat capacity by isothermal titration calorimetry, differential scanning calorimetry, equilibrium constant.

L – 60; P – 00; TOTAL HOURS – 60

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
3. Crieghton, T.E, Biophysical Chemistry
4. LubertStryer, Second Edition.

OUTCOMES:

The students should be

- able to understand the chemistry of the structures of biomolecules.
- able to have the all basic information related to the biological structure.
- able to know about the detail structure elucidation by using the basic techniques.

LSC 2206	QUANTITATIVE APTITUDE & REASONING-2	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To learn about decimal fraction and details of calendar
- To learn profit loss, simple and compound interest calculations.
- Students will get in depth knowledge about arithmetic reasoning
- To get knowledge of seating arrangement calculations and problems on course of action

MODULE I Quantitative Aptitude -III 8

Square Root and Cube Root, Races and Games, Decimal Fraction and Calendar

MODULE II Quantitative Aptitude -IV 8

Profit and Loss, Simple Interest, Compound Interest, Stocks and Shares, Chain Rule, Odd Man Out and Series

MODULE III Logical reasoning-III 7

Course of Action, Making Judgments, Logical Deduction

MODULE IV Logical reasoning-IV 7

Seating arrangement, Verbal Reasoning, Statement and Conclusion, Course of Action

MODULE V Arithmetic reasoning 7

Problems in Arithmetic reasoning

L – 00; P – 45; TOTAL HOURS – 45

REFERENCES:

1. Quantitative Aptitude – R.S. Aggarwal – Sultan Chand Publication.
2. · Logical Reasoning - R.S. Aggarwal – Sultan Chand Publication.

OUTCOMES:

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

- To solve any problems in the arithmetic reasoning
- To calculate the Simple Interest, Compound Interest
- Learn about Stocks and Shares

SEMESTER V

LSC 3101	PLANT BIOTECHNOLOGY	L	T	P	C
		4	1	0	4

OBJECTIVES:

The purpose of the course is to provide

- training in the science behind plant biotechnology,
- an appreciation of the current scope and limits to its industrial application, and
- the implications of modern methods of genetic modification for plant industries

MODULE I INTRODUCTION TO PLANT TISSUE CULTURE 12

Introduction, History, Applications of Plant tissue culture, Laboratory facilities and operations, Nutrition medium composition and preparation, Sterilization Techniques and Types of culture- Organised and Unorganised Culture- Applications, advantages and disadvantages.

MODULE II MICROPROPAGATION AND IN VITRO PRODUCTION OF HAPLOIDS 12

Micro propagation techniques- Stages of micropropagation, Organogenesis and Embryogenesis, advantages and disadvantages. Haploid plant generation- Anther culture, Ovary culture and Distant Hybridisation, significance, method, advantage disadvantage.

MODULE III SOMATIC HYBRIDIZATION 12

Protoplast preparation, isolation, purification, viability and culturing, somatic hybridization- techniques, methods to screen, methods of verification/ characterisation. Advantage and disadvantage; Somatic hybridization Applications.

MODULE IV SOMACLONAL VARIATION, GERMPLASM STRORAGE AND 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 AND METABOLITE PRODUCTION 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, Cell suspension culture, secondary metabolite production, selection of high yielding line, Molecular farming.

L – 60; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Introduction to plant biotechnology by HS Chawla.
2. Biotechnology, Satyanarayana. U, 2008, Books and Allied (p) Ltd.
3. A Text Book of Biotechnology. R.C. Dubey. S.Chand& Co Ltd, New Delhi.

OUTCOMES:

The student will be able to :

- Perform and design method to culture and propagate plant using simple techniques
- Appreciate the significance of plants as a reactors to produce products
- Analyse and judge wisely on the choice of method for hybridization and need of genetic manipulation in plants.
- Be skilled in methods of long term storage/preservation of germplasm.

LSC 3102	PLANT BIOTECHNOLOGY LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the preliminary methods of preparing media and to culture plants using different techniques.
- To learn about the factors affecting tissue culture
- Learn the basics of establishing a plant tissue culture and its commercialization

LIST OF EXPERIMENTS:

1. Laboratory safety guidelines and setting up a tissue culture lab
2. 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.

L – ; P – 30; TOTAL HOURS – 30

REFERENCES:

1. Laboratory Manual

OUTCOMES:

- On performing the above experiments students will be able to:
- Grow plants through different micropropagation techniques and troubleshoot.
- Isolate DNA from plant material
- Understand the intricacies and the opportunities of plant tissue culture lab

LSC 3103	ANIMAL BIOTECHNOLOGY	L	T	P	C
		4	1	0	4

OBJECTIVES:

The objective of the course:

- To familiarize the students with fundamentals of different culturing and propagation techniques of animals.
- To highlight the applications and potential benefits of biotechnology in enhancing human lives.

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; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Biotechnology, Satyanarayana. U, 2008, Books and Allied (p) Ltd.
2. Animal Tissue culture-Sudha Gangal. Second edition. University Press (India) Pvt Ltd. Hyderabad.
3. Animal Biotechnology –M. Ranga. Studam publishers, 2006.
4. Animal Biotechnology-R.Sasidhara, MJP Publishers, 2006.

a. 5 . Molecular biology and Biotechnology, 3rd edition– J M Walker & E B Gingold, Panima publishing corporation, 1999.

5. Animal cell Biotechnology: Methods and protocols – Nigel Jenkins (Ed), Humana press, New Jersy, 1999.
6. Recombinant DNA (2nd edition) – J S Watson, M Gillman, J Witknowski and M Zoller, Scientific American Books, NY , 1992.
7. A Text Book of Biotechnology. R.C. Dubey. S.Chand& Co Ltd, New Delhi.

OUTCOMES:

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

- Master concepts in cell culturing and transgenics generation.
- Understand the broad area of biotechnology and its potential applications in animal husbandry
- Critically understand the pros and cons of generating genetically modified organisms and the associated ethical issues.

LSC 3104	ANIMAL BIOTECHNOLOGY LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

The course aims to provide the students

- with the necessary skills for the isolation of animal cells for in vitro studies,
- maintenance of cell culture and
- the basic techniques in animal cell culture.

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

L – ; P – 60; TOTAL HOURS – 60

REFERENCES:

1. Animal Biotechnology Lab Manual

OUTCOMES:

After the completion of course the students will have

- practical knowledge of sterilization techniques
- working knowledge of different types of media
- knowledge of cell lines
- isolation of different cell types
- identify different microorganisms

LSC 3105 ENVIRONMENTAL SCIENCE

L	T	P	C
4	1	0	4

OBJECTIVES:

- Imparting basic knowledge about the **environment** and its allied problems.
- Developing an attitude of concern for the **environment**.
- Motivating students to participate in **environment** protection and **environment** improvement.

