UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman 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 University
- 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 OF THE SCHOOL OF LIFE SCIENCES

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

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES
M.Sc. Bioscience

PROGRAMME EDUCATIONAL OBJECTIVES:

- To provide opportunities of higher studies in the professional area of Actuarial Science.
- To impart knowledge on various theoretical and practical aspects of Actuarial Science.
- To enable the students to apply their newly gained knowledge and skills in their workplace.
- To develop independent learning skills and transferable skills among the students.
- To help the students extend and develop their career plan and pursue their own professional development.
- To provide the students with a structured programme of study covering all Core Actuarial Science subject contents.
- To contribute to the education of academics, allowing the University to play an active role in the production of advanced studies in the areas of the Master in Actuarial Science.

PROGRAMME OUTCOMES

On Completion of the Programme, the students will be able to

- understand the fundamental probability tools for quantitatively assessing risk and demonstrate an ability to apply these tools to problems encountered in Actuarial Science.
- use the fundamental concepts of Financial Mathematics and demonstrate an ability to use those concepts to calculate present and accumulated values for various streams of cash flows as a basis for future use. Also they can demonstrate an understanding of the financial instruments, including derivatives, and the concept of no–arbitrage as it relates to financial mathematics.

- understand the theoretical bases of certain Actuarial Models and Life Contingent models and can apply those models to insurance and other financial risks.
- understand the frequency and severity models and an ability to carry out the steps involved in the modeling process in solving Actuarial Science problems.
- demonstrate the ability to summarize and communicate, orally and in writing, Actuarial problems and the ability to communicate solutions to Actuarial problems to specialized and non-specialized audiences, and,
- demonstrate highest standards of Actuarial ethical conduct and Professional Actuarial behavior, critical, interpersonal and communication skills as well as a commitment to life-long learning.

B.S.ABDUR RAHMAN
UNIVERSITY
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)
(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS - 2013
FOR
M.Sc. DEGREE PROGRAMMES

B.S. ABDUR RAHMAN UNIVERSITY, CHENNAI 48.
REGULATIONS - 2013 FOR M.TECH / MCA / M.Sc. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i) **"Programme"** means Post Graduate Degree Programme (M.Tech./ MCA / M.Sc.)

ii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.

iii) **"University"** means B.S.Abdur Rahman University, Chennai, 600048.

iv) **"Institution"** unless otherwise specifically mentioned as an autonomous or off campus institution means B.S.Abdur Rahman University.

v) **"Academic Council"** means the Academic Council of this University.

vi) **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S.Abdur Rahman University.

vii) **"Dean (Student Affairs)"** means Dean(Student Affairs) of B.S.Abdur Rahman University.

viii) **"Controller of Examinations"** means the Controller of Examinations of B.S.Abdur Rahman University who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. Programmes Offered

The various P.G. Programmes and their modes of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
M.Tech.	Part Time – Day / Evening
M.C.A.	Full Time
M. Sc.	Full Time

2.2 MODES OF STUDY

2.2.1 Full-time

Students admitted under "Full-Time" shall be available in the Institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

2.2.2 A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department, if the student satisfies the clause 2.3.4 of this Regulation. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

2.2.3 Part time - Day time

In this mode of study, the students are required to attend classes for the courses registered along with full time students.

2.2.4 Part time - Evening

In this mode of study, the students are required to attend normally classes in the evening and on Saturdays, if necessary.

2.2.5 A part time student is not permitted to convert to full time mode of study.

2.3 ADMISSION REQUIREMENTS

2.3.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination of this University as specified in the Table shown for eligible entry qualifications for admission to P.G. programmes or any other degree examination of any University or authority accepted by this University as equivalent thereto.

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

2.3.3 All part-time students should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by this Institution from time to time.

2.3.4 A student eligible for admission to M.Tech. Part Time / Day Time programme shall have his/her permanent place of work within a distance of 65km from the campus of this Institution.

2.3.5 Student eligible for admission to M.C.A under lateral entry scheme shall be required to have passed three year degree in B.Sc (Computer Science) / B.C.A / B.Sc (Information Technology)

3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

3.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min.No.of Semesters	Max.No.of Semesters
M.Tech. (Full Time)	4	8
M.Tech. (Part Time)	6	12
M.C.A. (Full Time)	6	12
M.C.A. (Full Time) – (Lateral Entry)	4	8
M.Sc. (Full Time)	4	8

3.2 The PG. programmes consist of the following components as prescribed in the respective curriculum

i. Core courses
ii. Elective courses
iii. Project work / thesis / dissertation
iv. Laboratory Courses
v. Case studies
vi. Seminars
vii. Industrial Internship

3.3 The curriculum and syllabi of all PG. programmes shall be approved by the Academic Council of this University.

3.4 The minimum number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

3.5 Each academic semester shall normally comprise of 80 working days. Semester-end examinations will follow immediately after the last working day.

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
01.	Civil Engineering	M.Tech. (Structural Engineering)	B.E / B.Tech. (Civil Engineering) / (Structural Engineering)
		M.Tech. (Construction Engineering and Project Management)	
02.	Mechanical Engineering	M.Tech. (Manufacturing Engineering)	B.E. / B.Tech. (Mechanical / Auto / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M.Tech. CAD / CAM	
03.	Polymer Engineering	M.Tech. (Polymer Technology)	B.E./ B.Tech. degree Mech./Production/ Polymer Science or Engg or Tech / Rubber Tech / M.Sc (Polymer Sc./ Chemistry Appl. Chemistry)
04.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engg)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
		M.Tech. (Power Electronics & Drives)	
05.	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E / B.Tech (EEE/ ECE / E&I / I&C / Electronics / Instrumentation)
		M.Tech.(VLSI and Embedded Systems)	B.E./ B.Tech. in ECE / Electronics / EIE / ICE / EEE
		M.Tech.(Signal Processing)	
06.	ECE Department jointly with Physics Dept	M.Tech. (Optoelectronics and Laser Technology)	B.E./B.Tech. (ECE / EEE / Electronics / EIE / ICE) M.Sc (Physics / Materials Science / Electronics / Photonics)
07.	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E./ B.Tech. (EIE/ICE/Electronics/ECE/ EEE)
08.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. /B.Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics) MCA
		M.Tech. (Software Engineering)	B.E. / B.Tech. (CSE / IT) MCA
		M.Tech (Network Security)	B.E. /B.Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics) MCA
		M.Tech (Computer and Predictive Analytics)	
		M.Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	
09	Information Technology	M.Tech. (Information Technology)	B.E /B.Tech. (IT/CSE/ECE/EEE/EIE/ICE/ Electronics) MCA
		M.Tech. (Information Security & Digital Forensics)	

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
10	Computer Applications	M.C.A.	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		M.C.A. (Full Time) – (Lateral Entry)	B.Sc Computer Science / B.Sc Information Technology / B.C.A
		M.Tech. (Systems Engineering and Operations Research)	BE / B.Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
		M.Tech. (Data & Storage Management)	
11	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the Subjects of Study.
		M.Sc. Mathematics	B.Sc. (Mathematics)
12	Physics	M.Sc.(Physics)	B.Sc.(Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
		M.Sc. (Material Science)	
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry) of B.Sc. (Applied Science)
14	Life Sciences	M.Sc. Molecular Biology & Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Genetics	
		M.Sc. Biotechnology	
		M.Sc. Microbiology	
		M.Sc. Bioscience	

3.6 The curriculum of PG programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Minimum prescribed credit range
M.Tech.	75 to 85
M.C.A.	120 to 130
M.Sc.	75 to 85

3.7 Credits will be assigned to the courses for all P.G. programmes as given below:

* One credit for one lecture period per week
* One credit for one tutorial period per week
* One credit each for seminar/practical session/project of two or three periods per week
* One credit for two weeks of industrial internship.

3.8 The number of credits registered by a student in non-project semester and project semester should be within the range specified below:

P.G. Programme	Non-project Semester	Project semester
M.Tech. (Full Time)	15 to 29	12 to 20
M.Tech. (Part Time)	6 to 18	12 to 16
M.C.A. (Full Time)	15 to 29	12 to 20
M.Sc. (Full Time)	15 to 25	12 to 20

3.9 The electives from the curriculum are to be chosen with the approval of the Head of the Department.

3.10 A student may be permitted by the Head of the Department to choose electives offered from other PG programmes either within the Department or from other Departments up to a maximum of three courses during the period of his/her study, provided the Heads of the Departments offering such courses also agree.

3.11 To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas in the curriculum, "Special Electives" may be offered. A student may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Chairman, Academic Council before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.

3.12 The medium of instruction, examination, seminar and project/thesis/ dissertation reports will be English.

3.13 Industrial internship, if specified in the curriculum shall be of not less than two weeks duration and shall be organized by the Head of the Department.

3.14 PROJECT WORK/THESIS/DISSERTATION

3.14.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department.

3.14.2 A student may however, in certain cases, be permitted to work for the project in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization and the student shall be instructed to meet the faculty periodically and to attend the review committee meetings for evaluating the progress.

3.14.3 Project work / Thesis / Dissertation (Phase - II in the case of M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.

3.14.4 The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

3.14.5 The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.

3.14.6 If a student fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

3.14.7 A student who has acquired the minimum number of total credits prescribed in the Curriculum for the award of Masters Degree will not be permitted to enroll for more courses to improve his/her cumulative grade point average (CGPA).

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the whole class.

He/she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

4.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of 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 offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment every semester.

5.0 CLASS COMMITTEE

5.1 Every class of the PG Programme will have a Class Committee constituted by the Head of the Department as follows:

i. Teachers of all courses of the programme

ii. One senior faculty preferably not offering courses for the class, as Chairperson.

iii. Minimum two students of the class, nominated by the Head of the Department.

iv. Class Advisor / Faculty Advisor of the class - Ex-Officio Member

v. Professor in-charge of the PG Programme - Ex-Officio Member.

5.2 The Class Committee shall be constituted by the respective Head of the Department of the students.

5.3 The basic responsibilities of the Class Committee are to review periodically the progress of the classes to discuss problems concerning curriculum and syllabi and the conduct of classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and Dean (Academic Affairs). The class committee, without the student members, will also be responsible for finalization of the semester results and award of grades.

5.4 The Class Committee is required to meet at least thrice in a semester, first within a week of the commencement of the semester, second, after the first

assessment and the third, after the semester-end examination to finalize the grades.

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 (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 REGISTRATION AND ENROLMENT

7.1 For the first semester every student has to register and enroll for all the courses.

7.2 For the subsequent semesters registration for the courses will be done by the student during a specified week before the semester-end examination of the previous semester. The curriculum gives details of the core and elective courses, project and seminar to be taken in different semester with the number of credits. The student should consult his/her Faculty Adviser for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Adviser.

7.3 From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

7.4 A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Adviser. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

7.5 Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

7.6 Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (Academic Affairs), on the recommendation of the HOD, is permitted.

7.7 Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

8.0 TEMPORARY BREAK OF STUDY FROM THE 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. Such student has to rejoin only in the same semester from where he left. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / DISSERTATION

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum No. of credits to be earned to enroll for project semester
M.Tech. (Full time)	18 (III semester)
M.Tech. (Part time)	18 (V semester)
M.C.A. (Full time)	45 (V semester)
M.C.A. (Full time) – (Lateral Entry)	22 (V semester)
M.Sc. (Full time)	30 (IV semester) if project is in IV semester 18 (III semester) if project is in III semester

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 DISCIPLINE

10.1 Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the Institution.

10.2 Any act of indiscipline of a student reported to the Head of the Institution will be referred to a Discipline and Welfare Committee for taking appropriate action.

10.3 Every student should have been certified by the HOD that his / her conduct and discipline have been satisfactory.

11.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

Attendance rules for all Full-time programme and Part-time – Day-time programmes are given in the following sub-clause.

11.1 A student should secure not less than 75% overall attendance in that semester taking into account the total no. of periods in all courses put together attended by the student as against the total no. of periods in all courses offered during that semester. If a student who could secure overall attendance between 65% and 75% only in a particular semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level sports events with prior permission from the Officials concerned shall be given exemption from the prescribed attendance requirement and he / she shall be permitted to appear for the current semester examinations.

The students who do not fulfill the above attendance requirement will not be permitted to write the semester end examination and will not be permitted to move to next semester. Such students should repeat all the courses of the semester in the next Academic year.

11.2 The faculty member of each course shall furnish the cumulative attendance details to the class advisor. The class advisor will consolidate and furnish the list of students who have earned less than 75% overall attendance, to the Dean (Academic Affairs) through the Head of the Department / School Dean. Thereupon, the Dean (Academic Affairs) shall issue orders preventing students from appearing for the semester end examination of all the courses of that semester.