MODULE I Multidisciplinary Nature of Environmental Studies and Natural Resources 12

Definition, scope and importance, Need for public awareness. Natural resources and associated problems (a) Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people, (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer pesticide problems, water logging, salinity, (e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

MODULE II Ecosystems 12

Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of the following ecosystem (a) Terrestrial ecosystems (Forest, Grassland, Desert), (b) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

MODULE III Biodiversity and Human Population 12

Introduction - Definition : genetic, species and ecosystem diversity; Bio-geographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-spots of

biodiversity; Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and exsitu conservation of biodiversity. Population growth, variation among nations; Population explosion; Family Welfare Programme.

MODULE IV Environmental Pollution and its Control 12

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, Solid waste Management - Causes, effects and control measures of urban, industrial wastes and ewaste; ill-effects of fireworks and upkeep of clean environment - Role of an individual in prevention of pollution; Disaster management - flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE V Social Issues and the Environment 12

From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns; Environmental ethics: Issues and possible solutions; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness. Environment and human health; Human Rights; Value Education; HIV/AIDS; Women and Child Welfare; Role of Information Technology in Environment and human health.

L – 60; P – 00; TOTAL HOURS – 60

REFERENCES:

1. ErachBharucha, Textbook for Environmental Studies For Undergraduate Courses of allBranches of Higher Education for University Grants Commission, Orient BlackswanPvt.Ltd., Hyderabad, India, 2013.
2. Purohit S.S., Shammi Q.J., Agarwal A.K., A Text Book of Environmental Sciences, Student Edition of India, 2004.
3. Surinder Deswal and Anupama Deswal, A Basic Course in Environmental Studies, Dhanpat Rai & Co. (P) Ltd., India, 2005.
4. Madhab Chandra Dash and Satya Prakash Dash, Fundamentals of Ecology, Tata McGrawHill Education Pvt. Ltd, India, 2009.
5. Anil Kumar De and Arnab Kumar De, Environmental Chemistry, 5th Edition,

New Age International Pvt. Ltd., 2003.
6. Asthana D.K., Meera Asthana, Environment: Problems and Solutions, S. Chand & Company Ltd., 2003.
7. ErachBharucha, Jayalaxmi Rai, The Biodiversity of India, Mapin Publishing Pvt., 2002.
8. Lathi B.P., Modern Environmental Science and Engineering Systems, 3rd Edition, Oxford University Press, 2007.
9. Benny Joseph, Environmental Studies, Tata McGraw - Hill Education, India, 2009.
10. Ravikrishnan A., Environmental Science and Engineering, Sri Krishna Publications, Tamil Nadu, India, 2015.
11. Raman Sivakumar, introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
12. Venugopala Rao P., Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.
13. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age international Pvt. Ltd., New Delhi, India, 2009.

OUTCOMES:

- Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
- Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners

SEMESTER VI

LSC 3201	IMMUNOTECHNOLOGY	L	T	P	C
		4	1	0	4

OBJECTIVES:

The course is aimed at introducing the science of immunology and detailed study of various types of immune systems and their classification structure and mechanism of immune activation.

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 immunogenicity ; s: Different characteristics of antigens, mitogens, Hapten, Immunogen, Adjuvants; Molecular structure of antibody; antigen-antibody interaction; Hybridoma technology

MODULE III IMMUNOLOGICAL TECHNIQUES 12

Precipitation, agglutination, Immunodiffusion, immunoelectrophoresis, ELISA, RIA,; western blot, immunoprecipitation. fluorescence activated cell sorter.

MODULE IV FUNCTIONAL IMMUNOLOGY 12

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

MODULE V APPLIED IMMUNOLOGY 12

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

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Essential Immunology by Roitt I. Blackwell Scientific Publications, Oxford, 10th Edition, 2001
2. Molecular Immunology By Benjamini E., 1990

3. Immunology a short course by Benjamini E. and Leskowitz S. Wiley Liss, 2nd Edition, 1992
4. The Immune System by Peter Parham, Garland Science, 4th Edition, 2014
5. Understanding Immunology by Peter Wood, Pearson Education., 1st Edition, 2006

OUTCOMES:

To develop and extend the knowledge of cellular and molecular components of the human in

- Understanding the mechanisms involved in immune system development and responsiveness.
- 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.
- To allow you to develop and practice a range of transferable skills during the practicals, including teamwork, software applications and data analysis.
- To understand about how immunologists think and work.

LSC 3202 GENOMICS AND PROTEOMICS

L	T	P	C
4	1	0	4

OBJECTIVES:

- To provide information about genomics and proteomics.
- To offer basic knowledge of genome sequencing methods
- To provide information functional genomics
- To provide introduction to proteomics and tools to analyse proteome
- 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 Fingerprinting

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 –45 ; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Arthur M. Lesk (2012). Introduction to Genomics. 2nd Ed. Oxford University Press.
2. NachimuthuSaraswathy and Ponnusamy Ramalingam (2011). Concepts and Techniques in Genomics and Proteomics. Biohealthcare Publishing (Oxford) Limited.
3. Daniel C. Liebler (2002). Introduction to Proteomics: Tools for the New Biology. Humana Press Inc. Totowa, NJ

OUTCOMES:

At the end of the course students will be

- Able to get a better understanding of the basics of the genome structure, organization, different databases etc.
- Able to learn different tools for genome sequencing
- Able to learn concept and different tools of functional genomics
- Able to learn basics of the proteomics and its different applications

LSC 3203	IMMUNOLOGY LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

- To acquire knowledge on immunological techniques
- To train in various techniques involving antigen and antibody reactions

LIST OF EXPERIMENTS

1. Double diffusion, Immuno-electrophoresis and Radial Immunodiffusion.
2. Rocket electrophoresis
3. Antibody titre by ELISA method.
4. ELISA for detection of antigens and antibodies-DOT ELISA
5. Sandwich ELISA
6. Blood group mapping
7. Separation of leucocytes by dextran method
8. Separation of mononuclear cells by Ficoll-Hypaque
9. Preparation of antigens from pathogens and parasites
10. Slide and tube agglutination reaction

REFERENCES:

1. Rose et al., Manual of Clinical laboratory Immunology, 6th Ed ASM Publications, 2002.
2. Lefkovis and Pernis. Immunological methods. Academic Press, 1978.
3. Hudson L. and Hay F.C. Practical Immunology. Black Well publishers, 1989

OUTCOMES:

- Students could independently perform diagnostics assays involving antigen antibody reaction.
- They also learn to perform the qualitative and quantitative analysis using antibody