11.3 A student who is awarded "U" grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the semester-end (re-do) examination. If any student obtained "U" grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

11.4 If a student with "U" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing 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.

12.0 ASSESSMENTS AND EXAMINATIONS

12.1 The following rule shall apply to the full-time and part-time PG programmes (M.Tech./ M.C.A. / M.Sc.)

For lecture-based courses, normally a minimum of two assessments will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided in the Class Committee will be announced to the students right from the beginning of the semester by the course teacher.

12.2 There shall be one examination of three hours duration, at the end of the semester, in each lecture based course.

12.3 The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

12.4 At the end of industrial internship, the student shall submit a certificate from the organization and also a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

13.0 WEIGHTAGES

13.1 The following shall be the weightages for different courses:

i) **Lecture based course**

Two continuous assessments	- 50%
Semester-end examination	- 50%

ii) **Laboratory based courses**

Laboratory work assessment	- 75%
Semester-end examination	- 25%

iii) **Project work**

Periodic reviews	- 50%
Evaluation of Project Report by External Examiner	- 20%
Viva-Voce Examination	- 30%

13.2 Appearing for semester end examination for each course (Theory and Practical) is mandatory and a student should secure a minimum of 40% marks in semester end examination for the successful completion of the course.

13.3 The markings for all tests, tutorial, assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per the weightages given in clause 13.1.

14.0 SUBSTITUTE EXAMINATION

14.1 A student who has missed for genuine reasons any one of the three assessments including semester-end examination of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident or admissions to a hospital due to illness, etc.

14.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean (Academic Affairs) through the Head of the department within a week from the date of missed assessment. However the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

15.0 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES

15.1 Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

Letter grade	Grade points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
AB	-

Flexible range grading system will be adopted

"W" denotes withdrawal from the course.

"U" denotes unsuccessful performance in a course.

"AB" denotes absent for the semester end examination

15.2 A student is considered to have completed a course successfully if he / she secure five grade points or higher. A letter grade 'U' in any course implies unsuccessful performance in that course.

15.3 A course successfully completed cannot be repeated for any reason.

16.0 AWARD OF LETTER GRADE

16.1 A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the semester end examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

16.2 After finalization of the grades at the class committee meeting the Chairman will forward the results to the Controller of Examinations, with copies to Head of the Department and Dean (Academic Affairs).

17.0 DECLARATION OF RESULTS

17.1 After finalization by the Class Committee as per clause 16.1 the Letter grades awarded to the students in the each course shall be announced on the

departmental notice board after duly approved by the Controller of Examinations.

17.2 In case any student feels aggrieved about the results, he/she can apply for revaluation after paying the prescribed fee for the purpose, within one week from the announcement of results.

A committee will be constituted by the concerned Head of the Department comprising of the Chairperson of the concerned Class Committee (Convener), the teacher concerned and a teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised marks to the Controller of Examinations with full justification for the revision, if any.

17.3 The “U” and “AB” grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

18.0 COURSE REPETITION AND ARREARS EXAMINATION

18.1 A student should register to re-do a core course wherein "W" grade is awarded. If the student is awarded "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

18.2 A student who is awarded “U” or “AB” grade in a course shall write the semester-end examination as arrear examination, at the end of the next semester, along with the regular examinations of next semester courses.

18.3 A student who is awarded “U” or “AB” grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the end-semester (re-do) examination.

18.4 If any student obtained “U” or “AB” grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

18.5 If a student with “U” or “AB” grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing 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.

19.0 GRADE SHEET

19.1 The grade sheet issued at the end of the semester to each student will contain the following:

(i) the credits for each course registered for that semester.

(ii) the performance in each course by the letter grade obtained.

(iii) the total credits earned in that semester.

(iv) the 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.

19.2 The GPA will be calculated according to the formula

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i} \qquad Where\ \ n = number\ of\ courses$$

where C_i is the number of credits assigned for i^{th} course GP_i - Grade point obtained in the i^{th} course For the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point of time.

'W' grade will be excluded for GPA calculations.

'U', 'AB' and 'W' grades will be excluded for CGPA calculations.

19.3 Classification of the award of degree will be as follows:

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above, having completed within a period of 2 semesters beyond the programme period	First Class
All others	Second Class

However, to be eligible for First Class with Distinction, a student should not have obtained U grade in any course during his/her study and should have completed the PG Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The 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.

20.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

20.1 A student shall be declared to be eligible for the award of the Masters Degree, if he/she has:

i) successfully acquired the required credits as specified in the Curriculum corresponding to his/her programme within the stipulated time,

ii) no disciplinary action is pending against him/her

20.2 The award of the degree must be approved by the University.

21.0 POWER TO MODIFY

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

CURRICULUM & SYLLABI FOR M.SC. BIOCHEMISTRY & MOLECULAR BIOLOGY

(FOUR SEMESTERS / FULL TIME)

CURRICULUM

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1	LSB1101	Biomolecules	3	0	0	3
2	LSB1102	Cell & Molecular Biology	3	0	0	3
3	LSB1103	Biochemistry	3	1	0	4
4	LSB1104	Microbiology	3	0	0	3
5	LSB1105	Analytical Techniques	3	0	0	3
6	LSB1106	Human Physiology	3	0	0	3
7	LSB1107	Cell & Molecular Biology Lab	0	0	2	1
8	LSB1108	Biochemistry Lab	0	0	4	2
9	LSB1109	Microbiology Lab	0	0	2	1
					Credits	**23**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1	LSB1211	Bioinformatics	3	1	0	4
2	LSB1212	Biostatistics	3	1	0	4
3	LSB1213	Immunology &Immunotechnology	3	0	0	3
4	LSB1214	Recombinant DNA Technology/ Genetic Engineering	3	0	0	3
5	LSB1215	Principles of Genetics	3	0	0	3
6	LSB1216	Bioinformatics Lab	0	0	4	2
7	LSB1217	Immunology &Immunotechnology Lab	0	0	4	2
					Credits	**21**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1	LSB2106	Scientific Writing	0	0	2	1
2	LSB2107	Technical Presentation	0	0	2	1
3	LSB2108	Animal and plant Cell Culture	3	0	0	3
4	LSB2109	Plant Biotechnology	3	0	0	3
5	LSB2110	Proteomics & Genomics	3	0	0	3
6	LSB2111	Nanotechnology & Tissue Engineering	3	0	0	3
7	LSB2112	Plant Biotechnology Lab	0	0	2	1
8	LSB2113	Animal and plant cell/culture Lab	0	0	4	2
9		Elective I	3	0	0	3
10		Electives -I	3	0	0	3
					Credits	**23**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1	LSB2211	Project work	0	0	16	8
					Credits	**8**
					TOTAL CREDITS	**75**

LIST OF ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	LSBY001	Pharmaceutical Biotechnology	3	0	0	3
2.	LSBY002	Drug Design and Development	3	0	0	3
3.	LSBY003	Food Process Technology	3	0	0	3
4.	LSBY004	Recombinant DNA Technology	3	0	0	3
5.	LSBY005	Bioreactor Design and Analysis	3	0	0	3
6.	LSBY006	Molecular & Cellular Diagnostics	3	0	0	3
7.	LSBY007	Biomedical Engineering	3	0	0	3
8.	LSBY008	Biosafety and Bioethics	3	0	0	3
9.	LSBY009	Nanobiotechnology	3	0	0	3
10.	LSBY010	Stem Cells in Health Care	3	0	0	3
11.	LSBY011	Intellectual Property Rights	3	0	0	3

SEMESTER I

LSB1101	BIOMOLECULES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the structural and functional role of carbohydrate and aminoacids.
- To enable the learners about the structural properties of nucleic acids and lipids and their biological role.
- To expose themselves about the secondary metabolites in plants and animals.

MODULE I BIOMOLECULES **9**

Biomolecules- chemical composition and bonding, chemical reactivity, ionization of water, weak acids and weak bases, buffers and buffering in biological systemsCarbohydrates monosaccharides, disaccharides, oligosaccharides, sugar derivatives, amino sugar, phosphate esters, deoxysugar and sugar acid. Polysaccharides, structure types and biological functions of homo and hetero polysaccharides.- Isolation, identification and characterisation of various carbohydrate molecules.

MODULE II AMINOACIDS & ENZYMES **9**

Aminoacids- Classification, structure and function, proteins- primary, secondary, tertiary and quaternary structure, - alpha helix and beta pleats Ramachandran plot, super secondary structures and helix loop Enzymes as biomolecules, Isolation, identification and characterisation of peptides and protein molecules

MODULE III NUCLEIC ACIDS **9**

Nucleic acids- types and structural organization, triple helix of DNA, DNA denaturation and renaturation, hypochromicity- Tm. Discovery of DNA- evidence for DNA as the genetic material, DNA-supercoiling, linking number, satellite DNA, possible functions, Cot curve, C- value paradox- RNA types- rRNA, mRNA, tRNA, miRNA, siRNA and their biological function.

MODULE IV LIPIDS **9**

Lipids- classification- simple, compound and derived Lipids, structure and properties, phospholipids, glycoplipids,sphingolipids and cholesterol. Fatty acids- saturated and unsaturated fatty acids, structure and biological role of prostaglandins, thromboxanes and leukotrienes. (6h)

MODULE V SECONDARY METABOLITES **9**

Secondary Metabolites in plants and animals - Polyphenols, flavonoids, tannins, lignin and saponins, terpenes, alkaloids - structure, and biological functions, isolation, characterisation and estimation of various secondary metabolites.

Total Hours: 45

REFERENCES:

1. NelsonD.L, Cox M. M. Lehninger's Principle of Biochemistry. 5th Edition, W. H. Freeman, 2008.
2. BergJ.M, TymoczkoJ.L, Stryer L. Biochemistry. 6th Edition, Freemanand Company, 2006.
3. Adams R.L, KnowlerJ.Leader. D.P. Biochemistry of Nucleic Acids. Cambridge Univ. Press, 1998.
4. Finar I. L, Organic Chemistry vol 2. 3rd. Edition, Longmans Green & Company, 1964.

OUTCOMES:

- On the completion of the above objectives student will be able to understand the structural and functional role of primary metabolites like amino acids, carbohydrate, nucleic acids and lipids. They will also be familiar with the secondary metabolites in plants and animals.

LSB1102 CELL & MOLECULAR BIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To get overview of different types of cell and structural and function aspects of plasma membrane.
- To develop knowledge on cell organelle.
- To develop skill to understand molecular aspects of cell cycle and cell division.
- To get familiar with transcription and translation in details.

MODULE I INTRODUCTION TO CELL & ITS COMPONENTS 9

Basic properties of cell-water, inorganic-organic constituents of cell- Different classes of cell: Prokaryotic- animal and plant cell and their characterstics- Cell wall composition- function of bacterial cell wall- Plasma membrane- structure-function, fluid mosaic model- membranes-lipids and proteins- membranes transport - passive- active- phagocytosis-endocytosis and role of clatherin coated vesicles

MODULE II CELL ORGANELLES AND EXTRACELLULAR MATRIX 9

Endoplasmic reticulum- golgi complex- Lysosomes exocytosis- phagocytosis- endocytosis- Plant cell vacuoles- Structure of mitochondria and organization of respiratory chain- Structure of chloroplast and photophosphorylation- Structure of nucleus- nucleolus- nuclear membrane- transport across nuclear membrane and Extracellular matrix- collagen- proteoglycans- fibronectin- laminins- integrins- selectin- cadherins-) role of tight junctions and gap junctions

MODULE III DNA REPLICATION & CELL DIVISION 9

Molecular aspects of cell division and cell cycle, regulation of cell cycle events, molecular aspects of apoptosis, necrosis, auotphagy DNA replication- prokaryotic and eukaryotic DNA replication, mechanism of replication. Enzymes and necessary proteins in DNA replication. Telomeres, end replication, role of telomerase in aging and cancer,

MODULE IV TRANSCRIPTION 9

Transcription- Prokaryotic and eukaryotic Transcription, RNA polymerases, general and specific transcription factors, regulatory elements, mechanism

of transcription regulation, Transcription termination, Post transcriptional modification- 5' cap formation-3' end processing and polyadenylation, splicing, editing, nuclear export of mRna, and mrna stability (6h)

MODULE V TRANSLATION **9**

Translation- Genetic code, Prokaryotic and eukaryotic translation, translational machinery, Mechanism of initiation, elongation and termination and regulation of translation.

Total Hours: 45

REFERENCES:

1. Lodish H. F, Cell and Molecular Biology, W.H. Freeman & Co Ltd, 2000.
2. Cooper G. M, Cell: a Molecular Approach, Sinauerassociates,USA2000.
3. Lewin B, Gene VIII, Prentice Hall, USA 2003.

OUTCOMES:

- On the completion of the above objectives student will be able to get the overview of classes of cells and structural and functional aspects of plasma membrane and cell organelle. They can develop skill to understand molecular aspects of cell cycle, cell division, transcription and translation.

LSB1103 BIOCHEMISTRY L T P C
3 1 0 4

OBJECTIVES:

- To explore about enzyme and metabolism in details.
- To get overview of metabolism of lipids and general reaction of aminoacids.
- To expose themselves catabolism of porphyrins and overview of signal transduction.

MODULE I ENZYMES 9

Enzymes in biochemical reactions - classification, Enzymatic catalysis- mechanism of action, Enzyme kinetics- Factors affecting enzyme activity - Michaelis-Menten equation- Lineweaver-burk plot- catalytic efficiency- Haldane relationship- Hills plot- Bisubstrate reactions- Enzyme Inhibition- Irreversible, reversible, competitive, non-, competitive - uncompetitive inhibition- Enzyme regulation- allosteric enzymes, Isoenzymes, Coenzymes and cofactors.

MODULE II METABOLISM OF CARBOHYDRATES 9

Introduction to metabolism- anabolism, catabolism, interrelations and regulation of metabolic pathways, antimetabolites- Metabolism of Carbohydrates and their regulation- glycolysis, citric acid cycle, HMP pathway, glycogenesis and glycogenolysis, gluconeogenesis, glyoxylate cycle.

MODULE III METABOLISM OF LIPIDS 9

Metabolism of lipids- Biosynthesis and catabolism in general-oxidation of fatty acids Biosynthesis of Mono and PUFA - Biosynthesis and degradation of triacylglycerol- phospholipids- sphingolipids - Cholesterol synthesis, transport and storage- Arachidonic acid metabolism Prostaglandins- Leukotrienes - Thromboxanes.

MODULE IV METABOLISM OF AMINO ACIDS AND NUCLEIC ACIDS

General reactions of degradation of amino acids - transamination, oxidative deamination, decarboxylation, disposal of ammonia, urea cycle. Metabolism

of proteins and non-essential amino acids, specialized products from amino acids- Inborn errors of metabolism- interrelations between metabolism of carbohydrates, lipids and amino acids. Biosynthesis and catabolism of porphyrins- heme-bile pigments-transport and excretion- Biosynthesis of Purines and pyrimidines - catabolism and regulation- Inborn errors of nucleotide metabolism. (11h)

MODULE V SIGNAL TRANSDUCTION 8

Signal Transduction- intracellular receptor and cell surface receptors in the regulation of metabolic pathways. Role of G- proteins coupled receptors, camp, Tyrosine kinase in cell signal transductions.

Total Hours: 45

REFERENCES:

1. Nelson D. L, Cox M. M. Lehninger's, Principle of Biochemistry,5th Ed.,W. H. Freeman, 2008.
2. Martin D. W, Mayer P. A. and Rodwell V. W. Harper's, Review of Biochemistry , 30th Ed., Maruzen Asian Lange Med.,2010.
3. Dixon M, Webb E. C,Thorne C.J.R and Tipton K.F, Enzymes. 3rd Ed., Longmans, Green & Co.,Academic Press, New York, 1979.
4. Enzyme Nomenclature (1992),Recommendations of the Nomenclature Committee of the International Union of Biochemistry and Molecular Biology, Academic Press, San Diego, 1984.
5. Berg J.M, TymoczkoJ.L, Stryer L, Biochemistry, 6th Ed., Freemanand Company, 2006.

OUTCOMES:

- On the completion of the above objectives student will be able to explore about enzyme, lipids and their reaction metabolic processes. They will have an overview of catabolism of porphyrins and signal transduction.

LSB1104 MICROBIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To expose the fundamentals and scope of microbiology.
- To learn the classification of bacteria, Virus, Fungi & Protozoa
- Learn microbial culture and disease related to microbes.

MODULE I INTRODUCTION TO MICROBIOLOGY 9

History and scope of microbiology- Classification of microorganisms-bacteria, fungi, virus, alga, protozoa- sterilization techniques, disinfectant and antiseptic agents. Microscopy - types of microscopes and their applications-simple and compound, bright field, dark field, fluorescence, phase-contrast and electron microscopes.

MODULE II BACTERIOLOGY 9

Major groups of bacteria- Archaebacteria, Actinomycetes, chemoautotrophs, eubacteria, Pseudomonads, cyanobacteria, rickettsias, chlamydias and spirochetes- Bacterial cell- structure and functions of cellular components-cell wall composition of Gram positive and Gram negative bacteria, sub-cellular organizations, flagella, capsule and spores- bacterial staining- antimicrobial agents-antibiotics, chemotherapeutic drugs-antibacterial agents-mode of action- antibiotic resistance.

MODULE III VIROLOGY 9

Classification, morphology and characteristics of virus, fungi and Protozoa. Structure of DNA and RNA viruses, viral replication, Bacteriophages- lysogeny and lytic cycle- virus like agents-satellites, viroids and prions, antiviral and antifungal drugs. Classification of Helminthic parasites- Life cycle of malarial and filarial parasites.

MODULE IV CULTURING OF MICROORGANISMS 8

Microbial culture, continuous and synchronous culture- composition of culture media -solid and liquid media, chemically defined media, complex and differential media- Effect of PH, temperature and radiation on microbial growth.

MODULE V MICROBES AND DISEASES **10**

Major human diseases caused by bacterial, viral and fungal pathogens Diseases of the respiratory tract-diphtheria, tuberculosis, pneumonia, influenza, mumps- Diseases of the skin-systemic mycoses, candidiasis- herpes viral infections, chicken pox, zoster and small pox- Genito-urinary infections-Gonorrhea, syphilis, leptospirosis, and AIDS- trichomoniasis- Diseases of GIT-Cholera, ETEC and EIEC infections- shigellosis- Typhoid- Hepatitis, gasteroenteritis. Major human protozoan diseases-Malaria, Amebiasis, Toxoplasmiases.

Total Hours: 45

REFERENCES:

1. Prescott, Harley and Klein, Microbiology, 5th Edition, Publisher: mcgraw Hill science, 2002.
2. Gerard J. T, Berdell R. F, Christine L. C, Microbiology: An Introduction, 8th Edition, Benjamin Cummings, 2004.
3. Kenneth J. R,George R, John C. S, Medical Microbiology: An Introduction to Infectious Diseases, mcgraw-Hill Professional, 2003.

OUTCOMES:

- On the completion of the above objectives student will be able to learn the fundamentals and scope of microbiology, classification of Protozoa, bacteria, Fungi Virus, microbial culture and diseases.

LSB1105 ANALYTICAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To learn the electrochemical techniques and principles of centrifugation and spectrophotometry.
- To learn the principles of chromatography and microscopy and their several aspects.
- To understand the information of radioactive methods, detection and measurement of radioactivity.

MODULE I ELECTROCHEMICAL TECHNIQUES 9

Basic principles of electrochemical techniques - pH electrode, ion selective-gas-sensing and oxygen electrodes- biosensors. Centrifugation- basic principles-types of centrifugation units ,colloidal nature of particles, centrifugation methods and accessories, sedimentation velocity, sedimentation equilibrium and cell fractionation methods.

MODULE II SPECTROPHOTOMETRY 10

Principles and techniques of colorimetry and spectrophotometry-Beer-Lamberts Law -instrumentation - qualitative and quantitative methods of analysis- hypo and hyper chromicity- coupled assays –Spectrofluorimetry-Turbidimetry - Flame and Atomic absorption Spectrophotometer and Mass spectrometer. Chromatography- types- column, thin layer, paper, adsorption, partition, gas, liquid, ion exchange, affinity, HPLC- principles type of instrumentation and accessories- detection methods qualitative and quantitative aspects-applications.

MODULE III MICROSCOPY 8

Basic principles of microscopy and application of Light, Compound, Phase contrast inverted microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM),Fluorescence Microscopy-Scanning Tunneling Microscopy (STM),Automated Fluorescence Microscopy and Confocal Microscopy.

MODULE IV ELECTROPHORESIS 9

Types of Electrophoresis- paper and gel-agarose and SDS-PAGE.pulsed

field-capillary - isoelectric focusing- 2 Dgel electrophoresis- blotting methods- Western, Southern and Northern application in life sciences.

MODULE V RADIOACTIVE METHODS 9

Types of radioisotopes-half life- units of radioactivity- uses of radioisotopes in life sciences and biotechnology- detection and measurement of radioactivity- liquid scintillation counting- solid state counting- Geiger counter - Radiation hazards Techniques and applications of Electron spin resonance- Nuclear magnetic resonance- Circular Dichroism (CD) - Optical Rotary Dispersion (ORD).

Total Hours: 45

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.
4. Horst F, Basic One and Two-dimensional spectroscopy, VCH Publisher, 1991.
5. West E. S, Todd W. R, Mason H. S, Bruggen J, Textbook of Biochemistry, 4th Ed, Oxford and IBH Publishing Co, 1995.
6. Freifelder D. M, Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd Ed., W.H. Freeman, 1982.

OUTCOMES:

- On the completion of the above objectives student will be able to know the electrochemical techniques and principles of centrifugation, spectrophotometry, chromatography and microscopy. They will have the information of radioactive methods.

LSB1106 HUMAN PHYSIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand human physiology, digestive process and body functions by various organ systems.
- Explore scholars with cardiovascular system and respiratory physiology in full details.
- To expose themselves with structure and function of renal, muscular and nerve physiology.

MODULE I INTRODUCTION TO HUMAN PHYSIOLOGY 9

Internal environment and homeostasis - coordinated body functions by various organ systems. Digestion- digestive processes at various regions of digestive system, regulation of gastric secretion and motility- intestinal secretion and motility-role of gastrointestinal hormones.

MODULE II CARDIOPHYSIOLOGY 9

Functional anatomy of heart- genesis and spread of cardiac impulses, cardiac cycle- heart sounds- cardiac output - cardiovascular regulatory mechanisms - electrocardiogram

MODULE III RESPIRATORY PHYSIOLOGY 9

Functional anatomy of air passages and lung- respiratory muscles - mechanism of respiration- lung volumes and capacities- gas exchange in the lungs- regulation of respiration.

MODULE IV RENAL PHYSIOLOGY 9

Structure of nephron- glomerular filtration- tubular reabsorption and secretion- formation of urine- regulation of water and mineral excretion - counter current multiplier and exchanger renal role in acid base balance.

MODULE V MUSCLE PHYSIOLOGY 9

Physiology of skeletal and smooth muscle - electrical and ionic properties- types of muscle contraction- neuromuscular transmission. Nerve physiology

- structure of neuron and synapse- excitability -action potential - conduction of nerve impulse- synaptic transmissions- neurotransmitter systems.

Total Hours: 45

REFERENCES:

1. Guyton A.C, Hall J.E, Textbook of Medical Physiology, 11th Ed., Saunders Company, 2005.
2. Widmaier E. P, Raff H, Strang K. T. Vander's, Human Physiology : The mechanism of Body Function, 9th Ed. Mc. Graw Hill, 2003.
3. Ganong W. E, Review of Medical Physiology, 21st Ed., Mc. Graw Hill, 2003.

OUTCOMES:

- On the completion of the above objectives student will be able to understand human physiology, digestive process, cardiovascular, respiratory, renal, muscular and nerve physiology and functions of various organ system.

LSB1107 CELL & MOLECULAR BIOLOGY LAB

L	T	P	C
0	0	2	1

OBJECTIVES:

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

EXPERIMENTS : 30

1. Preparation of competent cell by calcium chloride method and checking its efficiency
2. Preparation of slides from onion root tip for mitosis
3. Isolation & Purification of genomic DNA from bacteria
4. Isolation & Purification of plasmid DNA
5. Isolation of RNA
6. Agarose gel electrophoresis of chromosomal & plasmid DNA

7. Restriction Digestion of chromosomal & plasmid DNA

8. Isolation of DNA fragment from agarose gel

REFERENCE:

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.