LSC3204	GENOMICS AND PROTEOMICS LAB	L	T	P	C
		0	0	3	2

OBJECTIVES:

- To learn the preliminary methods of computational analysis of genome
- To learn about the genome separation
- Learn the basics of proteome analysis

List of experiments:

1. accessing different genome database
2. handling viral genome database
3. using different types of BLAST program
4. construction of phylogenetic tree using different algorithm
5. Introduction to Galaxy server
6. Isolation of bacterial genome
7. analysis of mass spec data for peptide mass fingerprinting
8. Introduction to different proteomics related tools

L – ; P – 45; TOTAL HOURS – 45

REFERENCES:

1. Lab manual

OUTCOMES:

Students shall be able to learn

- different tools for genomic analysis
- hands on to isolate bacterial genome
- online tools to analyze proteomic data

SKILL BASED ELECTIVES (ODD SEMESTER)

LSCX 102	CYTOGENETICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

students shall obtain

1. basic idea of genetics
2. concept of mutation
3. concept of structure and function of chromosome
4. concept of cell division
5. the idea of different techniques in cytogenetics

MODULE I introduction to genetics 9

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 9

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 9

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, lampbrush chromosomes, polytene chromosomes, B chromosomes

MODULE IV Cell division 9

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 three point cross in Drosophila, RFLP mapping genetic control of meiosis, Karyotyping and its importance

MODULE V Techniques 9

karyotyping, spectral keryotping, FISH, multicolor FISH, locus specific FISH, comparative genomic hybridisation, Flow cytometry, application of cytogenetics

L – 45; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Brooker R.J (1999) Genetics : Analysis and Principles. Benjamin/Cummings, Longman Inc
2. Gardner EJ, Simmons M.J and D.P.Snustad (1991) Principles of Genetics. John Wiley and Sons. Inc. N.Y.
3. Griffiths A.J.F, Miller J.H, Suzuki D.T, Lewontin R.C and W.M.Gelbart (1996). An introduction to genetic analysis. W.H.Freeman and Company, N.Y
4. Gersen, Steven L., Keagle, Martha B. (2005). The Principles of Clinical Cytogenetics Springer Nature, Singapore

OUTCOMES:

students shall have the idea of

- principles of genetics
- cause and effect of mutation
- structure-function of chromosome
- different features of cell division
- different techniques and application of cytogenetics in different fields of biotechnology

LSCX 103 BIOFERTILIZER TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To provide an in depth knowledge of biofertilizer types and production methods
- To explain the significance of Nitrogen fixation using examples
- To illustrate the role of different microbes in biofertilizer technology
- To introduce the concept of organic farming
-

MODULE I Introduction To Biofertilizers 9

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 9

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 9

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation

MODULE IV Fungal Biofertilizers 9

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 9

Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Applicatioons

L – 45; P – 00; TOTAL HOURS – 45

REFERENCES:

- Textbook of Agricultural Biotechnology by Dr. Ahindra Nag, PHI Learning Private Ltd., New Delhi, 2009.
- Subba Rao, N. S. (1982). Advances in Agricultural Microbiology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

OUTCOMES:

After the completion of the course students will be able to

- To demonstrate a deep understanding on Biofertilizer production methods
- To analyse and compare the mechanism of Nitrogen fixation and phosphate bacteria as biofertilizers
- To perceive the nuances of organic farming

SKILL BASED ELECTIVES (EVEN SEMESTER)

LSCX 201	AGRICULTURAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To understand

- The principles of the underlying properties and reactions of various Microorganisms and their various development strategies with a clear understanding in terms of
- Agricultural Biotechnology and to update students knowledge of new developments in biology of industrial relevance.

MODULE I Agricultural Biotechnology- An Introduction 9

Agriculture - Definition - Importance and scope - Branches of agriculture - Evolution of man and agriculture - History of agricultural development in the World and India Exploitation of microorganisms and their products

MODULE II Microorganisms in Agriculture 9

Microorganisms as biofertilizers (Rhizobial, Cyanobacterial, Mycorrhizal, Azotobacter): production and application of Microbial biopesticides, recombinant pesticides, GMO and their impact.

MODULE III Microorganisms in Agriculture and Plant Diseases 9

Microbial diseases of crops: transmission of pathogens, Citrus canker, little leaf of brinjal, red rot of sugarcane, mosaic virus, tomato spot, early and late blight, wilt disease. Control of plant diseases

MODULE IV Recombinant DNA Technology and Genetic Transformation 9

Bacterial transformation **-** Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method - Tissue specific promoters, selectable and scorable markers, reporter genes- Molecular analysis of transgenic plants – Transgenic plants

MODULE V Molecular Farming 9

Introduction, foreign protein production systems - Plant tissue culture - Suspended cultures - Hairy root cultures, shoot teratoma cultures - Secretion of foreign proteins

- Foreign protein stability Stability inside the cells

L – 45; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Principles of Food Science, Vol-I by FennmaKarrel
2. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company
3. Casida, L.E. “Industrial Microbiology”, New Age International (P) Ltd, 1968.
4. Presscott, S.C. and Cecil G. Dunn, “Industrial Microbiology”, Agrobios (India), 2005.
5. Molecular Farming – Plant-made Pharmaceuticals and Technical Proteins, Rainer Fischer and Stefan Schillberg. Wiley.VCH Verlag GmbH and Co. KGaA. 2004
6. Molecular Pharming: Applications, Challenges and Emerging Areas 1st Edition,Allison R. Kermode, Liwen Jiang 2017

OUTCOMES:

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

- Explain the objective, need for the sustainability and also the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Recommend relevant energy conservation measures in a building
- Describe the elements in green building design and suggest ideas for attainting sustainability in building.

LSCX 202 HERBAL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To provide an overview of the importance of herbal medicines in Siddha and Ayurveda practices
- To explain the medicinal uses of common Indian herbs as examples
- To introduce methods of extraction and characterization of phytocompounds
- To highlight futuristic applications of herbal technology

MODULE I Introduction of Herbal Medicines 9

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 9

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

MODULE III Phytochemistry 9

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*(anti-rheumatic) and *Centella asiatica* (memory booster).

MODULE IV Analytical pharmacognosy 9

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 9

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

L – 45; P – 00; TOTAL HOURS – 45

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

OUTCOMES:

After the completion of this course the students will be able

- To appreciate the importance of Indian herbs in medicinal uses
- To design experiments to analyse the phytochemical compounds of herbal plants and its parts
- To innovate new applications of common herbs in food and medicine

LSCX 203 DISEASE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To strengthen the concept of disease and disease transmission
- To provide insight on the study designs used to understand a disease
- To introduce the factors that cause chronic diseases
- To emphasise the factors considered for a reliable prognostic and diagnostic test.

MODULE I INTRODUCTION TO EPIDEMIOLOGY 9

Epidemiology introduction, descriptive and analytical epidemiology, endemic, epidemic and pandemic diseases, disease transmission concept, epidemiology triangle, disease prevention

MODULE II DISEASE CONCEPTS 9

Concept of health and disease, sources and modes of disease transmission, acute and chronic diseases, major stages in disease progress, categories of diseases, zoonosis and carriers of infectious diseases, prevention and control measures.

MODULE III DESCRIPTIVE AND ANALYTICAL EPIDEMIOLOGY 9

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 9

Chronic and acute diseases, Environmental factors – physical stress, chemicals, biologic agents, social factors, Behavioural factors – smoking, diet, obesity, hereditary factors

MODULE V CLINICAL EPIDEMIOLOGY 9

Introduction, screening and diagnosis, validity, reliability and yield, prognosis, prognostic indicator, biases in disease prognosis, health outcomes research.

L – 45; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Ray M Merrill, Introduction to Epidemiology, Jones and Barlett Learning.

2. Leon Gordis, Epidemiology, Saunders, Elsevier.

OUTCOMES:

- To predict the nature of a disease and design preventive measures
- To measure disease prevalence and to identify the cause-effect of a disease.
- To strategize methods of implementing a change in a patient's life through the health belief model.
- To evaluate sensitivity, specificity and yield of a test.

CORE ELECTIVES (ODD SEMESTER)

LSCX 111	HUMAN PHYSIOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

The course aims to build on

- the basic understanding of the organs systems and human physiology.
- This will help students in critical evaluation of scientific literature,
- challenge you to investigate new developments in selected,
- medical applications of biotechnology

MODULE I Basic cell physiology 12

Cell- Introduction, Cell Organelles, Cellmembrane, Movement of the substances and water through the cell membrane, Bioelectric potentials

MODULE II Neuro muscular system & Nervous system 12

Muscles- Skeletal muscles-Properties of skeletal muscles, Muscular contraction and relaxation, Neuromuscular junction, Sarcotubular system, Smooth muscle-mechanism of contraction, Sensory nervous system, Motor nervous system ,Higher functions of the nervous system, Synapse, Reflexes Cerebrospinal fluid, Blood brain and blood CSF barrier

MODULE III Blood and lymph & Circulatory system 12

Functions of Blood, Hemopoesis, Erythropoeisis,Anemias,granulocytes and agranulocytes,Macrophage system, lama proteins,Hemostasis,Blood groups. Functional anatomy of the heart, Properties of cardiac muscles,Conducting system of the heart ,Pressure changes during cardiac cycles, Capillary circulation, Arterial and venous blood pressure

MODULE IV Gastro intestinal system & Renal physiology 12

General structure of alimentary canal, Gastric secretion, Pancreatic secretion, Gastric motility-digestive peristalsis Gastrointestinal hormones. Structure of kidney, Nephrones, Juxtra glomerular filtrate, Reabsorption, Secretion-mechanism of secretion, Concentrating and diluting mechanism of urine, Dialysis

MODULE V Endocrinology & Respiratory system 12

Endocrine glands, hormones, their functions. Mechanism of breathing, Ventilation,

Regulation of respiration, Transport of gases, Hypoxia, Artificial ventilation, Non respiratory functions of the lungs.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Ganong WF Review of Medical Physiology.
2. JOHNSON, Leonard R,Essential Medical Physiology
3. Nordin M and Frankel VH,Basic biomechanics of the musculoskeletonsystem,Lippincot,Williams and Wilkins.
4. Foundation and principle of bacteriology-A.J.Salle

OUTCOMES:

At the end of the course students will be able to

- understand the basics of physiology
- have understanding of blood composition and circulatory system
- understand the basics of nervous system and neuromuscular system
- will know the role of endocrine organs and respiratory system
- will understand renal physiology and gastrointestinal system

LSCX 112 MEDICAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

The course aims to build on

- Understanding of proteins as therapeutic agents
- Preparation and use on monoclonal antibodies
- Understanding of human diseases
- Concepts of different types of vaccines
- Application of new technologies in healthcare settings

MODULE I SIMPLE AND RECOMBINANT PROTEIN SOURCES 12

Production of proteins- recombinant versus non-recombinant sources. Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression. Heterologous protein production- inclusion bodies-extra-cellular production- E.coli, yeast, fungi, plants, transgenic animals, insect cell culture system-advantages, disadvantages.

MODULE II THERAPEUTIC PROTEINS 12

Blood products-blood derived proteins, recombinant blood factors. nticoagulants, thrombolytic agents. Therapeutic enzymes. Hormones and growth factors- insulin, glucagon, gonadotrophins, growth hormones, other hormones.

MODULE III HUMAN DISEASES 12

Viral and bacterial diseases - Diseases caused by protozoan and parasitic worms (helminths) - Emerging infectious diseases – Active and passive immunity – Autoimmunity- Rational of immunization - Diseases controllable by vaccination – Vaccines, designing vaccines adjuvants - Whole organisms vaccines - Attenuated viruses and bacteria - Inactivation of pathogenic organisms by heat and chemical treatment

MODULE IV VACCINES 12

Bacterial polysaccharides, proteins and toxins as vaccines - Recombinant vaccines- subunit, attenuated and vector vaccines - Multivalent vaccine development against AIDS - Commercial and regulatory aspects of vaccine production and its distribution

MODULE V APPLICATION OF GENETIC ENGINEERING IN HEALTH CARE 12

Therapeutic antibodies- monoclonal antibodies, hybridoma technology, chimeric and humanized antibodies, applications of monoclonal antibodies. Antibody conjugates- radiolabelled, toxin, enzyme. Bi-specific antibodies. Interferons-interleukins-tumor necrosis factors.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Glick, B.R., Pasternak, J. J., Molecular Biotechnology, Principles and Application of Recombinant DNA, ASM press, Washington, 2nd Edition, 1998
2. Ratledge, C., Kristiansen, B., Basic Biotechnology, Cambridge University Press, USA, 2nd Edition, 2001.
3. David, E., Technology and Future of health care, Preparing for the Next 30 years, Jhon Wiley, Singapore, 2nd Edition, 2000.

OUTCOMES:

At the end of the course students will be able to

- Research, evaluate and critically assess the theoretical basis and practical application of selected medical biotechnologies
- Demonstrate knowledge and understanding of selected medical biotechnologies
- Describe in detail essential facts and theory in molecular biology and biotechnology when applied to medicine
- Describe and critically evaluate aspects of current research in the biosciences with reference to reviews and research articles
- With limited guidance, deploy established techniques of analysis and enquiry within the biosciences.