LSB1108	BIOCHEMISTRY LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the preliminary methods in biochemistry by preparing buffer and adjusting pH.
- To estimate various biomolecules by biochemical assays

EXPERIMENTS: **30**

1. Laboratory safety guidelines
2. Preparation of Buffer solutions and checking pH
3. Isolation and estimation of proteins by Lowry's method
4. Estimation of glucose by Benedicts method
5. Estimation of cholesterol by Zaks method
6. Estimation of Urea by DAM Method
7. Estimation of glutathione in liver tissue
8. Separation of various lipoproteins by electrophoresis
9. Estimation of enzyme activity under various conditions viz., pH, temperature and substrate

REFERENCES:

1. Wilson K and Walker J, Principles and Techniques in Practical Biochemistry, 5th Ed., Cambridge University Press, 2000.
2. Holtzhauer M, Basic Methods for the Biochemical Lab, Springer, 2006.
3. Nigam, Lab Manual in Biochemistry: Immunology and Biotechnology, Tata McGraw-Hill Education, 2007.

OUTCOMES:

- On performing the above experiments students will be able to know and perform the routine biochemical assays.

LSB1109 MICROBIOLOGY LAB L T P C
0 0 2 1

OBJECTIVES:

- To learn various sterilization techniques
- Hands on experience in preparing culture media, growing and preserving bacterial cultures.
- To get exposed to identifying microbes by visualizing and by staining techniques

EXPERIMENTS: 30

1. Introduction to Good Laboratory Practice (GLP) in Microbiology-sterilization techniques
2. Preparation of liquid and solid media
3. Isolation and maintenance of bacteria
4. Pure culture techniques-streak, pour plate and spread plate techniques
5. Bacterial growth curve, measurement of bacterial population by turbidimetry and serial dilution and colony counting methods
6. Bacterial Staining-differential staining-spore staining, Grams staining
7. In vitro antibiotic sensitivity tests
8. Preservation of cultures: slant, water stock, glycerol stock and lyophilization.
9. Use of various types of microscopes

REFERENCES:

1. Prescott, Harley and Klein, Microbiology,5th Ed Mcgraw Hill science 2002.
2. Joanne W. Prescott's, Microbiology w/Harley Lab Manual, 8th Ed.,
3. Robert W. B. and Nichol D, Microbiology Laboratory Manual, 3rd Ed., Pearson Learning Solutions, 2008.

OUTCOMES:

- Students will be able to isolate culture and identify microbes and also to efficiently use light microscope.

SEMESTER II

LSB1211	BIOINFORMATICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The course is aimed to make the scholars conversant with the

- To study history and scope of bioinformatics.
- To learn about the database Management Systems, Biological Databases and Data Retrieval, Molecular Sequence Alignment.
- To get a basic understanding of principle involved Gene Prediction and Phylogenetic Analysis and Molecular Modeling and Drug Designing.
- To know about the Networks and Linux

MODULE I INTRODUCTION TO BIOINFORMATICS 9

Introduction- scope- Historical account Database Management Systems- Database System Versus File Systems- View of Data- Data Models- Database Languages- Database Usrs and Administrators- Database System Structure- RDBMS- SQL commands.

MODULE II BIOLOGICAL DATABASES AND DATA RETRIEVAL 9

Nucleotide database (Genbank-EMBL- DDBJ)- Sequence submission Methods and tools (Sequin, Sakura, Bankit)- Sequence retrieval systems (Entrez& SRS)-Sequence File Formats and Conversion tools- Protein (Swiss-prot, PIR, Expasy)- Structural Databanks (PDB and NDB)- Protein Structure Classification (SCOP, CATH and FSSP)- Metabolic Pathway db (KEGG)- Specialized db (IMGT, Rebase, COG).

MODULE III MOLECULAR SEQUENCE ALIGNMENT 9

Pair wise Alignment- Global Alignment- Local Alignment- Visual Alignment- Dynamic Programming- Heuristic approach- Scoring Matrices and Affine Gap costs- Database Search methods- Multiple Sequence Alignment methods. Gene Prediction and Phylogenetic Analysis: Gene structure in Prokaryotes and Eukaryotes- Gene Prediction methods- Construction of Phylogenetic trees - Distance Methods- Maximum Parsimony Method- Maximum likelihood method.

MODULE IV MOLECULAR MODELING AND DRUG DESIGNING 9

Introduction to Protein Structure Prediction- Rational drug discovery- Recent advances in drug design methodologies- Structure-based drug design- Drug-receptor interactions- Structure-Activity Relationships.

MODULE V INTRODUCTION TO NETWORKS AND LINUX 9

Introduction to Network-Intranet- Internet- DNS- TCP/IP- Web Designing- HTML tags- tables-frames- forms- XML- UML- SOAP- Files and Directories- Bash commands- Users and Groups- Permissions- Software installation- communicating with other computers using Telnet- FTP- SCP- SSH-Shell scripting- STDI/O- Pipes and control.

Total Hours: 45

REFERENCES:

1. Claverie J. M, Notredame C, Bioinformatics, Wiley Publishing, Inc. 2003
2. Dan.E.K, Michael L. R, Fundamental concepts in Bioinformatics, Ist Ed., Pearson Education. 2006.
3. David Mount, Bioinformatics: Sequence and Genome Analysis, CSHL Publisher, 2001.
4. Andreas D. Baxevanis& B.F. Francis Ouellellette, Bioinformatics. A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, UK, 1998.
5. Higgins. D andTaylor W, Bioinformatics Sequence, Structure databanks, OUP Oxford, 2000.
6. Silberschatz A, Korth H. F, Sudarshan S.,Database System Concepts, 3rd Ed., mcgraw-Hill, 2010.

OUTCOMES:

- On completion of the course the students will be able to understand the history and importance of bioinformatics Learn Database Management Systems, Biological Databases and Data Retrieval, Molecular Sequence Alignment. Grasp the principle involved Gene Prediction and Phylogenetic Analysis and Molecular Modeling and Drug Designing..

LSB1212	BIOSTATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To learn about the concepts of biostatistics.
- To handle and analyses bulk data.
- To explore the application and scope of biostatistics

MODULE I INTRODUCTION TO STATISTICS **9**

Definition of statistics-population and universe-the sample and population-statistical inference-parameter and statistics. Construction a histogram-interpretation of histogram the normal distribution- the mean-mode-and standard deviation- representing the normal curve as straight line-uncertainties in estimating a mean.

MODULE II STATISTICAL ANALYSIS SOFTWARE (SAS) **9**

Accessing Data- Use FORMATTED, LIST and COLUMN input to read raw data files, Combine SAS data sets using the DATA step. Creating Data Structures- Create temporary and permanent SAS data sets, Control with observations and variables in a SAS data set are processed and output Managing Data- Investigate SAS data libraries using base SAS utility procedures. Generating Reports- Generate list reports using the PRINT and REPORT procedures, Generate HTML reports using ODS statements. Handling Errors- Identify and resolve programming logic errors, syntax errors, data errors.

MODULE III PROPORTION DATA AND ANALYSIS **9**

Examples of Proportion data- MPM-sterility testing of medicines- animal toxicity-infection and immunization studies e.g., LD50, ED50, PD50 statistical treatment to proportion data- Chi-square test-goodness of fit to normal distribution.

MODULE IV COUNT DATA **9**

Introduction to Count data, Examples of count data (bacterial cell count, radioactivity count, colony and plaque count, etc.). Statistical treatment to count datapossion distribution-standard error-confidence limits of counts.

MODULEV ANALYSIS OF VARIANCE 9

Introduction procedure-F and t test. Correlation regression and line fitting through graph points-standard curves- correlation-linear regression (fitting the best straight line through series of points) - standards curves and interpolations of unknown values thereon.

Total Hours: 45

REFERENCES:

1. Green. R. H, Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons,1979.
2. Snedecor G. W. and Cochran W. G,Statistical methods, 8th Edition, Iowa State Press, 1989.
3. Glover T, Mitchell K, Introduction to Biostatistics, 1st Edition, Mcgraw Hill Science, 2001.
4. Matthews, Sucessful Scientific writing: A step-by-step Guide for Biomedical Scientists. 2nd Edition, Cambridge University Press, 2001.
5. Jerrold H. Z, Biostatistical Analysis, 4th Edition, Pearson Education, 2006.

OUTCOME:

- On completion of the course the students will possess knowledge of biostatistics to handle and analysis of bulk data in a significant way.

LSB1213 IMMUNOLOGY/IMMUNOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To know the history and scope of immunology.
- To learn about the component of immunity, innate and adaptive.
- To understand antigen and immunogenicity, antigen-antibody interaction and complement system.

MODULE I INTRODUCTION TO IMMUNOLOGY 9

Historic perspective, Overview and Concepts, Mile stones in immunology, Discovery of humoral and cellular immunity, Functions of humoral and Cell-Mediated Immunoresponses, Components of immunity, Innate and Adaptive immunity, Cells and Tissues of the Immune System: Lymphoid organs, lymphoid cells and other cells involved in Immunological responses. Cellular Immunity, Immune Tolerance and suppression, Hypersensitivity Reactions, Types of Hypersensitivity, Autoimmunity, Immunization principles and Immune deficiencies

MODULE II ANTIGENS & ANTIBODY 9

Nature of antigens and antibodies. preparation and purification of Antigens, Extraction of antigens from pathogens, parasites and other biological materials. Antigen fractionation and purification. Preparation of synthetic antigens, Recombinant antigens. Theories of antibody formation. Antibody structure, structural basis of antibody diversity- Immunoglobulins as antigens, properties of immunoglobulins, subtypes. Production, purification and characterization of antibodies. Hybridoma and monoclonal antibody techniques, Production of murine hybridoma, Production of monoclonal antibody in cultures and animal (Ascites),

MODULE III CYTOKINE AND COMPLEMENT SYSTEM 9

Cytokines - Properties, receptors, antagonists, diseases, therapeutic use of Cytokines. Complement system - Activation, Regulation, Biological consequence of complement activation and Complement deficiency.

MODULE IV MHC AND REGULATION OF IMMUNE RESPONSE 9

Cellular distribution of MHC molecule, Antigen processing and presentation – exogenous and endogenous antigen processing. Self -MHC restriction of T

cells. Presentation of non-peptide antigens. Activation of B and T lymphocytes, T-cell regulation. B-cell generation, activation and differentiation.

MODULE V TECHNIQUES IN IMMUNOLOGY 9

Introduction: scope of Immunotechnology, Strength of antigen and antibody reaction- cross reactivity, precipitation and agglutination reactions, Radioimmunoassay and ELISA, Markers of immunocompetant cells, separation and purification of immunocompetant cells. Functional tests for immunocompetant cells and histocompatibility testing. Immunological assays- Complement fixation tests, In-vivo tests/ neutralization tests, immunodiffusion, immunoblotting, immunohistochemistry and immunofluorescenece techniques.

Total Hours: 45

REFERENCES:

1. Coleman, Lombard and Sicard,Fundamental Immunology, WCB publishers, 1992.
2. Goldsby R. A, Kindt T. J, Osborne B. A. Kuby, Immunology, 4th Edition, W.H. Freeman and company, New York, 2000.
3. Burdon and Khippiberg, Laboratory techniques in Biochemistry and Molecular Biology, Humana Press, 1984.
4. Weir D.M, Herzenberg L.A, and Blackwell C, Handbook of ExperimentalImmunology, Black well Science Oxford, 1989.
5. Boorebaeck, Antibody Engineering, 2nd Ed., Wiley, 1995.
6. Dixon F.J, Advances in Immunology, Academic Press. 1986.

OUTCOMES:

- On Completion of the course the scholars will be able to know the background history and scope of immunology, Grasp the knowledge of Component of immunity, innate and adaptive. Develop better understanding of antigen and immunogenicity, antigen-antibody interaction and complement system.

LSB1214 RECOMBINANT DNA TECHNOLOGY GENETIC ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about r-DNA technology, principles involved in introducing genes into prokaryote.
- To know about cloning strategies and prokaryotic expression systems.
- To acquire basic understanding of techniques in genetic engineering.

MODULE I INTRODUCTION TO GENETIC ENGINEERING 9

Enzymes used in genetic engineering- Restriction endonucleases, DNA polymerases, Reverse transcriptase, Ligases, Polynucleotide kinase, Alkaline phosphatase, Nucleases, Klenow fragment, Terminal deoxynucleotidyltransferase, RNAase.Vectors for cloning- Plasmids, Bacteriophage, Filamentous phage vectors, Cosmids, Phagemids,yacs. Ligation of DNA fragments with vectors - Homopolymer tailing, Ligation of cohesive termini, Blunt-end ligation, Linker molecules.