LSCX 113 **BIOINFORMATICS** **L T P C**
4 0 0 4

OBJECTIVES:

- Students will learn the concept of bioinformatics
- Students shall learn about biological database
- Students shall learn about sequence alignment techniques
- Students shall learn about phylogenetic analysis
- Students shall learn about other applications of bioinformatics like gene finder, molecular docking etc.

MODULE I Introduction to Bioinformatics 12

History of bioinformatics. Applications of Bioinformatics, Resources of Bioinformatics, Internet basics, FTP, Gopher, World-wide web, Sequence data format-FASTA and PhyLIP

MODULE II Biological Databases 12

Biological database- concept of database, importance of biological database; NCBI; retrieval of databases-Entrez system; primary database- nucleotide and protein; secondary database-PFAM, PROSITE etc.; Molecular structure database-PDB, CATH, SCOP

MODULE III Sequence Alignment and Database Searching 12

Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Pairwise alignment methods; Database similarity searching, FASTA, BLAST; Multiple Sequence Alignment: Progressive alignment methods

MODULE IV Phylogenetic Analysis 12

Elements of phylogenetic models, data analysis: Alignment, substitution model building, tree building and tree evaluation, building methods, searching for trees, hooting trees, Evaluating trees and data, phylogenetic tree construction softwares

MODULE V Advanced Bioinformatics 12

Marking repetitive DNA, Database search, Codon bias detection, Detecting function sites in the directed mutagenesis, Molecular docking and binding site prediction

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Mukhopadhyaya, C. S., Chaudhary, R. K. and Iquebal, M. I. (2018) Basic Applied Bioinformatics. Wiley Blackwell.
2. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
3. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
4. Xiong, J (2006) Essential Bioinformatics. Cambridge University Press.

OUTCOMES:

- Students should know about basics of bioinformatics and internet and different file format
- Students should know different types of biological databases
- Students are able to perform BLAST and other related analysis
- Students are able to perform phylogenetic analysis using proper tree construction method
- Students should know about different applications of bioinformatics and problem solving

LSCX 114 BIOETHICS, IPR AND BIOSAFETY

L	T	P	C
4	0	0	4

OBJECTIVES:

The aim of this course is to teach

- biosafety issues, biosafety and biotechnological applications,
- biosafety in laboratory, waste management, registration,
- national and international regulations, bio-ethical issues in medicine, environment and genetics, related regulations and laws.

MODULE I BIOETHICS 12

Introduction of ethics, bioethics, different ethical issues, stem cell technology, its uses and controversies, Biosecurity, Bioterrorism, Biodefense, gene drives, biopiracy, ethical guidelines for biomedical research in human

MODULE II BIOSAFETY 12

Introduction to biosafety, biocontaminants, biosecurity and major components, biosafety requirements, biosafety issues, biosafety levels (BSL)-I, II,III, IV, biosafety cabinets and types, types of filters, Safe use of BSC in lab, Biohazards

MODULE III IPR 12

Intellectual Property, Origin and Development of Intellectual Property, Types of IPR, Copyright Law of India, IPR Education, Training and Human Resource Development, Intellectual Property System – Global Scenario

MODULE IV GENETICALLY MODIFIED ORGANISM 12

Introductions of GMOs, advantages and disadvantages, genetic engineering vs traditional breeding, GMO regulation, risk factors, Biosafety : Indian status, traits of GMO, biosafety guidelines in india, GMO uses in food and medicine, Status of GMO today.

MODULE V HUMAN CLONING 12

Methods of animal cloning, adverse effects and concerns, human cloning, procedure, why human cloning, ethical implications of human cloning, pros and cons of human cloning, future prospect, why no reproductive cloning in humans, legal issues: UK, UN, US, India.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Manuals
2. judgements

OUTCOMES:

The students will be idea about the:

- ethical issues related to different areas of science and social life.
- biosafety measures and its importance for biological experiments.
- intellectual property and different laws related to that current scenario of GMOs and about human cloning.

LSCX 115 ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- Imparting basic knowledge about the environment and its allied problems.
- Developing an attitude of concern for the environment.
- Motivating students to participate in environment protection and environment improvement.

MODULE I **12**

Perspective of Wastewater, Waste, Off-Gas and Soil Treatment – Contributions of Biotechnology to waste treatment and environmental managements – Overcoming persistent pollutants by co-operation between anaerobic and aerobic bacteria

MODULE II **12**

Aerobic and Anaerobic Biological treatment processes for liquid and solid wastes - Biofilm Technologies - Recent advances in Nitrogen removal - Enhanced Biological Phosphorous Removal

MODULE III **12**

Denitrification: Physiology of denitrifying bacteria – Tertiary denitrification – Sludge denitrification – Drinking water treatment: Anaerobic treatment by methanogenesis – Uses for methanogenic treatment.

MODULE IV **12**

Role of Biocatalysts in pollutant removal – Immobilized Enzymes and cells - Use of Genetically Engineered Organisms in wastewater treatment

MODULE V **12**

Detoxification of Hazardous chemicals: Factors causing molecular recalcitrance – Biodegradation of problem environmental contaminants – Bioremediation of problem - Engineering strategies for evaluating bioremediation.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Clair N. Sawyer, Perry L. McCarthy and Gene F. Parkin, Chemistry for Environmental Engineering and Science, 5th Edition, Tata McGraw-Hill

Education Pvt. Ltd, India, 2011.
2. J. Glynn Henry and Gary W. Heinke, Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
2. J. Jeffrey Peirce, P. AarneVesilind, Ruth F. Weiner, Environmental Pollution and Control, Butterworth-Heinemann, 1997.
3. Trivedi, R.K., Handbook of Environmental Law's, Rules, Guidelines, Compliances and Standards, Volume 1, Envio Media.
4. Trivedi, R.K., Handbook of Environmental Law's, Rules, Guidelines, Compliances and Standards, Volume 2, Envio Media.
5. Masters G.M., introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
6. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall international Inc., New Jersy, 1996.
7. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES:

- Explain the technologies, tools and techniques in the field of environmental biotechnology.
- To know the role of microorganisms as biotechnological agents.
- Master the basic terminology of molecular biology and genetics.
- Study bioreactors for environmental application.