MODULE II GENES AND GENE TRANSFER 9

Natural gene transfer methods-Transformation, transduction, calcium chloride mediated transformation, Transfection with phage vectors. Introducing genes into eukaryotes- Gene transfer by viral transduction, Calcium phosphate mediated transformation- Liposome mediated transformation, Microinjection, Electroporation.

MODULE III CLONING STRATEGIES 9

Producing genomic libraries in cloning vectors, Genomic libraries in high-capacity vectors, cDNA cloning, Shotgun cloning, Cloning in E.coli, Identifying the recombinant DNA and its products- Immunochemical screening, Hybrid arrested translation, Nucleic acid probes.

MODULE IV EXPRESSION SYSTEMS 9

Gene expression based on bacteriophage T7 RNA polymerase, Eukaryotic expression systems- Fused genes, Unfused genes, Secreted proteins, Gene expression by transcription factors- NFkB, PPAR, Antisense RNA technology-siRNA, miRNA.

MODULE V TECHNIQUES IN GENETIC ENGINEERING 9

Hybridization technique -Southern, Northern and Westernblotting techniques. Site directed mutagenesis, Restriction mapping, DNA profiling in forensic science, Chromosome walking, Chromosome jumping, DNA sequencing, PCR.

Total Hours: 45

REFERENCES:

1. Primrose S. B,Twyman R.M, and Old R.W, Principles of gene manipulation , 6th Ed., Blackwell Publishers2001.
2. Sandhyamitra,Genetic Engineering, Macmillan India Limited, 2005.
3. Primrose,Principles of Genome analysis, Blackwell Sciences, 2003.
4. Watson,Recombinant DNA, 2nd Ed., American Publishers, 1992.
5. Fernandez J. M and Hoeffler J. P, Gene expression systems,Academic Press, 1999.

OUTCOMES:

- On completion of the course the scholars will acquire knowledge on the principle involved in r-DNA technology, mechanism in cloning strategies techniques of genetic engineering. They will also get familiarity on the prokaryotic and eukaryotic expression systems.

LSB1215 PRINCIPLES OF GENETICS L T P C
3 0 0 3

OBJECTIVES:

- To have an understanding about the basic principles of inheritance, theorems and their several aspects.
- To provide a full exposure of linkage, recombination and mapping in eukaryotes
- To enable the student to understand the mechanism of sex determination and various aspects of chromosomes.
- To expose the fundamental concepts of extrachromosomal inheritance, gentic mapping and role of genetics in agriculture, industry and medicine.

MODULE I BASIC MECHANISMS OF INHERITANCE 9

Mendelian Inheritance-Mendelism and Mendel's experiments, Laws of Segregation and Independent Assortment with specific examples from drosophila, plants and humans, Extensions to Mendelism- Dominance, Co-dominance and incomplete dominance - Penetrance, expressivity (Polydactyly) and Pleiotropism (Marfan syndrome, sickle cell anemia) -Lethals and sub-lethals. Epistasis, complementation- modified Mendelian ratios- Multiple Alleles Pseudoalleles - Rh blood group incompatibility- Inheritance of quantitative characters - Polygenes

MODULE II LINKAGE, RECOMBINATION AND MAPPING IN EUKARYOTES 9

Discovery of linkage - phases of linkage - Cytological demonstration of crossing over. Recombination frequency and map construction- Detection of linkage in Drosophila and maize. Detection of linkage by test cross- two point cross, three point cross, four point cross, coincidence and interference. Cytological mapping of Zeste - White region of drosophila X-chromosome. Correlating genetic and cytological maps- Mapping of genes by tetrad analysis - Neurospora.- Mitotic recombination in Aspergillus nidulans, Drosophila melanogaster and mitotic maps.

MODULE III SEX DETERMINATION 9

Mechanisms of sex determination, Autosomes and sex chromosomes - Drosophila melanogaster- Bridge's experiment, molecular basis of genic balance theory- Sex chromosomes - heterogametic and homogametic sex XO -grasshopper, ZZ/ZW birds, XX/XY - Melandrium and man- Variation in chromosome behaviour - Sciara- Environmental effect -Bonelia, lizards sex differentiation and development in man, aberrant sexual development - Eg. Pseudo-hermaphroditism- Sex-linked traits - X and Y- linkage - red and white eye colour in drosophila, haemophilia and colour blindness in man. Sex limited and sex influenced traits.

MODULE IV EXTRACHROMOSOMAL INHERITANCE 9

Non-Mendelian Inheritance : Leaf variation of higher plants, Corren's studies in Mirabilus jalapa. Maternal inheritance - Poky in Neurosopora - Heterokaryon test Maternal influence -Shell coiling in snails- Extra nuclear genes in Chlamydomonas, Mutants showing uniparental inheritance, Mapping chloroplast genome in Chalmydomonas- Extra nuclear genes in Baker's Yeast : Petite mutants, Genetic mapping of mitochondrial genes in yeast. Other examples of extra nuclear inheritance : Male sterility in maize and its use, S-gene in Nicotiana.

MODULE V GENETICS IN BIOLOGY 9

Role of Genetics in agriculture, industry and medicine- Genetic disorders in man- pathology and diagnosis.

Total Hours: 45

REFERENCES:

1. Griffiths A.J.F, Miller J, H, Suzuki D. T, Lewontin R. C. and Gelbart W. M, Suzuki D. An Introduction to Genetic Analysis. Freeman W. H & Co Ltd, 1976.
2. Gardner E. J, Gardner S, Snustad. Principles of Genetics-By 8th Edition, John Wiley & Sons, 2006.
3. Tamarin R. H. Principles of Genetics. 7th Edition, McGraw-Hill Companies2004
4. Stansfield W.D. Theory and Problems in Genetics. McGraw-Hill Inc., 1983.
5. Griffiths A. J F, Wessler S. R, Lewontin R. C, Carroll S. B. Freema W. H. An Introduction to Genetic Analysis, 9th Edition, 2008.

OUTCOMES:

- On the completion of the above objectives student will be able to understand the basic principles of inheritance, linkage, recombination and mapping in eukaryotes. They will be able to know various aspects of chromosomes and fundamental concepts of extra chromosomal inheritance, genetic mapping and role of genetics in agriculture, industry and medicine.

LSB1216	BIOINFORMATICS LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To get hands on experience on plasmid construction, mappings and analysis.
- To explore to various tools in bioinformatics.

EXPERIMENTS: **30**

1. Plasmid Construction
2. Restriction Mapping
3. PCR Primer Designing
4. Sequence Retrieval and Format Conversion
5. ORF Finding
6. Homology Search
7. Multiple Sequence Alignment
8. Gene Prediction in prokaryotes
9. Motif finding in DNA and Protein Sequences
10. Structure Visualization
11. Phylogenetic Analysis
12. Protein Secondary Structure Prediction

REFERENCES:

1. Rashidi H, Buehler L. K. Bioinformatics Basics: Applications in Biological Science and Medicine. 2nd Edition, CRC Press, 2005.
2. Baxevanis A. D, Ouellette B. F. F. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3nd edition Wiley, John & Sons, Incorporated, 2004.
3. Krawetz S. A, Womble D. D. Introduction to Bioinformatics: A Theoretical and Practical Approach. Humana press, 2003

OUTCOMES:

Students will be familiar with various soft skills/tool used in understating modern biology. They will also be able to analyze and interpolate data starting from PCR primer designing to structure predictions.

LSB1217	IMMUNOLOGY/IMMUNOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To acquire knowledge on immunological techniques
- To learn and perform antibody production in rabbit
- To train in various techniques involving antigen and antibody reactions

EXPERIMENTS: **30**

1. Immunization and generation of Anti-sera in rabbit against antigen
2. Separation of immunoglobulin fractions using affinity chromatography
3. Single diffusion methods of immunoelectrophoresis
4. Double diffusion method of immunoelectrophoresis
5. Rocket electrophoresis
6. Titer value determination
7. ELISA for detection of antigens and antibodies
8. Sandwich ELISA
9. Blood group mapping
10. Preparation of antigens from pathogens and parasites
11. Slide and tube agglutination reaction
12. Immunofluorescence technique
13. Culturing of leucocytes
14. SDS-PAGE and Immunoblotting
15. Rapid detection of HBV and HCV candidate antigens
16. Isolation and identification of lymphocytes
17. Separation of CD cells using flow cytometry

REFERENCES:

1. Rose et al., Manual of Clinical laboratory Immunology, 6th Edition, 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.

SEMESTER III

		L	T	P	C
LSB2106	**SCIENTIFIC WRITING**	**0**	**0**	**2**	**1**

Methodology for writing science report- program of writing-use of vocabulary-use of good english-art of illustration- report writing-editing and correcting-technique

LSB2107	TECHNICAL PRESENTATION	L	T	P	C
		0	0	2	1

Oral presentation of experimental work, good presentation and communication skills.

LSB2108 ANIMAL AND PLANT CELL/TISSUE CULTURE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the plant and animals cells and factors affecting their growth
- To understand the principles of plant and animal cell culture and their applications
- To get the information on growth characteristics of animal cells and their biochemistry.

MODULE I INTRODUCTION TO PLANT AND ANIMAL CELLS 8

Growth characteristics of cells- plant and animal- Morphological and ultra structural properties of cells. Types of growth factor affecting animal and plant cell proliferation - physical and chemical factors- exogenous and endogenous factors..

MODULE II ANIMAL CELL CULTURE 10

Cell - cell interaction and differentiation - factors promoting and inhibiting cell differentiation. Characterisation of differentiated cells. Laboratory set-up for animal cell culture. Sterilization techniques, types of culture media, components and significance of culture media. Primary and immortalized cell cultures, scaling up of animal cells in culture, cell synchronization, cell cloning and micro manipulation. Cancerous and non-cancerous cell lines and their applications. Flow cytometric detection of cancer cells.

MODULE III APPLICATION OF ANIMAL CELL CULTURE 9

Application of animal tissue culture in medical research. Ethical issues. Production of special proteins/enzymes in cultured cells - monoclonal antibodies, insulin, growth hormones, interferon, etc., In-vitro fertilization, organogenesis. Stem cell culture and their applications.

MODULE IV PLANT CELL CULTURE 9

Introduction to plant tissue culture, laboratory requirements. Sterilisation techniques in plant tissue culture. Media components and significance. Plant growth regulators. Micropropagation - axillary bud, shoot tip and meristem culture.

MODULE V APPLICATION OF PLANTCELL CULTURE 9

Application of plant tissue culture in industry and research field. Plant genetic engineering - Somaclonal variation and applications, Somatic Hybridization and its applications, Virus free plants, Germplasm conservation, Synthetic seeds, DNA transformation methods in plants and its applications, Secondary metabolite production.

Total Hours: 45

REFERENCES:

1. Pelengaris S, Khan M. The Molecular Biology of Cancer. Blackwell Publication,. 2002.
2. Weinberg R. A. The Biology of Cancer, Garland Science. 2006.
3. Yadav P. R, Tyagi R. Biotechnology of Animal Tissues. Discovery Publishing House, 2006.
4. Vasil I. K, Trevor A. Plant Cell and Tissue Culture. Thorpe Springer, 1994 .
5. Pollard J. W. Plant Cell and Tissue Culture. Humana Press, 1990.
6. Slater A, Scott N and Fowler M. Plant Biotechnology: The genetic manipulation of plants. Oxford University Press, 2003.
7. Buchanan B. B, Gruissen W and Jones R. L. Biochemistry and Molecular Biology of Plants. American Society of Plant Biology, Rockville, 2000.
8. Cullis C. A. Plant Genomics and Proteomics. John Wiley & Sons, 2004.
9. Grotewold E. Plant Functional Genomics. Humana Press, Totowa2003.
10. Gilmartin P. M and Bowler C. Molecular Plant Biology, Vol I & II. Oxford University Press, 2002.

OUTCOMES:

- On the completion of the above objectives student will be able to explore themselves about pre -requisites for animal as well as plant tissue culture. They will be able to understand cell cycle, signaling pathways and also technical applications of cell culture.

LSB2109 PLANT BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To give an idea of water, mineral nutrition, their role on growth and development and principles and importance of breeding of plants.
- To familiarize the concepts of photochemistry and detail knowledge of plant genetic engineering.
- To introduce the concepts gene expression in plants, special features of plant cell culture and to learn transformation strategies.

MODULE I INTRODUCTION TO PLANT BIOLOGY 9

Water relations, mineral nutrition, nitrogen, phosphorus and sulphur metabolism, stomatal physiology, source and sink relationship, physiology and biochemistry of seed dormancy and germination, hormonal regulation of growth and development- Photoregulation, growth responses, physiology of flowering, senescence.

MODULE II PLANT BREEDING & TISSUE CULTURE 9

Plant breeding principles, important conventional and non-conventional methods of breeding in self and cross pollinated and vegetatively propagated crops-Non conventional methods, mutation breeding- Plant tissue culture: Basic techniques, culture media, shoot and root tip culture and somatic embryogenesis.

MODULE III PHOTOCHEMISTRY 9

Chlorophyll fluorescence, excitation, singlet level and triplet state, fluorescence, phosphorescence- Photosynthesis in higher plants chloroplast (Calvin cycle, C4 cycle,C3 cycle).

MODULE IV GENETIC ENGINEERING OF PLANTS 9

Transformation of plants, manipulating gene expression in plants, selectable markers and reporter genes, Agrobacterium tumefaciens- Genetic elements present on the Ti plasmid, genetic engineering of Ti plasmid, vectors used to introduce foreign DNA into plant cells-binary cloning vector, disarmed Ti plasmid, Cointegrate cloning vector, comparative study methods for DNA transfer of in plants.

MODULE V MANIPULATION OF GENE EXPRESSION IN PLANTS 9

Production of transgenic plants without reporter or marker genes. Special features of plants- Micropropagation- Plant cell cult ure- Haploid culture and regeneration- Specific promoters for plant- Light regulated cis elements- Incorporation of T-DNA into nuclear DNA of plant cells and transformation strategies.

Total Hours: 45

REFERENCES:

1. Hughes M. A. Plant Molecular Genetics. Harlow, England: Addison Wesley Longman, 1996.
2. Kirsi-Marja, Barz W, Dekker M. Plant Biotechnology and Transgenic Plants. CRC press, 2002.
3. Salisbury F. B. and Ross C.W. Plant Physiology. 4th ed. Wadsworth Pub. Co., 1992.

OUTCOMES:

- On the completion of the above objectives student will be able to understand aboutnutritional value of water and mineral, their role in plnat growth and development and also the principles and importance of plant breeding techniques. They will be familiar with photochemistry and genetic engineering. They will have clear concepts of gene expression, cell culture and transformation Strategies.

LSB2110 PROTEOMICS AND GENOMICS L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamentals of gene sequencing and genetic analysis in prokaryotes and eukaryotes.
- To understand the different approaches and their applications in genomic illustrations.
- To provide an overview of genomics and proteomics and the related analytic approaches.

MODULE I GENOME MAPPING & LIBRARY CONSTRUCTION 9

High resolution physical mapping. Marker associated and clone assisted mapping: Genome library construction - YAC, BAC and PAC libraries of genome.

MODULE II GENOME SEQUENCING 9

Hierarchical and shot gun sequencing methods - Variation in sequencing methods - pyrosequensing - Automation in genome sequencing - Sequence analysis - Databanks - Data mining.

MODULE III FUNCTIONAL GENOMICS 9

Experimental and computational approaches of genome annotation- Functional genomics - experimental and computational approaches - Gene knockouts, yeast two hybrid system - Gene expression profiling - microarrays - cDNA and oligo arrays - DNA chips - Applications of DNA arrays - SNPs.

MODULE IV GENOMICS VERSES PROTEOMICS 9

Tools for proteomics - 2D Electrophoresis - Protein digestion techniques and mass spectrometry - MALDI TOF - Protein analysis.

MODULE V PROTEOME ANALYSIS 9

Algorithms for proteomics, protein expression profiling, protein arrays, protein -Protein interactions, protein microarrays- Advantages and disadvantages of DNA and protein microarrays.

Total Hours: 45

REFERENCES :

1. Twyman R. M and Primrose S. B. Principle of Genome Analysis. Blackwell Publisher, 2003

2. Brown T. A. Genomes 2, Wiley-Liss, 2007.

OUTCOMES:

- On the completion of the above objectives student will be able to learn the fundamentals of genomic sequencing and genomic analysis in prokaryotes and eukaryotes and overview of genomics and proteomics, their approaches and applications.

LSB2111 NANOTECHNOLOGY &TISSUE ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

- To impart the students about nanotechnology, bio-nanotechnology and their implications and several aspects.
- To expose the stidents about the structure and organization of tissues: types and characterization.
- To study nanotechnology in tissue engineering, drug delivery and ethical issues related to that.

MODULE I INTRODUCTION TO NANOTECHNOLOGY **8**

Multilayer thin film: Polyelectrolyte multilayers, coated colloids, smart capsules, LbL self-assembly, colloids and colloid assemblies for bio-nanotechnology, nanoengineered biosensors, fiber optic nanosensors in medical care, semiconductor and metal nanoparticles: synthesis and applications.

MODULE II BIO-NANOTECHNOLOGY **10**

Cellular nanostructures, self-assembly of colloidal nanostructures of biological relevance, bioactive nanoparticles (respiratory surfactants, magnetic nanoparticles), Nanoparticles for drug delivery (including solid lipid nanoparticles, synthetic and biopolymeric nanoparticles), carbon nanotubes, polymeric nanofibers, Implications in neuroscience, tissue engineering and cancer therapy, Environmental safety aspects of bio-nanotechnology.

MODULE III STRUCTURE, ORGANISATION AND FUNCTION OF CELL 10

Introduction, structural and organization of tissues: Epithelial, connective-vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing. Cell culture- Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Different aspects of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors - Molecular biology aspect of cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment, differential cell adhesion, receptor -ligand binding and cell surface markers.

MODULE IV NANOTECHNOLOGY IN MEDICINE 9

Nanotechnology in Tissue Engineering, Nanoemulsions and Drug Delivery in Nanotechnology. Scaffold and transplant- Engineering biomaterials, Degradable materials, porosity, mechanical strength, 3-D architecture and cell incorporation-Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology stems cells.

MODULE V REGULATORY ISSUES 8

Cell transplantation of hepatic, musculoskeletal, cardiovascular, neural, visceral tissue-Ethical, FDA and regulatory issues.

Total Hours: 45

REFERENCES:

1. Decher G, Schlenoff J. B. Multilayer Thin Films. Wiley-VCH Verlag GmbH & Co. KGaA, 2003.
2. Goodsell D.S. Bionanotechnology : Lessons from Nature. Wiley-Liss , 2004.
3. Palsson B, Bhatia S. Tissue Engineering. Pearson Prentice Hall, 2003
4. Vunjak-Novakovic G, Freshney R. I. Culture of Cells for Tissue Engineering, WIS, 2006.
5. Lanza R. P, Langer R. and Chick W. L. Principles of tissue engineering, Academic press, 1997.

OUTCOMES:

- On achieving the above objectives student will be able to know about nanotechnology, bio-nanotechnology, structure and organization of tissues. They will be able to understand the application of nanotechnology in tissue engineering, drug delivery and their ethical issues.

LSB2113	ANIMAL AND PLANT CELL/ TISSUE CULTURE LAB	L T P C 0 0 4 2

OBJECTIVES:

- To establish primary and secondary animal cell cultures.
- To test drug toxicity in the cultured cells.
- To study cell morphology and also to perform different staining procedures to identify the functional status of the cells.

EXPERIMENTS: **30**

1. Continuous cell culture
2. Drug/Toxicity testing
3. MTT assay
4. Morphological and Biochemical characterization of modes of cell death
5. Morphological characterization of cancer cells
6. Acridine orange/Ethidium bromide staining
7. Explant selection, treatment and inoculation
8. Subculture of establised cultures
9. Acclimatization of cultures
10. Estimation of peroxidase activity in plants
11. Study of ? - amylase enzyme from germinated pulses.

REFERENCES:

1. Yadav P. R, Tyagi R. Biotechnology of Animal Tissues. Discovery Publishing House, 2006.
2. Freshney R. I. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Ed.,John Wiley & Sons, Inc. 2010.
3. Freshney R. I. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell. 6th Ed., 2010.
4. Razdan M. K. Introduction to Plant Tissue Culture . Science Publishers, 2003
5. Laimer M, Rcker. W. Plant Tissue Culture. Springer, 2003.

6. Reinert J, Yeoman M. M. MacDonald P. Plant Cell and Tissue Culture: A Laboratory Manual. Springer. 2012.

OUTCOMES:

- By performing the mentioned experiments students will be able to culture and maintain animal and plant cells/tissues. Students will also be able to screen drugs in the cultured animal cells.

LSB2112 PLANT BIOTECHNOLOGY LAB L T P C
0 0 2 1

OBJECTIVES:

- To study the activity of secondary metabolites and endogenous enzymes for the isolated from various plant sources.
- To study cell morphology and also to perform different staining procedures to identify the cells, also to plant genetic engineering.

EXPERIEMNTS:

1. Estimation of total chlorophyll, chlorophyll a and b, xanthophylls and carotenoid pigments from the leaves.
2. Isolation of chloroplasts and estimation of photochemical activity.
3. Estimation of starch content by Anthrone method.
4. Spectrophotometric estimation of Indoleacetic acid in plant tissues.
5. Determination of nitrate reductase activity in crop plants under low water regimes.
6. Determination of Gibberallic acid by half seed method.
7. Determination of succinic dehyrogenase activity in presence and absence of inhibitors.
8. Determination of peroxidase activity.
9. Determination of protein under abiotic stress.
10. Isolation and estimation of genomic DNA from dicot and monocot plants
11. Amplification and cloning of a plant gene
12. Overexpression of plant protein in Escherichia coli

REFERENCES:

1. Hughes M. A. Plant Molecular Genetics. Harlow, England: Addison Wesley Longman, 1996.
2. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.

OUTCOMES:

- By performing the mentioned experiments students will be able to perform enzymatic assays in plant tissue extracts. Students will also be able to screen and isolate plant secondary metabolites and will also get an idea about various plant genetic engineering tools.

SECOND YEAR - SEMESTER - IV

		L	T	P	C
LSB2211	PROJECT WORK	0	0	16	8

ELECTIVES

LSBY001 PHARMACEUTICAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand and analyze novel techniques of production, purification and characterization of enzymes, biotechnologically produced biomedicines and pharmaceuticals.
- To elaborate the theoretical aspects and practical requirements for the growth of microorganisms in industries and R and D organizations.
- To understand and perform novel techniques of genetic engineering namely, recombinant DNA technology, enzyme immobilization, etc.

MODULE I PHARAMCOGENOMICS **9**

Functional analysis of gene variation, Genotyping techniques, Gene Therapy: In vivo gene therapy with adeno viruses, Ribozymes, Cytokines, Anti-sense, immunoliposomes. Stability studies of biotechnology derived products, cell lines culture process validation and characterization, purification process for viral clearance, validation of recovery, purification, cleaning, filtration, issues of DNA vaccines and plasmid DNA vaccines.

MODULE II BIOPROCESS TECHNOLOGY **9**

Design features of bioreactors / fermenters, Fundamentals of bioprocess technology, Principles underlying product formation, Principles underlying product recovery and purification, Large scale production of fermentation products, Fermentation kinetics: Reaction kinetics, Scale up of fermentation process, Downstream processing, Biosynthetic pathways for some secondary metabolites

MODULE III IMMUNOBIOTECHNOLOGY AND MICROBIOLOGY **9**

Isolation of bacteria, actinomycetes, fungi, yeasts from different sources, Isolation of bacteriophage, Study of morphological features of bacteria, actinomycetes, fungi, yeasts using staining, motility and biochemical characteristics, Gradient plate technique, Screening for microorganisms producing antibiotics, organic acids and pigments, Plant tissue culture techniques.

MODULE IV ADVANCED PHARMACEUTICAL BIOTECHNOLOGY 9

Genetic engineering, brief understanding of instruments involved in genetic engineering, production of recombinant insulin and hepatitis B vaccine, Immobilized enzyme engineering, design and operation of immobilized enzyme reactors, future of enzyme engineering, overview of proteomics, genomics, pharmacogenomics and biomarkers.

MODULE V MICROBIAL PATHOLOGY AND CHEMOTHERAPY 9

Identifying features of pathogenic bacteria, viruses and fungi, mechanism of microbial pathogenecity, etiology and pathology of common microbial diseases, currently recommended therapies for common bacterial, fungal and viral infection, mechanism of action of anti- microbial agents and possible sites for chemotherapy.

Total Hours: 45

REFERENCES:

1. Microbiology, an Introduction- 8th Edition, Tortora, Funke and Case, Pearson Education, Singapore, 2010.
2. Prescott's Microbiology, 4/e, Lasing Prescott, John Harley and Donald Klein, McGraw Hill
3. Kuby Immunology, Tomas J Kindt, Barbara A Osborne, Richard A Goldsby
4. Biopharmaceuticals: Biochemistry and Biotechnology, 2nd Ed, Gary Walsh, Wiley Publications.
5. General Microbiology, RY Stanier, John L Ingraham, ML Wheelis, PR Painter, 5th Ed, Macmillan Press, London
6. Microbial genetics, Jones and Bartlet Series in Biology, SR Maloy, John JrCronan, David Freider Topley & Wilson's Microbiology and Microbial infections
7. Biochemical engineering - fundamentals, James E Bailey and David F Ollis. McGraw-Hill international edition.

OUTCOMES:

At the end of the syllabus student will be able to understand the genotype techniques and fundamentals of bioprocess techniques and idea of instruments involved in genetic engineering. They will acquire knowledge about screening techniques and assays of fermentation products independently. They will also able to develop skills to operate different types of fermenters and can implement various fermentation procedures.

LSBY002 DRUG DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVE

- Provide students with an understanding of the process of drug discovery.
- Learn new aspects in Drug Discovery and Design

MODULE I INTRODUCTION TO DRUG **9**

Properties of drug, role of drugs in medicine, natural substances as drugs, Stages and cost of drug design, failures in Drug Design, Inter and Intramolecular-Weak interactions in drug molecules- Chirality and basis of drug action- Types of bonding-Covalent, ion, ion-dipole, hydrogen bonding, C-H hydrogen bonding, dihydrogen bonding, van der Waals interactions.

MODULE II DRUG TARGETS **9**

Enzymes and receptors. Competitive, non-competitive and allosteric inhibitors, transition-state analogs and suicide substrates. Nucleic acids as drug targets: Classes of drugs that interact with nucleic acids, reversible DNA binding agents, DNA alkylating agents and DNA strand breakers. Factors affecting Absorption, Distribution, Metabolism, Elimination and Toxicity (ADMET).

MODULE III HIGH-THROUGHPUT SCREENING (HTS) **9**

Targets in HTS, Biochemical assays- FRET, FP, HTRF, FCS, Cell Based assays- Second Messenger assays, Reporter gene assays, cell proliferation assays.

MODULE IV LIGAND BASED DRUG DESIGN **9**

Structure activity relationship (SAR), QSAR and 3D-QSAR, Principles of receptor based denovo ligand design, Optimization of drug-target interactions and access to drug targets. Drug delivery systems.

MODULE V COMPUTATIONAL METHODS IN DRUG DISCOVERY **9**

Protein Data Bank, Relationship between sequence and 3D structure, Databases, Binding site prediction, Homology Modeling, Docking tools, Ligand design and Target prediction.

Total Hours: 45

REFERENCES:

1. Drug Discovery and Development- Technology in Transition. Second edition. Raymond G Hill

2. The Organic Chemistry of Drug Design and Drug Action, Second Edition Richard B Silverman.

OUTCOMES:

This course will train students encompassing different aspects of drug design and development up to date topics in pharmaceutical sciences which is associated with contemporary drug discovery.

LSBY003 FOOD PROCESS TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To explore about food process and technology.
- To get overview of processing of various types of food
- To expose themselves to storage and handling of food and food products.

UNIT I STORAGEA & HANDLING OF CEREALS 9

Infestation control- Drying of grains, Processing of rice and rice products. Milling of wheat and production of wheat products, including flour and semolina. Milling of corn, barley, oat, coarse grains including sorghum, ragi and millets- Processing of tea, coffee and cocoa.

UNIT II FRESH FRUITS AND VEGETABLES 9

Preservation of fruits and vegetable by heat treatment. Production and preservation of fruits and vegetable juices, preservation of fruit juice by hurdle technology. Non-alcoholic beverages- Food Laws, food rules and standards, Statistical Quality Control- Various types of packaging.

UNIT III SEA FOOD 9

Commercial handling, storage and transport of raw fish- Average composition of fish- Freshness criteria and quality assessment of fish- Spoilage of Fish- Methods of Preservation of fish: Canning, Freezing, Drying, Salting, Smoking and Curing. Quality control of processed fish- Fish processing industries in India.

UNIT IV ANIMAL PRODUCT 9

Slaughtering technique of animal- Meat cuts and portions of meat, muscle- Color of meat- Post mortem changes of meat- Meat processing - curing and smoking- fermented meat products (meat sausages & sauces)- Frozen meat & meat storage. Classification of poultry meat- Composition and nutritional value of poultry meat & eggs - Processing of poultry meat and eggs- Spoilage and control- Byproduct utilization and future prospects- Poultry farms in India.

UNIT V DIARY PRODUCT 9

Composition of milk- Varieties of milk- Checks for purity of milk- Handling of fresh milk. Pasteurization of milk- HTST and UHT techniques- Packaging of milk- Fermentation of milk and fermented milk products. Manufacture of milk products like evaporated milk, powder milk, condensed milk, cream butter, cheese, yogurt, ice cream, ghee, baby food and sweet meat. Quality control of milk and milk products- Milk plant hygiene and sanitation.

Total Hours: 45

REFERENCES:

1. Principles of Food Science, Vol-I by Fennma Karrel
2. Modern Dairy Products, Lampert LH- 1970, Chemical Publishing Company.
3. Developments in Dairy Chemistry - Vol 1 & 2-
4. Processed Meats- Pearson AM & Gillett TA- 1996, CBS Publishers.
5. Meat- Cole DJA & Lawrie RA- 1975, AVI Pub.
6. Post Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC
7. Egg and poultry meat processing- Stadelman WJ, Olson VM, Shemwell GA & Pasch S- 1988, Elliswood Ltd.
8. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon
9. Developments in Meat Science - I & II, Lawrie R- Applied Science Pub. Ltd.
10. Egg Science & Technology- Stadelman WJ & Cotterill OJ- 1973, AVI Pub.
11. Technology of Food Preservation by Desrosier Fish as Food- Vol 1 & 2- Bremner HA- 2002, CRC Press.
12. Fish & Fisheries of India- Jhingram VG- 1983, Hindustan Pub Corp.
13. Robinson RK- 1996- Modern Dairy Technology, Vol 1 & 2- Elsevier Applied Science Pub.
14. Milk & Milk Processing- Herrington BL- 1948, McGraw-Hill Book Company.
15. Fox PF- Applied Science Pub Ltd. Outlines of Dairy Chemistry, De S- Oxford.

OUTCOMES:

- On the completion of the above objectives student will have a sound knowledge on the various techniques involved in food processing, storage and handling of food and food products.

LSBY004 RECOMBINANT DNA TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Recombinant DNA
- To learn applications of Recombinant DNA Technology

MODULE I CLONING & CLONING VECTOR **9**

Types of cloning vectors viz. Plasmids, cosmids, ssDNA Phages, Yeast cloning vectors, Animal viruses, Ti plasmids and Cauliflower Mosaic Virus. Structural and Functional Organization of Plasmids, Plasmid Replication, Stringent and Relaxed Plasmids, Incompatibility of Plasmid Maintenance.

MODULE II MANIPULATION OF PURIFIED DNA **9**

Enzymes involved in DNA Manipulation- Nucleases, Ligases, Polymerases and DNA modifying enzymes, Restriction endonucleases-Types, Blunt and sticky ends, Liagtion- Mode of action of DNA Ligase.

MODULE III CONSTRUCTION OF RECOMBINANT DNA **9**

Preparation of competent cell-Transformation, transfection - Recombinant selection and screening- Genomic DNA library- cDNA synthesis strategies - Linkers - Adapters - Homopolymer tailing- Making genomic and cDNA libraries in plasmids and phages. PCR product cloning (TA cloning). Cloning strategies in yeast, E. coli and B. subtilis.

MODULE IV HYBRIDIZATION TECHNIQUES & MUTAGENESIS **9**

DNA hybridization, colony hybridization and in-situ hybridization (Southern, Northern and Dot blots and immunological techniques Western blotting), Mutagenesis - Deletion mutagenesis, Oligonucletoide derived mutagenesis, Site directed mutagensis - Its applications- Applications of rDNA technology in Diagnostics.

MODULE V APPLICATIONS OF rDNA TECHNOLOGY **9**

Gene Cloning and DNA analysis in Agriculture, Forensic Science and Medicine- Production of Recombinant pharmaceuticals, identification of genes

responsible for human disease, Genetic Finger printing, Gene Therapy, Plant Genetic engineering, Problems with Genetically modified plants.

Total Hours: 45

REFERENCES:

1. Recombinat DNA Second eition by Watson

2. Gene Cloning and DNA analysis: An Introduction by T. A. Brown.

OUTCOMES:

This course will introduce the students with the basics about genes, and approaches to manipulate the gene according to need such as production of therapeutic proteins in plants.

LSBY005 BIOREACTORS DESIGN AND ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the design of Bioreactors
- To enable the learners about the operation and function of Bioreactors
- To expose to the merits and demerits of using various types of Bioreactors.

MODULE I INTRODUCTION TO BIOREACTORS 9

Understanding of bioreactors, Elements in Bioreactor Design, Development of Bioreactors, Purpose and importance of Bioreactors, Bioreactor Development for Solid-State Fermentation (SSE), Classification of Bioreactors, Bioreactors for animals cell cultivation, Bioreactors for plant cell culture, Bioreactors for Immobilized system, Sterilization Bioreactors, Bioreactor used in Different Areas of Environmental Control and Management, Bioreactors used for combined reactions and separation.

MODULE II BIOREACTOR OPERATION 9

Common Operations of Bioreactor, Factors affecting operation of Bioreactors, Spectrum of basis Bioreactor Operations, Reactor Operation for Immobilized Systems, Operation for Animal Cell Bioreactors, Plant Cell Culture and Waste Management, General growth reaction, Rate laws, Temperature dependence of rate law for growth, Stoichiometry, Application of yield factors, The mass balance General energy balance in Bioreactors, Batch Bioreactors, Continuous Flow Bioreactors Combination and Semi-Continuous Bioreactors, Kinetic Modeling of Enzyme Reactors.

MODULE III TYPE OF BIOREACTORS 9

Analysis of non- ideal behavior in bioreactors: Non- ideal parameters, Residence Time Distribution- Some Aspects of Macro Mixing, E (t) or F (t) and the Bioreactor Design Models for Non-ideal Flow, Multi Parameter Models, Drawbacks of Classical RTD Measurements, Transient Behaviors in Bioreactors, Stability Analysis for Continuous Flow Bioreactor with Substrate inhibition, Phase Plane Analysis, The Bifurcation Analysis

MODULE IV CONTROLS IN BIOREACTORS **9**

Instrumentation to control a Bioreactor, Controlled variables and Measurement Devices, Procedure for Design of Efficient Control Systems, Conventional Control Techniques, Advanced Control Techniques, Consistency Checks on Measurements, Adaptive Online Optimizing Control of Bioreactor System. Application of computational fluid dynamics in Bioreactor Analysis and design- Fluid Dynamic Modeling, Simulation

MODULE V SCALE-UP OF BIOREACTORS **9**

Scale-Up Problems in Bioreactors, Scale-Up Methods, Generalized Approaches to Scale-Up in Combinations of Methods, Requirements for Construction of a Bioreactor, Guidelines for Bioreactor Design- Bioreactor Vessels, Agitator Assembly.

Total Hours: 45

REFERENCES:

1. Bioreactors: Analysis and Design- Prof Tapobrata Panda - Tata McGraw-Hill Education Private Limited, 2011.
2. Fundamentals of Food Process Engineering, 2nd edition, Toledo Romeo T- CBS Publishers.
3. Preservation of Fruits & Vegetables- Lal G, Sidhapa GS & Tandon GL- ICAR.
4. Process Equipment Design- Brownell LE & Young EH- John Wiley and Sons, Inc.
6. Computer Aided Design of Chemical Process Equipment- Bhattacharyya BC & Narayanan CM- New Central Book Agency.
7. Mechanical Design and Fabrication of Process Equipment- Bhattacharyya BC- Khanna Publishers.
8. Manufacturing Facilities Design and Material Handling by Fred E. Meyers, and Matthew P. Stephens, 3rd Edition, Pearson Prentice Hall, 2000.
9. James M Moore, "Plant Layout and Design", Mcmillan & Co., (1959)
10. J M Apple, " Plant layout and Material Handling", John Willey & Sons, (1977)

OUTCOMES:

- On the completion of the above objectives student will be able to understand the design of Bioreactors. They will be able to learn about the operation and functional of bioreactors. They can know merits and demerits of using various types of bioreactors.

LSBY006 MOLECULAR & CELLULAR DIAGNOSTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Developing the basic concept of molecular and cellular diagnostics procedures
- Understanding the common procedures which are used in disease diagnosis

MODULE I INTRODUCTION TO CLINICAL DIAGNOSTICS **9**

Biological assays used in diagnosis- PCR, ELISA, FISH, gene sequencing, microarrays, protein arrays, assays for liver, cardiac, skeletal, thyroid, renal and reproductive endocrine function, specimen collection, processing and preservation techniques.

MODULE II INFECTIONS **9**

Infection and mode of transmission, types of infectious diseases- bacterial and fungal infections, diagnosis of infections caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium- diagnosis of fungal infections, major fungal diseases, Dermetophytoses, Candidiosis and Aspergillosis

MODULE III DIAGNOSIS OF PATHOGENS **9**

Diagnosis of DNA and RNA viruses- pox virus, rhabdo virus, hepatitis virus- diagnosis of protozoan diseases, amoebiosis, malaria, trypanosomiosis, leishmaniasis- study of helminthic diseases- Fasciola hepatica and Ascaris lumbricoides. Filariasis and Schistosomiasis.

MODULE IV MEDICAL GENETICS **9**

Introduction to medical genetics- organization of human genome, human genome project, cancer genetics- oncogenes, tumor suppressor genes- gene therapy, genes in pedigree, genetic counseling- genetic disorders, sickle cell anaemia, Duchenne muscular dystrophy, retinoblastoma, cystic fibrosis and sex -linked inherited disorders- analysis of mitochondrial DNA for maternal inheritance.

MODULE V IMMUNODIAGNOSTICS 9

Introduction to immunodiagnostics, antigen-antibody reactions, antibody production, antibody markers, CD markers, FACS, Human Leukocyte Antigen (HLA) typing, agglutination (ABO/Bacterial), immunoprecipitation, immunodiffusion.

Total Hours: 45

REFERENCES:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.
2. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld

SUGGESTED READINGS:

1. The Science of Laboratory Diagnosis, Crocker Burnett

OUTCOMES:

- The student will gain knowledge about the relevance and application of molecular biology and cell biology in disease diagnosis and forensic science.

LSBY007 BIOMEDICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand about the general body physiology and various systems inside the body.
- To acquire knowledge on the hot topic of nanotechnology and different aspects of biomaterials.
- To get familiarity on the medical instrument used in hospitals.
- To know about the tissue engineering and its several aspects.

MODULE I GENERAL PHYSIOLOGY 9

Basic biological (biophysical & biochemical) Principles, blood vascular system, Ultra structure & functions of blood vessels (artery & vein),Muscular Physiology:-Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles,Neuro Physiology, Neuroglia. Myelinated and unmyelinated nerve fibers.Cardio Vascular System and Renal System.

MODULE II NANOTECHNOLOGY IN MEDICINE 9

Fundamentals, preparation, characterization and application of Nanoscience-Semiconducting nanoparticles, Thermal Stability, Basic Material Properties-Nanotubes, nanowires, and nanodevices, Microelectromechanical systems (MEMs), Nanoelectromechanical systems (NEMs), Biosensors, Drug Delivery using Nanoparticles and Molecular Carriers.

MODULE III BIOMATERIALS 9

Definition and classification of biomaterials, Metallic and polymeric implant materials, Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications, bioceramics, biocompatibility, blood compatibility and tissue compatibility.

MODULE IV MEDICAL INSTRUMENTATION 9

Static characteristics of instruments, basic methods of measurements, Analytical equipments used in clinical environment, Transducers - Classification, selecting of transducers, circuit based on transduction,

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG).

MODULE V TISSUE ENGINEERING 9

Introduction: Basic definition, Structural and organization of tissues, Cell culture: Different cell types, progenitor cells and cell differentiations, Cell signaling molecules, receptor-ligand binding, and Cell surface markers, cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering, ethical, FDA and regulatory issues of tissue engineering.

Total Hours: 45

REFERENCES:

1. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.
2. Sujit K.Chaudhuri - Concise Medical Physilogy - New Central Book agency, 1997
3. Vinod Labhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications Of Nanotechnology, Wiley-Interscience A John Wiley & Son, Inc., Publication, 2007
4. R.Anandanatarajan, "Biomedical Instrumentation", PHI Learning, 2009.
5. David O. Cooney., Biomedical Engineering Principles (Volume - II). Marcel Dekker Inc.
6. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008
7. Vicki H. Grassian, Nanoscience And Nanotechnology: Environmental And Health Impacts John Wiley & Sons(Hardcover - 2008),

OUTCOMES:

- At the end of the syllabus student will be able to know about our general body physiology and their functions. Students will be acquainted with how nanotechnology is implemented in medicine and to deal with all medical instruments. They will also be familiar with the use of biomaterial and biopolymers, cell culture and tissue engineering.

LSBY008 BIOSAFETY AND BIOETHICS L T P C
3 0 0 3

OBJECTIVES:

- Developing a good work ethics and laboratory working condition
- Understanding the importance of following and maintaining laboratory safety guidelines

MODULE I ETHICS IN BIOLOGY 9

Principles and purpose of studying bioethics, legal, moral and ethical issues in biological research, human rights, privacy and justice, IPR and technology transfer.

MODULE II BIOSAFETY 9

Biosafety in laboratory practices, laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, biosafety regulations in handling of recombinant DNA processes and products.

MODULE III GENETICALLY MODIFIED CROPS AND FOOD 9

Genetically modified food and biosafety assessment procedures for GM foods and related consumables, including transgenic food crops, ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (e.g. BT cotton).

MODULE IV ETHICAL ISSUES IN LABORATORY RESEARCH 9

Ethical issues and guidelines for research with laboratory animals, current uses of laboratory animals in biomedical research, animal experimentation using hazardous chemicals, animal care and maintenance, CPSEA guidelines for laboratory animals.

MODULE V ETHICAL ISSUES IN CLINICAL RESEARCH 9

Ethical issues and guidelines for research with clinical samples and humans studies, Role of Institutional Human ethical board, ICMR's ethical guidelines and clinical trials registration in India and challenges in clinical trials.

Total Hours: 45

REFERENCES:

1. Thomas, J.A., Fuch, R.L. Biotechnology and Safety Assessment (3rd Ed). Academic Press, 2002

2. Fleming, D.A., Hunt, D.L. Biological safety Principles and practices (3rd Ed). ASM Press, Washington, 2000.

3. H.-J. Rehm and G. Reed, Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.

OUTCOMES:

- At the end of the course student will develop an idea about the importance of good laboratory practice in high quality research. They will also develop an awareness about the basic fundamental safety measures that a researcher should follow in laboratory.

LSBY009 NANOBIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I FUNDAMENTALS OF NANOSCIENCE 9

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

MODULE II CHARACTERIZATIONS IN NANOBIOTECHNOLOGY 9

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

MODULE III APPLICATIONS OF NANOBIOTECHNOLOGY 9

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

MODULE IV NANOMATERIALS AND DIAGNOSTICS 9

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

MODULE V NANOMATERIALS AND TOXICITY EVALUATION 9

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

Total Hours: 45

REFERENCES:

1. C. M. Niemeyer, C. A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspective, Wiley - VCH, 2004.
2. 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 nanotechnology in biotechnology. In detail understanding of the application of Nanomaterials in biotechnology and acquire the knowledge about the DNA, proteins, amino acids, drug delivery, biomedicine etc.

LSBY010 STEM CELLS IN HEALTH CARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To obtain knowledge on wide-ranging topics related to stem cell
- To learn about the application of stem cells in health care
- To get familiar with the issues and challenges of stem cell political and ethical issues surrounding the stem cell debate.

MODULE I GENESIS OF CELLS **9**

Concept of stem cells: types, self-renewal and pluripotency, isolation and characterization, Niche and its role on differentiation of stem cells, Stem cells and restorative biology, Reprogramming of genome function through epigenetic inheritance.

MODULE II STEM CELLS **9**

Embryonic stem cells, Stem Cells from adults. Pluripotency necessary, or is unipotency enough? What are the mechanisms? Stem-cell plasticity, Regulators of pluripotency and differentiation of stem cell. The isolation, expansion, genetic manipulation, genomic reprogramming, and cloning of stem cells. The problem of differentiation of stem cells. Stem Cells and imprinted genes. Differences between adult and embryonic stem cells, what types of cells adult stem cells can become.

MODULE III CELL & TISSUES **9**

From single to multicellular components - Regulation of cell division and cytoskeleton, Stem cells in regeneration, Cell specification and early signaling events during morphogenesis, Development of cell adhension and motility , Cellular imprinting.

MODULE IV CELL GROWTH & DEVELOPMENT **9**

Factors controlling cell development - Environmental factors like temperature, oxeygen, location, time, cell number , Chemical factors like growth factors, hormones, cytokines, microRNAs , Genetic factors.

MODULE V STEM CELLS AND THERAPEUTICS 9

Cancer stem cells , Stem cells treatment to diseases , Current stem cell therapies, how we can use stem cells for studying cancer and finding cures to other diseases, Correlation between stem cells and cancer, Stem cells and aging. Clinical applications of hematopoietic stem cells from cord blood first successful transplantation of cord blood in a child with Fanconi's anemia. Treatment of neural diseases such as Parkinson's disease, Huntington's disease and Alzheimer's disease. Repair of damaged organs such as the liver and pancreas. Ethical issues associated with stem cells.

Total Hours: 45

REFERENCES:

1. Kiessling A. A, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.
2. Quesenberry P. J. Stem Cell Biology and Gene therapy, 1st Edition, Willy-Less, 1998.
3. Lanja L, Essential of stem cell Biology, 2nd Edition, Academic Press, 2006.
4. Ho A. D. and Hoffiman R. Stem Cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
5. Potten C. S. Stem Cells, Elsevier, 2006.

OUTCOMES:

- After the completion of the course the student will have overall knowledge of scientific research, management, implications and exploitation in Stem Cells in Health care.

LSBY011 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the Intellectual Property Rights
- To understand about criteria in applying and maintaining patents.
- To be familiarized with the law and enforcement in Intellectual Property Rights

MODULE I INTRODUCTION TO IPR **9**

General regime of intellectual property rights and law. Theories of Intellectual Property Rights, Kinds of Intellectual Property. Intellectual Property as an Instrument of Development, Economic importance of Intellectual Property. Need for Protecting Intellectual Property. National and international perspectives.

MODULE II TRADE MARK **9**

Introduction to Trade mark, Trade mark registration and maintenance Process, Transfer of Rights, Inter parties Proceeding, Infringement, Dilution Ownership of Trade mark, Likelihood of confusion, Trademarks claims, Trademarks Litigations and International Trade mark Law. Trade Secret, Employee Limitation, Unfair Competition and Trade Secret Litigations.

MODULE III COPYRIGHTS **9**

Introduction to Copyrights, Principles of Copyright, Copyright Law, Copy right Ownership, Transfer and duration, Right to prepare Derivative works, Rights of Distribution, Rights of Perform the work Publicity Copyright Formalities and Registrations, Limitions, Copyright disputes and International Copyright Law.

MODULE IV GEOGRAPHICAL INDICATIONS **9**

Registration, Duration of Protection and Renewal- Infringement, Penalties and Remedies. Layout designs of Integrated Circuits- Semiconductor Integrated Circuits Layout-Design Act, 2000, Registration and Effect of Registration, Assignment and Transmission. Protection of Plant Varieties and Farmers' Rights - Authority and Registry, Duration, Effect of Registration and Benefit Sharing, Farmers' Rights, Plant Varieties Protection Appellate Tribunal, Infringement, Offences and Penalties.

MODULE V IPR LEGISTLATION AND PATENTING 9

World Intellectual property organization WIPO - establishment, role, membership, etc., Indian IPR legislation, Indian patent act, national intellectual property policy. Rationale for Intellectual Property Protection in Biotechnology, Patenting Biotechnology Inventions-Objective, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions. Protection of Plant Varieties. Protection of Traditional Knowledge. Case studies on Basmati rice, turmeric, neem and also current cases.

Total Hours: 45

REFERENCES:

1. Debirag E. B. Intellectual Property. Cengage learning, New Delhi
2. Prabhuddha G. Intellectual Property Rights. Tata Mc-Graw-Hill, New Delhi
3. Gopalakrishnan N. S. and Agitha, T. G. Principles of Intellectual Property, Eastern Book Company, Lucknow 2009.
4. Subbaram N. R. Handbook of Indian patent law and practice, S. Viswanathan printers and publishers Pvt Ltd, 1998.

OUTCOMES:

- On the completion of the above objectives student will be able to know about IPR and also the importance of protecting their innovation. They will be familiar with international and national law practiced and also recent issues on it.