CORE ELECTIVES (EVEN SEMESTER)

LSCX 211	NANOBIOTECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To provide an introduction to nanobiotechnology.
- To make the students understand about the functional principles of nanobiotechnology

MODULE I FUNDAMENTALS OF NANOSCIENCE 12

Introduction, the nanoscale dimension and paradigm, definitions and historical evolution (colloids etc.) and current practice, types of nanomaterials and their classifications (1D, 2D and 3D etc. nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc), Polymer, Carbon, Inorganic, Organic and Biomaterials –Structures and characteristics.

MODULE II CHARACTERIZATIONS IN BIONANOTECHNOLOGY 12

Optical (UV-Vis/Fluorescence), X-ray diffraction, Imaging and size (Electron microscopy, light scattering, Zeta potential), Surface and composition (ECSA, EDAX, AFM/STM etc), Vibration (FT-IR and RAMAN), SERS -3, Magnetic, Electrical and Electrochemical**.**

MODULE III APPLICATIONS OF BIONANOTECHNOLOGY 12

Materials in Biosystems: Proteins - Lipids - RNA and DNA, Protein Targeting – Small Molecule/Nanomaterial - Protein Interactions Nanomaterial-Cell interactions-Manifestations of Surface Modification (Polyvalency),Drugs-Photodynamic therapy, molecular motors, neuroelecronic interphases, development of nanoluminiscent tags**.**

MODULE IV NANOMATERIALS AND DIAGNOSTICS 12

Drug Delivery and Therapeutics, MRI, Imaging, Surface Modified Nanoparticles, MEMS/NEMS, based on Nanomaterials, Peptide/DNA Coupled Nanoparticles, Lipid Nanoparticles For Drug Delivery, Inorganic Nanoparticles For Drug Delivery, Metal/Metal Oxide Nanoparticles (antibacterial/anti fungal/anti viral), Anisotropic and Magnetic Particles (Hyperthermia).

MODULE V NANOMATERIALS AND TOXICITY EVALUATION 12

Designer biopolymers, Procollagen, DNA Polynode, RNA topoisomerase, Protein –magnetic materials, Cyto-toxicity, Geno-toxicity, In vivo tests/assays.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. C. M. Niemeyer, C. A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspective, Wiley – VCH, 2004.
2. T. Pradeep, —Nano: The Essentials, McGraw – Hill education, 2007.
3. Nicholas A. Kotov, Nanoparticle Assemblies and Superstructures, CRC, 2006.
4. David S Goodsell, “Bionanotechnology”, John Wiley & Sons, 2004.

OUTCOMES:

After the completion of the course the student will have

- the basic knowledge of nanoparticles and the field of bionanotechnology.
- Understanding the techniques used for the characterization of nanoparticles
- understanding the application of Nanomaterials in biotechnology and acquire the knowledge about the DNA, proteins, amino acids, drug delivery, biomedicine etc.
- it will also impart correct scientific understanding of current evironmnetal problems that can be solved using nanobiotechnology.
- focus on advanced nanobiotechnology techniques to facilitate nanoparticles and toxicity evaluation

LSCX 212 CANCER BIOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

This course will cover

- the origins of cancer and the genetic and cellular basis for cancer.
- It will examine the factors that have been implicated in triggering cancers;
- the intercellular interactions involved in cancer proliferation;
- current treatments for cancer and how these are designed;
- 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 PI3K/AKT pathways, The WNT/APC pathways, TGF-Beta/SMAD 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, Adoptive immunotherapy.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

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

OUTCOMES:

- Differentiate between carcinoma, sarcoma, leukemia, and lymphoma and how these terms are used to name cancer types.
- Summarize why it is important to understand basic biology in the study of cancer.
- Name the six hallmarks of cancer.
- Outline how cancer starts and how it spreads

LSCX 213	PHARMACOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- The student will be able to report the clinical applications, side effects and toxicities of drugs used in medicine.
- The student will be able to explain the mechanisms of action and pathology of ethanol and drugs of abuse. \
- The student will be able to translate **pharmacological** principles into clinical decision-making.

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 and Pharmacodynamics 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 and Biopharmaceuticals 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, Secondry cell culture, role of pharmaceutical companies in drug testing procedures, Cancer, Diabetes, Ageing and neurodegenerative animals models, role of biopharmacueticals in vaccine development.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, andPatent Issues, CRC Press, 2006.
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes intodrugs, 1stEdition, Wiley Liss, 2003.
3. Curtis D. Klaassen, Casarett&Doull's Toxicology: The Basic Science of Poisons, 9th edition.

OUTCOMES:

At the end of the course students will be able

- To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agent.
- To outline the drug manufacturing process including the role of quality control
- To quality assurance in protecting the public, workers, and the environment.
- To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical age

LSCX 214 REGENERATIVE MEDICINE

L	T	P	C
4	0	0	4

OBJECTIVES:

- We will explore basic mechanisms of how cells differentiate into specific tissues in response to a variety of biologic signaling molecules.
- We will discuss the use of such factors for *in vitro* tissue production.
- We will also study the cellular mechanisms involved in the cloning of animals, organ production
- We will also consider the molecular bases of cellular and functional changes of different organs that occur in disease and treatments that cause tissue remodeling to correct these changes.
- We will discuss how studies of the developmental, cellular and molecular biology of regeneration have led to the discovery of new drugs.

MODULE I BIOMOLECULES, LABORATORY METHODOLOGIES, AND ETHICS 12

Proteins, carbohydrates, nucleic acids, lipids, Physico-Chemical Principles of Lab Techniques, Clinical Research, Bioethics and Regulatory Guidance

MODULE II ARCHITECTURE OF CELLS TISSUES AND ORGANS 12

Basic Cell Structure and Functions,Tissue organization and functions, Organ Structure and Functions, Integrated Cell Biology

MODULE III EMBRYONIC DEVELOPMENT AND CELL DIFFERENTIATION 12

Early Embryonic Development, Mid to Late Embryonic Development, Tissue specific Stem Cells

MODULE IV INTERCELLULAR COMMUNICATION IN STEM CELL NICHES & BIOMATERIALS AND TISSUE ENGINEERING 12

Introduction to stem cell niches and niche regulation, Types of stem cell niches, Epithelial to Mesenchymal transition in stem cells, Properties and fabrication of Biomaterials, Types of intercellular junctions, Tissue Printing Ex vivo Organogenesis, Current Challenges in Cell and Tissue Engineering.

MODULE V CLINICAL APPLICATIONS OF STEM CELLS 12

Stem Cells Application in Ocular Diseases, Stem Cells Application in Endocrine Diseases, Stem Cells Application in Neurological Diseases, Stem Cells Application in Immunotherapy, Stem Cells Application in Hematological Disorders.

L –60 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. Principles of regenerative medicine, 3rd edition, 2018, Elsevier

OUTCOMES:

After completing the course, the student should be able to

- describe different types of stem cells and their specific characteristics
- describe methods of applications to replace damaged or destroyed cells including tissue engineering
- account for regenerative medicine applications to human diseases
- account for and evaluate current theories, methods and techniques within the research field, their practical execution and application
- compile, critically analyse and evaluate research results and present these both orally and in writing.

LSCX 215 rDNATECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

- To establish an understanding of DNA manipulation strategies
- To explore the advantages and disadvantages of novel methods for DNA purification, sequencing and mutagenesis
- To be aware of ethical issues associated with DNA engineering and cloning

MODULE I TOOLS OF GENETIC ENGINEERING 12

Restriction enzymes, DNA modifying enzymes, DNA ligase, Polymeraseetc, 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, Factors affecting expression of cloned genes, Reporter genes, Fusion proteins.

MODULE IV GENE MANIPULATION TECHNIQUES 12

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

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 ; P – 00; TOTAL HOURS – 60

REFERENCES:

1. From Genes to Clones by Winnacker. PANIMA

2. Molecular Biotechnology by Pasternack and Glick.
3. From Genes to Genomes: Concepts & Applications of DNA Technology by J.W. Dale & M.V. Schartz.
4. Gene Cloning & DNA Analysis: An Introduction (4th edition) by T.A. Brown.
5. Molecular Cloning by Sambrook, et al.
6. Principles of Gene Cloning by Old and Primrose.

OUTCOMES:

At the end of the course students will be able to

- Define recombinant DNA technology and explain how it is used to clone genes.
- Compare and contrast different types of vectors and describe practical features of vectors and their applications in molecular biology.
- Explain common techniques used to study gene expression.
- Be familiar with RNA interference (RNAi) as a powerful new technique for silencing gene expression.
- Understand potential scientific and medical consequences of the Human Genome Project, and discuss its ethical, legal, and social issues.

OPEN ELECTIVES (ODD SEMESTER)

LSCX 121	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

This course helps to

- provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of biotechnology.
- To update students' knowledge of new developments in biology of industrial relevance.
- To give students a broad understanding and experience of technological processes

MODULE I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

Overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Biotechnology and the developing world.

MODULE II METABOLIC STRATEGIES 9

General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis, Bioprocess/fermentation technology: Bioreactor, Scale-up, Media design, Technology for microbial, mammalian and plant cell culture, Downstream processing.

MODULE III PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 9

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,) Study of production processes for various classes of secondary metabolites.

MODULE IV ENZYME TECHNOLOGY& BIOPHARMACEUTICALS 9

Nature, Application, Genetic engineering & protein engineering, Immobilised enzymes and Technology of enzyme production, Introduction to genetic engineering, Antibiotics, Therapeutic proteins, Vaccines & monoclonal antibodies.

MODULE V APPLICATIONS 9

Introduction, Fermentation, Food processing, Sweeteners, Food wastes, Rapid diagnostics, Public acceptance & safety, Plant biotechnology, Forestry, Biological control, Animal biotechnology, Diagnostics in agriculture, Bioremediation.

L –45 ; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Presscott, Dunn, Industrial Microbiology, Agrobios (India), 2009.
2. Christoph Wittmann, James C. Liao, Industrial Biotechnology: Products and Processes, Wiley- VCH Verlag GmbH & Co. KGaA, 2017.

OUTCOMES:

At the end of the course students will be able to acquire knowledge on

- The facts, concepts, principles and theories relevant to the broad area of Biotechnology.
- The professional and ethical responsibilities of the Biotechnologist.
- Current themes and/or insights, at/or informed by, the forefront of the Biotechnology Industry and its related disciplines.
- The techniques applicable to the area of Biotechnology
- Processes which facilitate the critical evaluation of research, scholarship and methodologies within the area of Biotechnology.

LSCX 122 PHARMACEUTICAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to provide the students with the

- Introduction to terms and concepts used in pharmaceuticals
- Concepts of drug metabolism
- Introduction to drug manufacturing process
- Regulation in drug development and manufacture

MODULE I INTRODUCTION TO BIOPHARMACEUTICALS 9

Development of drug and pharmaceutical industry – Therapeutic agents, their use and economics Regulatory aspects. current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals.

MODULE II DRUG METABOLISM AND PHARMACOKINETICS 9

Definition, rationales, absorption, distribution and metabolism pathway. Factors governing, LD50, LC50, ED50, absorption of drug, Pharmacokinetics and Pharmacodynamics, Dose response relationship, interspecies scaling, In vitro studies, In vivo studies. Route of Administration of Drugs, Angle of Injection of drug, Drug Toxicities, Animal Models in Biopharmaceutical Research

MODULE III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS 9

Bulk drug manufacturers - Type of reactions in bulk drug manufacture and processes - Special requirement for bulk drug manufacture.

MODULE IV MANUFACTURING PROCESSES & THEIR USE 9

Manufacturing Process for Tablets, Dry granulation process, Wet granulation process, Dose conversion from preclinical studies to clinical studies, Route of administration of drugs, angle of injections of drug, different phases of clinical trials of drugs.

MODULE V REGULATORY AGENCIES AND THEIR CONTROL 9

Role of Regulatory agencies in drug development, FDA guidelines for drug development, Patenting process in India, Possible therapeutic intervention against COVID-19, Scheduling process of Drugs, Amphetamines, Cannabinoids,

Benzdizapines, CNS stimulant Drugs, Drug designing against apoptotic mediated diseases

L –45 ; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Curtis D. Klaassen, Casarett & Doull's Toxicology: The Basic Science of Poisons, 9th edition.

OUTCOMES:

At the end of the course students will be able

- To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agents.
- To outline the drug manufacturing process including the role of quality control
- To quality assurance in protecting the public, workers, and the environment.
- To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical age

OPEN ELECTIVES (EVEN SEMESTER)

LSCX 221	FERMENTATION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the students about microorganisms, development of media, and anaerobic digesters
- To make the students understand the fermentation process using these tools and its combination of bioprocess engineering

MODULE I Introduction to Fermentation technology 9

History, Scope and Development of Fermentation technology; Isolation and screening of industrially important microorganisms − primary and secondary screening; Maintenance of Strains; Strain improvement: Mutant selection and Recombinant DNA technology.

MODULE II Fermentation media 9

Natural and Synthetic media; Basic components of an media (Carbon sources; Nitrogen sources; Vitamins; Minerals; Anti-foaming agents); Role of buffers in media; Process of aeration, and agitation**.**

MODULE III Fermentor design 9

Basic designs of Fermentor; Type of fermentors: Waldhof, Tower, Deepjet, Cyclone column, Packed tower and airlift fermenter

MODULE IV Production of Microbial Products 9

Production of alcohol; Organic acid − Citric acid; Antibiotic − Penicillin, Amino acid − Glutamic acid; Vitamin − B1; Single Cell Protein (SCP).

MODULE V Scale up study and product development 9

Down-stream processing and Product recovery; Regulation and safety.

L –45 ; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Fermentation and biochemical engineering handbook by Henry C. Ogal, 2nd edition, Noyes Publications.
2. Advances in Biochemical Engineering Biotechnology by T. Sceper and J.J

Zhong; Springer Publication.
3. The Microbiology of anaerobic Digesters by Michael H. Gerardi, A John Wiley & Sons, Inc., Publication, 2003.

OUTCOMES:

- This course will give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.
- This course is taught to give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.

LSCX 222 HEALTHCARE BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

This course will enable students to acquire knowledge on the fundamentals of healthcare biotechnology. It enables them to understand emerging and advanced concept in molecular pathogenesis of disease and role of biotechnology in diagnosis, prevention and therapeutics. This programme will facilitate the students to acquire knowledge in fields various aspects and molecular tools used in clinical application in alleviation of human disease. It will also empower the students to have advanced focus on the molecular basis of diseases and development of advanced therapeutics.

MODULE I Introduction and Therapeutic Biomolecules 9

Molecular basis of disease, Biotechnology in disease prevention, therapeutics and diagnosis, Personalized Medicine; Therapeutic Biomolecules: Introduction, Nucleic acid, protein, carbohydrate and lipids, Role of biomolecules in diseases.

MODULE II Molecular diagnostics and Immunological products 9

Molecular diagnostics: gene based diagnosis, tools for screening of infectious disease, genetic disease; Immunological products: Overview, Vaccines, Cancer immunotherapy, Monoclonal Antibodies in Solid Organ Transplantation Monoclonal Antibodies in Anti-inflammatory Therapy.

MODULE III Oligonucleotides and Oligosaccharides 9

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozyme; Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate based cancer Vaccines

MODULE IV Radiological Agents and Cardiovascular Drugs and endocrine drugs 9

Radiological Agents: Radiosensitizers and Radioprotective agents; Cardiovascular Drugs and endocrine drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, antithrombotics and Haemostatics, Sex hormones and analogs.

MODULE V Chemotherapeutic Agents and Drug Targeting 9

Chemotherapeutic Agents: Synthetic antibacterial agents, antifungal, anti protozoal, Antihelminithic agents Antiamoebic agents, Antiviral agents; Drug Targeting: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery.

L –45 ; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Pharmaceutical Chemistry by Christine M. Bladon. John Wiley & Sons, Ltd.(2002).
2. Burger's Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E.Wolff. A Wiley (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. Wiley-VCH. (2002).
4. Medical Biotechnology, by JuditPongracz, Dr. Habil and Mary Keen. Churchill Livingstone (2008).
5. Healthcare Biotechnology: A Practical Guide 1st Edition by Dimitris Dogramatzis. CRC Press (2010)
6. Biotechnology in Healthcare: An Introduction to Biopharmaceuticals. Gavin Brooks, Pharmaceutical Press, (1998)
7. Biotechnology in Medical Sciences, ByFirdosAlam Khan, CRC press, Taylor and Francis, (2014)

OUTCOMES:

The students will be able

- To understand therapeutic biomolecules and their applications
- To get knowledge of molecular diagnostics
- know the applications of oligonucleotides and oligosaccharides

LSCX 223 DRUG DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get an overview of drug discovery process
- To obtain knowledge of various drug designing methods.
- To develop skill to understand the computation tools available for drug designing.

  To get familiarized with pre-clinical and clinical trial designs

MODULE I Introduction to Drug Design and Development **8**

Drug testing toxicities, LD50, EC50, ED50, Dose response curve, Biotransformation of drugs, Detoxification of drugs, Phase I and Phase II reaction in drug metabolism, Preclinical and clinical drug formulation, In vitro and In vivo models for drug designing, drug cytotoxicity assays

MODULE II Drug Testing Procedures **8**

Manufacturing Process for Tablets, Dry granulation process, Wet granulation process, Dose conversion from preclinical studies to clinical studies, Route of administration of drugs, angle of injections of drug, different phases of clinical trials of drugs.

MODULE III Manufacturing of Medicines and their control **7**

Preparation of capsules, hard gelatin capsules, soft gelatin capsules, manufacturing process for ointment preparation, narco-drug testing, narco-analysis process, drug doping control procedures, vaccine development against infectious diseases.

MODULE IV Regulatory Agencies for drug development **7**

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 diseases.

MODULE V Research Model for Drug Designing **7**

Introduction of Research Models, Primary cell culture, Secondry cell culture, role of pharmaceutical companies in drug testing procedures, Cancer, Diabetes, Ageing and neurodegenerative animals models, role of biopharmacueticals in vaccine

development.

L –45 ; P – 00; TOTAL HOURS – 45

REFERENCES:

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, andPatent Issues, CRC Press, 2006.
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes intodrugs, 1stEdition, Wiley Liss, 2003.
3. Curtis D. Klaassen, Casarett & Doull's Toxicology: The Basic Science of Poisons, 9th Edition, 2014.

OUTCOMES:

At the end of the course students will be able

- To explain the therapeutic mode of action, and understand structural considerations of at least four classes of biopharmaceutical agent.
- To outline the drug manufacturing process including the role of quality control
- To quality assurance in protecting the public, workers, and the environment.
- To Give an oral presentation to scientific audience on the biological mechanism of action and proposed evaluation of safety, efficacy and manufacturing controls on a biopharmaceutical age

LSCX 224 FOOD BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

This course helps to

- provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of food biotechnology.
- To update students' knowledge of new developments in biology of food industry
- To give students a broad understanding and experience of technological processes involved in the food industry.

MODULE I HISTORICAL BACKGROUND 9

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 9

Food Spoilage –Factors – Role of Microbes in Food – Food Infection & Food Intoxication – Food Pathogens – Food Toxins – Bacterial, Fungal & Biological

MODULE III FOOD COMPONENTS 9

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 9

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 9

Milk & Dairy Products (Yogurt & Cheese) – Fermentation & Fermented Products (Wine, Beer, DisSpirits) – Single Cell Protein-Other Food Products (Extruded Products/Cocoa/Coffee/Tea)

L –45 ; P – 00; TOTAL HOURS – 45

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.
3. Food Chemistry. The AVI Publishing Co Inc., Connecticut, MA, USA.

OUTCOMES:

The students will be able to search for, analysis and synthesis of data and information, with the use of the necessary technology

- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking