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

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

Regulations 2019
Curriculum and Syllabi

(Amendments updated upto June 2020)

M.Tech.
(Biotechnology)

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

REGULATIONS 2019
CURRICULUM AND SYLLABI
(Amendments updated upto June 2020)

M. TECH.
BIOTECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

SCHOOL OF LIFE SCIENCES

VISION AND MISSION

VISION

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

MISSION

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

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.Tech. (BIOTECHNOLOGY)

PROGRAMME EDUCATIONAL OBJECTIVES:

The course aims to provide an advanced understanding of the core principles and topics of Biotechnology and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. Hence, the main objectives of the program are:

- To provide an introduction to the basic concepts of Biotechnology and its recent advances.
- For the basic understanding, this course includes advanced biochemistry, cell and molecular biology, immunotechnology, and microbial biotechnology.
- Moreover, several laboratory courses given in the individual sections of the curriculum with detailed information on the importance of biotechnology in basic and applied research.
- Finally this course explains the advanced sections of biotechnology like genetic engineering, nanobiotechnology, computational biology and medical biotechnology.
- This course provides necessary theoretical and practical experience in all divisions of biotechnology to pursue a professional career in this field.
- To provide broad exposure to various societal, ethical and commercial issues in the various aspects of biotechnology.

PROGRAMME OUTCOMES:

After successfully completing this course, the student should be able to:

- Apply their knowledge of biotechnology into high end research.
- Advanced sections of like Immunology, bioinformatics, nano-biotechnology will give broad information on applications and opportunities in the field of biotechnological research.
- Identify research and solve biochemistry, cell and molecular biology related problems related to the different types of animal and plant diseases.
- Ability to work with multidisciplinary subjects in industries and research.
- Ability to communicate and function effectively in multi-disciplinary team related to the biochemistry and molecular biology.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE & TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS - 2019 FOR

M.Tech. / MCA / M.Sc. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires **"Programme"** means Post Graduate Degree Programme (M.Tech. / MCA / M.Sc.)

"Course" means a theory / practical / laboratory integrated theory / mini project / seminar / internship / Project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, etc.,

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

"Academic Council" means the Academic Council, which is the apex body on all academic matters of B.S. Abdur Rahman Crescent Institute of Science & Technology.

"Dean (Academic Affairs)" means Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology who administers the academic matters.

"Dean (Student Affairs)" means Dean (Student Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology, who looks after the welfare and discipline of the students.

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

2.0 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	

2.2 ADMISSION REQUIREMENTS

2.2.1 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 Institution as specified in the clause 3.2 [Eligible entry qualifications for admission to P.G. programmes] or any other degree examination of any University or authority accepted by this Institution as equivalent thereto.

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

3.0 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

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

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA (3 years)	6	12
MCA (Lateral Entry)	4	8
MCA (2 years)	4	8
M.Sc.	4	8

3.1.1 Each academic semester shall normally comprise of 90 working days. Semester End Examinations shall follow within 10 days of the last Instructional day.

3.1.2 Medium of instruction, examinations and project report shall be in English.

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Qualifications for admission
1.	Aeronautical Engineering	M. Tech. (Avionics)	B.E. / B. Tech. (Aeronautical Engineering)
2.	Civil Engineering	M. Tech. (Structural Engineering)	B.E. / B. Tech. (Civil Engineering) / (Structural Engineering)

		M. Tech. (Construction Engineering and Project Management)	B.E. / B. Tech. (Civil Engineering) / (Structural Engineering) / B. Arch.
3.	Mechanical Engineering	M.Tech. (Manufacturing Engineering)	B.E. / B.Tech. (Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M.Tech. (CAD/CAM)	
4.	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 and Drives)	
5.	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E. / B. Tech. (EEE/ ECE / E&I / CSE IT / I&C / Electronics / Instrumentation)
		M.Tech. (VLSI and Embedded Systems)	B.E. / B. Tech. (ECE / E&I / I&C / EEE / CSE / IT)
6.	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E. / B. Tech. (EIE/ICE/Electronics/ECE/EEE)
7.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B. Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics / MCA)
8.	Information Technology	M.Tech. (Information	B.E. / B. Tech. (IT/CSE/ECE/EEE/EIE/ICE/

		Technology)	Electronics / MCA)
9.	Computer Applications	MCA (3 years)	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		MCA – (Lateral Entry)	B.Sc. Computer Science / B.Sc. Information Technology / BCA
		MCA (2 years)	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level or B.Sc. Computer Science / B.Sc. Information Technology / BCA
10.	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the subjects of study
11.	Physics	M.Sc.(Physics)	B.Sc. (Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
12.	Chemistry	M.Sc.(Chemistry)	B.Sc. (Chemistry / Applied Science)
13.	Life Sciences	M.Sc. Molecular Biology & Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Biotechnology	B.Sc. in any branch of Life Sciences
		M.Sc. Microbiology	B.Sc. in any branch of Life Sciences
		M.Tech. Biotechnology	B.Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences

3.3. STRUCTURE OF THE PROGRAMME

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

i. Core courses
ii. Elective courses
iii. Laboratory oriented core courses
iv. Project work / thesis / dissertation
v. Laboratory Courses
vi. Seminars
vii. Mini Project
viii. Industrial Internship
ix. Value Added Courses
x. MOOC Courses (NPTEL, SWAYAM, etc.,)

3.3.2 The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

3.3.3 For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

3.3.4 The curriculum of 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	Range of credits
M.Tech.	74 - 80
MCA (3 years)	118 - 126
MCA (Lateral Entry)	80 - 85
MCA (2 years)	85 - 90
M.Sc.	77- 82

3.3.5 Credits will be assigned to the courses for all programmes as given below:

- One credit for one lecture period per week or 15 periods of lecture per semester
- One credit for one tutorial period per week or 15 periods per semester
- One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester
- One credit for four weeks of industrial internship or 160 hours per

semester.

3.3.6 The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 28	18 to 26
MCA	12 to 33	12 to 26
M.Sc.	9 to 32	10 to 26

3.3.7 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

3.3.8 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

3.3.9 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, during the entire period of study, with the approval of the Head of the department offering the course and parent department.

3.4. ONLINE COURSES

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

3.4.2 Students shall undergo project related online course on their own with the mentoring of the faculty member.

3.5 PROJECT WORK / DISSERTATION

3.5.1 Project work / Dissertation shall be carried out by the student under the supervision of a Faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research Organization, with the approval of the Head of the Department/ Dean of School. 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 meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last Instructional day of the semester in which Project / Dissertation is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work / dissertation and shall re-register in the subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD / Dean of School 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 / Dean of School of the students shall 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 in every semester.

5.0 CLASS COMMITTEE

5.1 A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted in every semester:

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

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department
ii) Faculty members of all courses of the semester
iii) All the students of the class
iv) Faculty advisor and class advisor
v) Head of the Department – Ex officio member

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

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

5.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

6.0 COURSE COMMITTEE

6.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling 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 handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and

ensure uniform evaluation of the assessment tests and semester end examination.

7.0 REGISTRATION AND ENROLLMENT

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

7.2 For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

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

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

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

8.1 A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first assessment test of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1). If any student is debarred for want of attendance or suspended due to any act of indiscipline, it will not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only in the subsequent year. The student availing break of study is permitted to write arrear examinations by paying the prescribed fees.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / 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.	18

MCA (3 years)	45
MCA (Lateral Entry)	22
MCA (2 years)	22
M.Sc.	18

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 ATTENDANCE

10.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds, representing for the institution in approved events, etc.) to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded "I" grade in that course. The courses in which the student is awarded "I" grade, shall register and redo the course when it is offered next.

10.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the Class Advisor. The Class Advisor will consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.

10.3 A student who has obtained 'I' grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall redo all the courses of the semester in the subsequent academic year. However he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

10.4 A student shall register to redo a core course wherein "I" or "W" grade is awarded. If the student is awarded, "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be chosen with the approval of Head of the Department / Dean of

School.

11.0 REDO COURSES

11.1 A student can register for a maximum of two redo courses per semester in the evening after regular working hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters, without affecting the regular academic schedule and not exceeding prescribed maximum credits.

11.2 The Head of the Department with the approval of Dean (Academic Affairs) may arrange for the conduct of a few courses in the evening after regular working hours, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

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

12.0 ASSESSMENTS AND EXAMINATIONS

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

Assessments	Weightage of Marks
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	50%

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

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However a student should have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

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

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

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

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

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

12.7 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be considered for grading along with the marks scored in the semester end arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination to award grades and the internal assessment marks secured during the course of study shall not be considered.

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

examination for lab component.

13.0 SUBSTITUTE EXAMINATIONS

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

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

14.0 SUPPLEMENTARY EXAMINATION

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

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7

D	6
E	5
U	0
W	0
I	0
AB	0

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

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

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department / Dean of School and it shall be declared by the Controller of Examinations.

15.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee to the Controller of Examinations. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as convener, the faculty member of the course and a senior faculty member knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

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

GPA is the ratio of the sum of the products of the number of credits of courses

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

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

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

Where n = number of courses

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

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

"U", “I”, "AB" and **"W"** grades are excluded for calculating CGPA.

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

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained ‘U’ or ‘I’ grade in any course during his/her period of study and should have completed the P.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the 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 is not considered.

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

16.0 DISCIPLINE

16.1 Every student is expected to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

16.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

17.1 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.
iii. Enrolled and completed at least one value added course.
iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

17.2 The award of the degree must have been approved by the Institute.

18.0 POWER TO MODIFY

Not withstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

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

M.TECH. BIOTECHNOLOGY

CURRICULUM & SYLLABUS, REGULATIONS 2019

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	LSD 6101	Advanced Biochemistry	4	0	0	**4**
2.	LSD 6102	Cell & Molecular Biology	4	0	0	**4**
3.	LTD 6101	Applied Biostatistics for Biotechnologists	3	0	0	**3**
4.	LTD 6102	Immunotechnology	4	0	0	**4**
5.	LTD 6103	Biomedical Instrumentation Technology	3	0	0	**3**
6.	LTD 6104	Microbial Biotechnology	3	0	0	**3**
7.	LTD 6105	Biochemistry Laboratory	0	0	3	**1**
8.	LTD 6106	Cell Biology Laboratory	0	0	3	**1**
9.	LTD 6107	Immunotechnology Laboratory	0	0	3	**1**
		Total Credits				**24**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	LTD 6201	Genomics & Proteomics	4	0	0	**4**
2.	LTD 6202	Bioprocess Engineering & Downstream Processing	4	0	0	**4**
3.	LTD 6203	Genetic Engineering	3	0	0	**3**
4.	LTD 6204	Computational Biology	3	0	0	**3**
5.	LTD 6205	Environmental Biotechnology	3	0	0	**3**
6.	LTD 6206	Computational Biology Laboratory	0	0	3	**1**
7.	LTD 6207	Genetic Engineering Laboratory	0	0	3	**1**
8.		*Value added course				**-**
		Total Credits				**19**

* Any relevant certification course offered by the institution / other institutions / universities / IIT Bombay (ST), MOOC courses, etc.

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.	LTD 7101	Pharmacogenomics	4	0	0	**4**
2.	LSD 7102	Plant and Animal Biotechnology	3	0	0	**3**
3.		Professional Elective I	3	0	0	**3**
4.		Professional Elective II	3	0	0	**3**
5.	LTD 7102	Project Phase I **	**0**	**0**	**12**	**6****
6.		MOOC Course (related to project)***				**-**
		Total Credits				**13**

Minimum of 3 credits

Minimum of 6 credits

** Credits for Project Phase I to be accounted along with Project Phase II in IV Semester.

*** A minimum of one credit MOOC course relevant to project work shall be selected. Enrollment in MOOC course is mandatory for Project Phase I completion.

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	LTD 7102	Project Phase II**	**0**	**0**	**36**	**18****
		Total Credits				**6**+18 = 24**

** Credits for Project Phase I to be accounted along with Project Phase II in IV Semester.

Grand Total of Credits 75

PROFESSIONAL ELECTIVE

Sl. No.	Course Code	Course Title	L	T	P	C
1	LTDY 021	Bioenterpreneurship	3	0	0	3
2	LTDY 022	Intellectual Property Rights & Patent Law	3	0	0	3
3	LTDY 023	Bio safety & Bioethics	3	0	0	3
4	LTDY 024	Bio nanotechnology	3	0	0	3
5	LTDY 025	Clinical Genetics & Counselling	3	0	0	3
6	LTDY 026	Molecular Diagnostics	3	0	0	3
7	LTDY 027	Food Process technology	3	0	0	3
8	LTDY 028	Industrial Biotechnology	3	0	0	3

SEMESTER I

LSD 6101	ADVANCED BIOCHEMISTRY	L	T	P	C
		4	0	0	4

OBJECTIVES:

This course aims to develop in the students' mind a concept regarding

- The diversity of metabolic processes occurring in biological system.
- The effect of the structural and functional role of the enzymes governing the metabolic processes.
- Importance of the metabolic pathways in maintaining homeostasis in biological system.
- The clinical implications of the metabolic pathway.

MODULE I AMINO ACIDS & PROTEIN: STRUCTURE AND FUNCTIONS **12**

Amino acids- Classification, structure and function, proteins- primary, secondary, tertiary and quaternary structure, Ramachandran plot, super secondary structures and helix loop.

MODULE II ENZYMOLOGY **12**

Classification of enzymes. How do enzymes work: activation energy, substrate specificity. Enzyme-substrate interaction: Lock and Key mechanism and Induced Fit mechanism. Effect of temperature and pH on enzyme action. Enzyme Kinetics: Michaelis-Menten Equation, Km, Measurement of Km and Vmax (Lineweaver-Burk equation). Kinetics of multisubstrate reaction: Sequential reactions and ping-pong reactions. Enzyme inhibition: reversible (competitive, uncompetitive and mixed) and irreversible. Allosteric regulation of enzyme activity. Multienzyme complex and multifunctional enzymes.

MODULE III ENERGY PRODUCTION AND OXIDATIVE PHOSPHORYLATION **12**

Introduction to metabolism: Anabolism, catabolism, metabolic pathways. Characteristics of metabolic pathways

Glycolysis: glycolytic pathway. Molecular mechanism of action of the glycolytic enzymes. Energetic of glycolysis. Glycolysis and cancer biology—Warburg

Hypothesis and PET scanning. Fates of Pyruvate under anaerobic conditions: alcohol and lactic acid fermentation. Importance of lactic acid fermentation.

TCA Cycle: Formation of Acetyl CoA and reactions of citric acid cycle. Molecular mechanism of pyruvate dehydrogenase complex and enzymes involved in Kreb's cycle. Energetic of TCA cycle and substrate level phosphorylation.

Lipid metabolism: Hormonal regulation of the mobilization of triglycerides from adiposities. Transport of fatty acid into mitochondria. Beta oxidation of saturated fatty acid (both even and odd). Regulation. Energetic.

Electron Transport Chain: structure and function of Electron carriers: Complex I—V. Passage of electrons from complex I to IV. Mitchell's chemiosmotic hypothesis and proton gradient. Structure of complex V or ATP synthase, Catalytic sites of ATP synthesis. Mechanism of ATP generation by Boyer's binding change mechanism—rotational catalysis. Energetic of ATP synthesis and efficiency of ATP synthase.

MODULE IV METABOLIC INTERRELATIONSHIP 12

Starve-Fed cycle. Glucose homeostasis. Switching of metabolism of liver between starve and fed cycle. Metabolic relationship of tissues in various nutritional and hormonal states—insulin resistance, diabetes, exercise, pregnancy, lactation, stress, liver and renal diseases, alcohol consumption.

MODULE V REGULATORY MECHANISMS OF METABOLIC PATHWAYS 12

Feed back inhibition by allosteric modulation of enzymes. Covalent modifications of enzymes. Isozymes. Propetolytic cleavage. Regulationg the amount of enzyme—regulation gene expression in prokaryotes and eukaryotes.

L – 60; Total Hours –60

REFERENCES:

1. Nelson D.L, Cox M. M. Lehninger's Principle of Biochemistry. 5th Ed.,W. H. Freeman, 2008.
2. Biochemistry by Lubert Stryer 7th ed. W. H. Freeman & Company.
3. Textbook of Biochemistry with Clinical Correlations. 4th Ed. Thomas M. Devlin. Wiley-Liss publication. 1997.

OUTCOMES :

Students to complete this course will be able to

- Various metabolic processes occurring in biological system and their role in governing homeostasis and normal physiology.
- The importance of enzymes as a regulatory molecule in metabolism.
- The interrelationship of metabolic pathways different physiological conditions.
- The role of liver in regulating metabolism.

LSD 6102 CELL & MOLECULAR BIOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- To get overview of classes of cells and structural and function aspects of plasma membrane and cell organelle.
- To develop skill to understand molecular aspects of cell cycle and cell division.
- To get familiar with transcription and translation in details.
- To understand the signaling pathways in cell functioning.

MODULE I INTRODUCTION TO CELL 12

Basic properties of cell, Different classes of cell: Prokaryotic, animal and plant cell.Plasma membrane- structure and function, Chemical composition of membranes, membrane lipids and proteins, fluid mosaic model, Transport across the membranes- diffusion, osmosis, facilitated diffusion,passive and active transport; membrane potential and nerve impulses.

MODULE II MEMBRANE TRANSPORT 12

Endoplasmic Reticulum, Golgi complex- glycosylation, Vesicle transport- COPI and COPII; Lysosomes-autophagy;Endocytic pathway- endocytosis and phagocytosis,transport of proteins into peroxisomes, mitochondria and chloroplast;

MODULE III ENERGY CONVERSION 12

Structure of mitochondria and organization of respiratory chain; Proton Pump and ATP generation in mitochondria; Structure of chloroplast and Photosynthesis, photorespiration; Genetic system of mitochondria and chloroplast.

MODULE IV BASIC GENETIC MECHANISMS 12

The structure and function of DNA, DNA packaging and Chromosomes, chromatin structure and function, DNA replication mechanisms, DNA damage and repair and homologous recombination and transposable elements, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer.

MODULE V TRANSCRIPTION AND TRANSLATION 12

Transcription- Prokaryotic and eukaryotic Transcription- RNA polymerases- general and specific transcription factors- regulatory elements- mechanism of transcription, Transcription termination Post transcriptional modification- splicing- editing- nuclear export of mRNA- mRNA stability; Translation- Genetic code, Mechanism of initiation- elongation andtermination- Regulation of translation.

L – 60; Total Hours –60

REFERENCES:

1. Molecular Biology of Cell by Alberts et.al. John Wiley & Sons, 6Ed, 2015
2. The Cell by Cooper. ASM Press, 4Ed, 2007
3. Cell and Molecular Biology by Karp. John Wiley & Sons, 7Ed, 2013
4. Lodish H. F.Cell and Molecular Biology. W.H. Freeman & Co Ltd, 7Ed, 2000

OUTCOMES :

Students to complete this course will be able to

- get the overview of classes of cells and structural and function aspects of plasma membrane and cell organelle.
- develop skill to understand molecular aspects of cell cycle, cell division, transcription and translation.

LTD 6101	APPLIED BIOSTATISTICS FOR BIOTECHNOLOGISTS	L	T	P	C
		4	0	0	4

OBJECTIVES:

This course aims to provide students with fundamental knowledge of statistical issues arising in biomedical research, and of important methods for the analysis of biostatistical data.

- Students will be able to make informed decisions based on data
- Students will be able to correctly apply a variety of statistical procedures and tests
- Students will know the uses, capabilities and limitations of various statistical procedures
- Students will be able to interpret the results of statistical procedures and tests

MODULE I CONCEPTS IN STATISTICS 08

Population and sample, qualitative and quantitative data, nominal, ordinal, ratio, interval data; cross sectional and time series data; discrete and continuous data. Descriptive statistics and Random variables; Measures of central tendency: mean, median, mode; the uses of measure of central tendency, Measures of spread: range, percentile, standard deviation, some properties of variance and standard deviation, the coefficient of variation, group data.

MODULE II INFERENTIAL STATISTICS 08

Displaying data: frequency table, line graph, bar chart, histograms, stem and-leaf plots, dot plot, scatter plot, box plots, frequency distributions; definition of probability, rules for calculating probability, definition from epidemiology, Bayes' theorem, probability in sampling, Bernoulli, Binomial, Poisson; Geometric distributions; Continuous random variables: Normal; Exponential distributions; Standard normal distribution. Counting and Probability, Permutations; Combinations.

MODULE III INTERVAL ESTIMATION 12

Prediction, confidence and tolerance Intervals, distribution free interval, confidence interval based on normal distribution, confidence interval and sample size, Point and interval estimates; the relation between population and sample,

Random-Number tables, randomized clinical trials, estimation of the Mean of Distribution, estimation of -variance of distribution, binominal distribution and poisson distribution.

MODULE IV HYPOTHSIS TESTING 12

Hypothesis testing: null and alternative hypotheses, decision criteria, critical values, type I and type II errors, Meaning of statistical significance; Power of a test; One sample hypothesis testing: Normally distributed data: z, t and chi-square tests; Binomial proportion testing, nonparametric hypothesis testing, Two sample hypothesis testing; Nonparametric methods: signed rank test, rank sum test; Kruskal-Wallis test;

MODULE V CURVE FITTING AND ANOVA 12

Regression and correlation: simple linear regression; Least squares method; Analysis of enzyme kinetic data; Michaelis-Menten; Lineweaver-Burk and the direct linear plot; Logistic Regression; Polynomial curve fitting. Analysis of variance: One-way ANOVA, two-way ANOVA. Fixed effect model, Random effect model, the intraclass correlation coefficient

MODULE VI ANALYSIS OF SURVEY DATA 08

Introduction, study design, measures of effect for categorical data, attribution risk, confounding and standardization, methods of inference for stratified categorical data-The Mantel-Haenszel test, power and sample, multiple logistic regression, meta Analysis, equivalence study, the cross-over design, longitudinal data analysis, measurement-error Methods.

L – 60; Total Hours –60

REFERENCES:

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.
4. Paul, Fundamental of Immunology, 4th edition, Lippenco

OUTCOMES :

Students to complete this course will be able to

- have a detailed understanding of concepts in staistics
- understand the principle and applications of different forms of data dispaly
- understand the concept of interval estimation
- understand the principleand applications of making a hyposthesis of the data and testing it
- have basic knowledge of curve fiiitng the data and design and categorize the data

LTD 6103	BIOMEDICAL INSTRUMENTATION TECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To understand the application of biomedical instrumentation
- To introduce the student to the various devices of electrical origin and non electrical origin.
- To provide awareness of electrical safety of medical equipments.
- To know the important and modern methods of imaging techniques.

MODULE I FUNDAMENTALS OF MEDICAL INSTRUMENTATION **12**

Role of technology in medicine, landmark developments in biomedical instrumentation, physiological systems of the body, sources of biomedical signals, basic medical instrumentation system, performance requirements of medical instrumentation systems, intelligent medical instrumentation systems, consumer and portable medical equipment, implantable medical devices, Basic components of a biomedical system, Transducers, Piezoelectric, ultrasonic transducers, Temperature measurements, Fibre optic temperature sensors. Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers Isolation amplifier.

MODULE II BIOELECTRIC SIGNALS AND ELECTRODES **12**

Origin of bioelectric signals, recording electrodes, silver-silver chloride electrodes, Electrodes, Limb electrodes, floating electrodes, pregelled disposable electrodes, electrodes for ECG, electrodes for EEG, electrodes for EMG, electrical conductivity of electrode jellies and creams, microelectrodes, Micro, needle and surface electrodes, Typical waveforms, Electrical safety in medical environment: shock hazards, leakage current-Instruments for checking safety parameters.

MODULE III BIOMEDICAL RECORDER **12**

Measurement of blood pressure, Heart rate, Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analysers : pH of blood measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements, Electrocardiograph, vectorcardiograph (VCG) , phonocardiograph (PCG),digital stethoscope,

electroencephalograph (EEG), electromyography, other biomedical recorders, biofeedback instrumentation.

MODULE IV CLINICAL INSTRUMENTS AND PATIENT MONITORING SYSTEMS **12**

Medical diagnosis with chemical tests, spectrophotometry, spectrophotometer type instruments, colorimeters, spectrophotometers, clinical flame photometers, selective-ion electrodes based electrolytes analyser, automated biochemical analysis systems, Radio graphic and fluoroscopic techniques, Computer tomography, MRI, Ultrasonography, X-ray Machines and Digital Radiography, Blood cell counter.

MODULE V THERAPEUTIC EQUIPMENTS AND PATIENT SAFETY **12**

Audiometers and Hearing Aids, Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart – Lung machine, Dialysers, Lithotripsy, electric shock hazards, leakage currents, safety codes for electromedical equipment, electrical safety analyzer, testing of biomedical equipment.

L – 60; Total Hours –60

REFERENCES:

1. R.S.Khandpur, ‘Hand Book of Bio-Medical instrumentation’, McGraw Hill Publishing Co Ltd. 2003
2. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.
3. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’, John Wiley & Sons, 1975.
4. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons, 1995.
5. C.Rajarao and S.K. Guha, ‘Principles of Medical Electronics and Bio-medical Instrumentation’, Universities press (India)

OUTCOMES :

After the completion of the course

- understand the importance of laboratory safety and standard operating procedures of common laboratory equipment’s used in medical sciences
- theoretically trained to with working knowledge of different instruments and be able design experiments

- understand the importance of measurement of blood pressure, ECG and other instruments used as biomedical recorder
- analyze and estimate biomolecules in normal and diseased conditions
- Learn the importance and gain working knowledge of medical test and instruments used in patient monitoring systems
- Understand the principle and working of therapeutic instruments such as hearing aids, vision aids etc and learn about patient safety protocols

LTD 6104 MICROBIAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the microbial growth kinetics, isolation and screening
- To understand the principles of bioprocess
- To get the protein expression strategies & recombinant production
- To give basic idea on metagenomics & risk management
- To inform students about application in microbial biotechnology

MODULE I MICROBIAL GROWTH KINETICS, ISOLATION AND SCREENING **9**

Microbial growth kinetics: batch cultures, continuous cultures, fed-batch culture. Isolation and screening of industrially important microbes; Large scale cultivation of industrial microbes; Strain improvement to improve yield of selected compounds e.g. antibiotics, enzymes or recombinant proteins. Biofilms, immobilized enzymes and immobilized cells as biocatalysts.

MODULE II PRINCIPLES OF BIOPROCESS **9**

Basic principles of bioprocess as applied to selected microbes; Process optimization of selected products. Thermo-bacteriology: Thermal microbial destruction kinetic. Decimal reduction time.

MODULE III PROTEIN EXPRESSION STRATEGIES & RECOMBINANT PRODUCTION **9**

Overview of protein expression strategies – choosing a heterologous host. Protein folding and inclusion bodies – the problem of protein refolding. Protein expression in *E. coli* and other Gram negative hosts. Recombinant protein production in microbes ; Commercial issues pertaining to the production of recombinant products from microbes; Downstream processing approaches; Industrial microbes as cloning hosts (Streptomyces/Yeast).

MODULE IV METAGENOMICS & RISK MANAGEMENT **9**

Culture Collections and Gene Banks. Microbial resources. Establishment of culture collections. Taxonomic Terminology. How are the strains preserved? Patent depository. Seed lot and cell bank system. Metagenomics in Biotechnology: understanding and exploiting microbial diversity. Risk

management solutions to indoor biological contamination. Risk management solutions to indoor biological contamination.

MODULE V APPLICATION IN MICROBIAL BIOTECHNOLOGY 9

Pathways of microbial biotech product development, compliance, and regulation. Microbial monitoring during bacterial vaccine manufacturing processes and rapid microbial identification in a pharmaceutical **Q**uality **C**ontrol (QC) microbiology laboratory. Industrial enzymes for biopolymer degradation: starch, pectin, biomass applications. Industrial biocatalysis: sweetener, detergent, textile, lipid hydrolysis applications. Environmental application of microbes; Ore leaching; Toxic waste removal; soil remediation.

L – 45; Total Hours –45

REFERENCES:

1. Basic Biotechnology, Third Edition 2006. Colin Ratledge, Bjorn Kristianse Editors.ISBN 0521840317, Cambridge University Press.
2. Demain AL, Davies JE, editors in chief 1999. Manual of Industrial Microbiolog and Biotechnology. ASM Press Washington, D.C. second edition.
3. Microbial Biotechnology, Second Edition, 2007. Alexander N. Glazer,Hiros Nikaido. ISBN 9780521842105, Cambridge University Press.

OUTCOMES :

At the end of this course, students will:

- Describe microbial growth kinetics, isolation and screening and metabolic pathway engineering approaches to engineer microbes for the over-production of metabolic intermediates and to generate novel compounds.
- Explain how microbial enzymes and genetically engineered microbes are used in industrial biocatalysis.
- The capability to apply principles of bioprocess to the enzyme production. Explain the advantages and disadvantages of production of peptides, proteins, glycoproteins, in Gram negative, Gram positive, yeast expression systems.
- Mathematically describe microbial growth and product formation in batch, fed-batch, continuous cultures and immobilized cells. Explain how each of these methods is used in microbial biotechnology and environmental remediation.
- An understanding of how science relates application in microbial biotechnology

LTD 6105	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To learn the preliminary methods in biochemistry by preparing buffer and different solutions.
- To learn about the factors affecting enzymatic activity.
- learn about several techniques of separations of sugar and amino acids.

EXPERIMENTS

1. Laboratory safety guidelines.
2. To prepare an Acetic-Na Acetate Buffer system and validate the Henderson-Hasselbach equation.
3. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer-Lambert's Law.
4. Determination of pH optima of an enzyme.
5. Determination of Km and Kcat of a particular enzyme.
6. Effect of temperature on enzyme activity.
7. Separation techniques for amino acids and sugar:
   (a) paper chromatography
   (b) thin layer chromatography.
8. Separation of proteins by native and SDS-PAGE.
9. Quantification of reducing sugar in different food material.
10. Estimation of different biochemical parameters of blood
    (a) sugar (b) cholesterol (c) urea.

Total Hours – 30

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, TataMcGraw-Hill Education, 2007.

OUTCOMES :

On performing the above experiments students will be able to:

- quantify different biomolecules from unknown samples.
- develop an idea about the separation of different biomolecules like proteins and carbohydrate.
- develop an idea about the factors regulating enzyme activity.
- determine the various parameters defining enzyme activity.
- estimate the concentration of various biomolecules in a wide range of samples.

LTD 6106	CELL BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

EXPERIMENTS

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

Total Hours – 30

REFERENCES:

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

OUTCOMES :

On the completion of the above experiments students will be able to

- understand the importance of laboratory safety and standard operating procedures of common laboratory equipment's
- The students will be trained to handle DNA samples and also to isolate, purify and visualize DNA.
- The students will be trained in isolation and purification of RNA from different sources.
- The students will be trained in basic molecular biology techniques.
- Students will be able to isolate culture and identify microbes and also to efficiently use light microscope.

LTD 6107	IMMUNOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
2. Rocket electrophoresis
3. Antibody titre by ELISA method.
4. ELISA for detection of antigens and antibodies-DOT ELISA
5. Sandwich ELISA
6. Blood group mapping
7. Separation of leucocytes by dextran method
8. Separation of mononuclear cells by Ficoll-Hypaque
9. Preparation of antigens from pathogens and parasites
10. Slide and tube agglutination reaction
11. Complement fixation test.
12. Immunofluorescence technique
13. Lymphoproliferation by mitogen / antigen induced
14. SDS-PAGE, Immunoblotting, Dot blot assays

Total Hours – 30

REFERENCES:

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

OUTCOMES :

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

SEMESTER II

LTD 6201	GENOMICS AND PROTEOMICS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To provide information about genomics and proteomics and
- To offer basic knowledge of genome sequencing, major differences between prokaryotic and eukaryotic genomes.
- To understand the basic proteomics and its potential application of both genomics and proteomics

MODULE I INTRODUCTION 12

Genomics classification, Prokaryotic and Eukaryotic genome; mitochondrial and chloroplast genome; DNA sequencing-principles and methods, Sanger Dideoxy and fluorescence method; coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis-physical and genetic mapping.

MODULE II GENOME SEQUENCING PROJECTS 12

Gene database for Microbes, plants and animals; Accessing and retrieving genome project; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, ESTs and SNPs.

MODULE III PROTEOMICS TECHNIQUES 12

Introduction to proteomics; Protein separation techniques: chromatography-ion-exchange, size-exclusion and affinity chromatography; Protein analysis-Polyacrylamide gel electrophoresis, Isoelectric focusing (IEF), Two dimensional PAGE for proteome analysis and image analysis of 2D gels; measurement of protein concentration, amino-acid composition, N-terminal sequencing.

MODULE IV PROTEIN ENGINEERING 12

Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system. High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug development.

MODULE V FUNCTIONAL GENOMICS AND PROTEOMICS 12

Recombinant DNA technology: Fundamentals of DNA cloning, Polymerase chain reaction, Human genome project; Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein in situ arrays.

L – 60; Total Hours –60

REFERENCES:

1. Brown TA, Genomes, 3rd Edition. Garland Science 2006
2. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007
3. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Ed, Blackwell, 2006.
4. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.

OUTCOMES :

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

- Apply the knowledge of omics to biological system of interest to obtain a snapshot of the underlying biology at a great resolution
- Able to design drugs at the level of transcriptome
- Understand the interaction of drugs at proteome level.
- Able to design strategies that can integrate genomics, proteomics, transcriptomics to understand the living systems
- Recognize proteases as the next target for treatment of emerging diseases.

LTD 6202	BIOPROCESS TECHNOLOGY AND DOWNSTREAM PROCESSING	L	T	P	C
		4	0	0	4

OBJECTIVES:

To develop the skills in the area of bioprocess technology and downstream processing and understand different types of fermentors, the separation and isolation steps involved in downstream process and methods in product purification and formulation.

MODULE I BIOPROCESS TECHNOLOGY 12

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 II MODELING AND DESIGN OF FERMENTATION PROCESSES 12

Principles of model building for biotechnological processes, modeling of recombinant systems. biomass growth and product formation, Kinetics of substrate utilization, inhibition on cell growth and product formation. Design and operation of continuous cultures, chemostat in series, batch and fed batch cultures, total cell retention cultivation, Case studies on Production of green chemicals, algal biofuels, recombinant Insulin. Case studies should deal with medium design, reactor design & process optimization etc.

MODULE III DOWNSTREAM PROCESSING 12

Introduction-downstream processing , biomolecules and bioprocesses, biomass removal and disruption technique- centrifugation, sedimentation, flocculation, ficrofiltration, sonication, Homogenizers, chemical lysis, enzymatic lysis , pretreatment and stabilisation of bioproducts.

MODULE IV SEPERATION AND ISOLATION 12

Unit operations for solid-liquid separation - filtration and centrifugation. Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis ;

Diafiltration ; Pervaporation; Perstraction Adsorption and chromatography: size, charge, shape, hydrophobic interactions, Biological affinity; Process configurations (packed bed, expanded bed, simulated moving beds).

MODULE V PRODUCT PURIFICATION AND FORMULATION 12

Ammonium Sulfate-precipitation, solvent),Chromatography, principles, instruments and practice, adsorption, reverse phase, ionexchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques. Crystallization, drying and lyophilization in final in product formulation.

L – 60; Total Hours –60

REFERENCES:

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pub. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology
   By Open Learning Series, Butterworth-Heinemann (1992).
3. Shuler, M.L. and Kargi, F. Bioprocess Engineering : Basic concepts, 2 nded., Prentice-Hall, 2002.
4. Doran Pauline M, Bioprocess Engineering Principles, Academic Press, 1995
5. Nielsen, J. and Villadsen, J. “Bioreaction Engineering Principles”. Springer, 2007.
6. Blanch, H.W and Clark D.S., “Biochemical Engineering”, Marcel Dekker,1997.

OUTCOMES :

On Completion of the course the students will be able to

- Understand the design and operation of fermenter and types of fermentation process
- Acquire knowledge about formulation of medium and its prerequisites
- Interpret stoichiometry and energetics of cell growth and product formation
- Analyze the modes of operation of bioreactor and its design equations
- Evaluate the kinetics and mechanism of microbial growth by using various models

LTD 6203	GENETIC ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about genetic engineering, principles involved in manipulating genes and DNA.
- To know about cloning strategies and expression systems.
- To acquire basic understanding of techniques in genetic engineering.

MODULE I BASICS CONCEPTS 9

DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interactions-Electromobility shift assay; DNaseI footprinting.

MODULE II CLONING VECTORS 9

Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; Expression vectors; pMal; GST; pET-can be omitted vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies; Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors. Criteria for selection of vectors.

MODULE III CLONING METHODOLOGIES 9

Insertion of Foreign DNA into Host Cells; Transformation; Transfection, Transduction, Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Southwestern and Far-western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression. Methods to confirm cloning and reporter genes and proteins.

MODULE IV PCR AND ITS APPLICATIONS 9

Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; Tvectors; Proof reading enzymes; PCR in gene recombination; Deletion; addition; Overlap extension; and SOEing; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis detection. Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides

MODULE V APPLICATION OF GENETIC ENGINEERING 9

Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knock out mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array. Ethics in genetic engineering and global policy.

L – 45; Total Hours –45

REFERENCES:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Desmond S. T. Nicholl An Introduction to Genetic Engineering Cambridge University Press 2008
6. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.

OUTCOMES :

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

- Familiarize with the basic concepts and principles of utilization of different expression vectors for cloning in prokaryotic and eukaryotic organisms
- Understand the different strategies of gene cloning and construction of genomic and cDNA libraries for applications of recombinant DNA technology
- Familiarize the concepts of structural and functional genomics
- Understand utilization and principle of mutagenesis studies and hybridization probes
- will be skilled enough to use these techniques in different fields, such as forensic science, agriculture, medicine , industry, etc.

LTD 6204	COMPUTATIONAL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the programming languages applied in computational biology.
- To understand the methods and applications for sequence analysis, Phylogenetics and Protein modelling.

MODULE I INTRODUCTION TO PROGRAMMING LANGUAGE 9

Introduction –Programming languages – Problem solving Technique: Algorithm, Flowchart, Compiling, Testing and Debugging - Basic Perl Data Types, File handle and File Tests – Perl Modules – SQL.

MODULE II PROGRAMMING IN C, C++ AND OOPS 9

C language Introduction – Tokens – Keywords, Identifier, Variables, Constants, Operators – Structure of a 'C' program - Expression – Data types – Control Statement - C++ programming – Object Oriented Concept: Encapsulation, Inheritance, Polymorphism.

MODULE III COMPUTATIONAL BIOLOGY AND SEQUENCE ANALYSIS 9

Molecular sequences, Genome sequencing: pipeline and data, Next generation sequencing data, Biological databases: Protein and Nucleotide databases, Sequence Alignment, Dynamic Programming for computing edit distance and string similarity, Local and Global Alignment, Needleman Wunsch Algorithm, Smith Waterman Algorithm, BLAST family of programs, FASTA algorithm, Functional Annotation, Progressive and Iterative Methods for Multiple sequence alignment, Applications.

MODULE IV PHYLOGENETICS 9

Introduction to Phylogenetics, Distance and Character based methods for phylogenetic tree construction: UPGMA, Neighbour joining, Ultrametric and Min ultrametric trees, Parsimonous trees, Additive trees, Bootstrapping.

MODULE V PROTEIN STRUCTURE, MODELLING AND SIMULATIONS **9**

Protein Structure Basics, Visualization, Prediction of Secondary Structure and Tertiary Structure, Homology Modeling, Structural Genomics, Molecular Docking principles and applications, Molecular dynamics simulations.

L – 45; Total Hours –45

REFERENCES:

1. Dan Gusfield. Algorithms on Strings Trees and Sequences, Cambridge University Press.
2. David W. Mount Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, Second Edition, 2004.
3. Arthur M. Lesk, Introduction to Bioinformatics by Oxford University Press, 2008.
4. Tisdall, James, Beginning PERL for Bioinformatics, O'Reilley Publications, 2001.
5. Andrew R. Leach, Molecular Modeling Principles and Applications, Second Edition, Prentice Hall.
6. Baldi, P., Brunak, S. Bioinformatics: The Machine Learning Approach, 2nd ed., East West Press, 2003
7. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002

OUTCOMES :

At the end of this course,

- students will be familiarized with language skills, basic Perl data modules
- skilled to make basic programs using C language
- will be able to handle computational methods for data analysis
- skilled to handle phylogenetic data and application part
- students will be able to analyze Protein structure , sequence analysis which can be used in analyzing the binding effect of drugs on proteins.

LTD 6205 ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the environment protection Act and Law related to environmental biotechnology
- To give basic idea on environmental sample analysis
- To understand the basic principles involved in waste water management
- To get the information on usage of Bioremediation-biotechnology
- To inform students about Biooxidation & microbial leaching

MODULE I INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY **9**

Water, Soil and Air: their sources and effects. Removal of Specific Pollutants : Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption & detoxification mechanisms. Environment protection Act: Environmental laws, Environmental policies, Environmental ethics. UN declaration. Environmental protection and conservation. Environmental Impact Assessment, Ecoplanning and Sustainable Development.

MODULE II ENVIRONMENTAL SAMPLE ANALYSIS **9**

Physicochemical and bacteriological analysis of soil and water, Problems associated with soil alkali soils, sodic soils, and solid waste, Fate of insecticides fungicides, pesticides in soil, use of genetically modified (insect- , pest- and pathogen resistant) plants. Ecotoxicology of soil pollutants, Municipal solid waste treatment strategies.

MODULE III WASTE WATER MANAGEMENT **9**

Waste water constituents, Analysis and selection of flow rates and loadings, Process Selection, Physical unit operations, Chemical unit operations, Fundamentals of biological treatment, Role of biotechnology in water purification systems. Types and kinetics of biological treatment, Advanced waste water treatment, Biological Processes for Industrial and domestic effluent, Treatment, Aerobic Biological Treatment,Anaerobic Biological Treatment.

MODULE IV BIOREMEDIATION-BIOTECHNOLOGY 9

Bioremediation-Biotechnology for clean environment, Biomaterials as substitutes for non-degradable materials, Metal microbe interactions: Heavy Metal Pollution and impact on environment, Microbial Systems for Heavy Metal Accumulation, Biosorption, molecular mechanisms of heavy metal tolerance Bioindicators and biosensors for detection of pollution. Biotechnology for Hazardous Waste Management, Persistent organic pollutants, Xenobiotics, Biological Detoxification of PAH, Biotechniques for Air Pollution Control. Solid Waste Management.

MODULE V BIOOXIDATION & MICROBIAL LEACHING 9

Biooxidation – Direct and Indirect Mechanisms – Biooxidation Kinetics; Bacterial oxidation of Sphalerite, Chalcopyrite and Pyrite.; Extraction of metals from ores; Recovery of metals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.

L – 45; Total Hours –45

REFERENCES:

1. Amann, R.I. Stromley, J. Stahl : Applied & Environmental Microbiology
2. Environmental Microbiology, W.D. Grant & P.E. Long, Blakie, Glassgow an London.
3. Microbial Gene Technology, H. Polasa (ED.) South Asian Publishers, Ne Delhi.
4. Biotreatment Systems, Vol. 22, D. L. Wise (Ed.), CRC Press, INC.
5. Standard Methods for the Examination of Water and Waste Water (14 t Education), 1985. American Public health Association

OUTCOMES :

After the completion of the course the student will have sufficient scientific understanding

- The concepts, types and factors affecting natural processes
- Of applications, specific advantages and disadvantages of specific bioremediation technologies, analysis of water samples, etc
- Of molecular techniques in used in waste water management
- Bioremediation of nuclear waste
- Bioremediation of heavy metals and oil

LTD 6206	COMPUTATIONAL BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

EXPERIMENTS

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

Total Hours: 30

REFERENCES:

1. Rashidi H, Buehler L. K. Bioinformatics Basics: Applications in Biological Science and Medicine. 2nd Ed., 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 :

At the end of the course the students will

- understand the importance and will handle plasmid construction and restriction mapping
- The students will be trained in performing PCR primer designing using different softwares.

- The students will be trained in retrieval of sequences, ORF finding, homology search
- The students will be trained in basic techniques in sequencing, alignment both local and global
- The students will be introduced to the concept of motif finding, gene prediction, structure visualization tools, phylogentic analysis etc

LTD 6207	GENETIC ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To practice the earned theoretical knowledge in genetic engineering techniques
- To get acquainted with DNA/gene products know about cloning strategies and expression systems.
- To get familiarize with the sequential processes in genetic engineering.

LIST OF EXPERIMENTS:

1. Isolation of desired DNA/gene by PCR or restriction enzymes
2. Gel elution and purification of inserts
3. Ligation
4. Transformation
5. Verification of cloning by PCR or reporter gene or by patching the positive colonies
6. Plasmid isolation from PCR positive colonies
7. Confirmation of cloning by restriction digestion
8. Set up DNA sequencing reaction
9. Cleaning the sequencing reaction product
10. Automated DNA sequencing
11. Sequence Editing
12. Sequence analysis by BLAST

Total Hours –30

REFERENCES:

- Laboratory Manual

OUTCOMES :

- Students will be familiar with various techniques globally used in isolation and amplification of nucleic acids.
- The students will be trained to perform ligation, transformation, verification of cloning
- The students will be able to isolate plasmid from colonies resulting from PCR experiments and confirm the restriction digestion
- They will be trained in handling DNA sequencing reaction,automated sequencing protocols
- The students will be trained in sequence editing and the use of softwares like BLAST

SEMESTER III

LTD 7101	PHARMACOGENOMICS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- Learn the basic principles of genetic variation in treatment response.
- Learn the molecular and cellular biology to explain the genetic basis of variability in drug response.
- Understand the concept of pharmacogenomics in different therapeutic areas.
- To identify important sources and reliable databases with pharmacogenomics knowledge base.

MODULE I GENOMIC APPROACHES TO BIOLOGY 12

Principles of Human Genomics, Organization, human Population Genomics,Application of Population Genomics to Genomic Medicine, Genomic Approaches to Complex Disease, Identifying Common and Rare Genomic Variations in the Population, Relating DNA Variation to Phenotypes, Human Health and Disease: Introduction to basic concept of pharmacogenomics. Importance, clinical application and challenges in Pharmacogenomics. Basic principles and paradigms of molecular biology (DNA→RNA→Protein) information on gene promoters, miRNA, identification of targets, splicing/alternate splicing. Introduction to genetic variation, types of variants, SNPs, coding and cis/trans regulatory variants, insertion/deletions, copy number variants SNPs, allele nomenclature, databases, National pharmacogenetics resources/efforts (PGRN).

MODULE II EPIGENETICS AND THE ENVIRONMENT 12

DNA Methylation Patterns Chromatin Modification DNA Methylation and Chromatin StatesCo-operatively Determine the State of Activityof Genes, Epigenetics and Human Disease, Systems Biology and the Emergence of Systems Medicine,Multi -parameter Blood-bourne Biomarkers , Emerging in vivo and in vitro Technologies ,Technology Platforms for GenomicMedicine, DNA Sequencing for the Detection of Human Genome Variation and Polymorphism, DNA Sequencing, Other Methodologies for Polymorphism

Detection, Genome-Wide Association Studies and Genotyping, Copy Number Variation and Human Health ,Detecting CNVs in a Genome-wide Manner, Association of CNVs to Disease and Disease Susceptibility, Implications of CNVs .

MODULE III PROTEOMICS: THE DECIPHERING OF THE FUNCTIONAL GENOME **12**

Gel-based and Solution-based Proteomics, Mass Spectrometry, Bioinformatics,Impact of Proteomics on Understanding Diseases, Comprehensive Metabolic Analysis for Understanding of Disease Mechanisms Comparison of NMR and MS Technologies for Unbiased Metabolic Profiling, MS Methods for Targeted Metabolic Profiling, Examples of NMR-based Metabolic Profiling in, Disease Research, Examples of Targeted MS-based Metabolic Profilingfor Understanding of Disease Mechanisms, Comprehensive Analysis of Gene Function: RNAinterference and Chemical Genomics Chemical Genomics Gene Function Studies.

MODULE IV INFLUENCE OF PHARMACOGENOMICS BASED DRUG INTERACTIONS **12**

Introduction to proteins of importance in drug pharmacokinetics. Understanding the role of proteins involved in phase I drug metabolism in pharmacogenomics,Proteins Involved in Pharmacogenetics, Pharmacogenetics of Phase I drug metabolizing enzymes, CYP2C9 Pharmacogenetic, CYP2D6 Pharmacogenomics, CYP2D19 Pharmacogenetics, Phase II Drug Metabolizing Enzymes, The role of proteins involved in phase I drug metabolism in pharmacogenomics, drug transporter pharmacogenetics, how genetic variation in drug transporters contribute to inter-individual differences in drug PK and PD.

MODULE V PHARMACOGENOMICS IN THERAPEUTIC AREAS **12**

Role of Pharmacogenomics in Drug Development, Pharmacokinetic profiles for metabolic CYP2D6 metabolizers (Metoprolol as Example Compound), Pharmacodynamic response profiles for metabolic CYP2D6 metabolizers (Metoprolol as Example Compound) Combined consideration and Clinical interpretation of significance of CYP2D6 metabolizer status for metoprolol, Cardiovascular Example of pharmacogenomic based drug drug interaction differential for statin based therapy, Other Cardiovascular based examples of

the significance of pharmocogenomics, Pharmacogenomics of Tamoxifin Epidermal Growth Factor Receptors and KRAS,Irinotecan and UGT1A1 Capecitabine and 5-FU in solid tumors, pharmacogenomics and adverse drug reaction, Carbamazepine and Abacavir induced ADRs.

L – 60; Total Hours –60

REFERENCES:

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

OUTCOMES :

The students will be

- Acquainted with parameters used in genomics and proteomics.
- Familiarized with mechanism of epigenetics and environment interaction
- Understand the principles and techniques like maas spectrometry, NMR, Metabolic Profilingfor Understanding of Disease Mechanisms, etc
- Acquainted with parameters desired in an ideal drug.
- Familiarized with mechanism of action and clinical uses of few Pharmaceutical agents. Knowing the current industrial methods of preparing certain special Pharmaceutical agents,

LSD 7102 PLANT AND ANIMAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- to learn about embryogenesis and other type of hybridization techniques.
- to know about genetic transformation and techniques about gene delivery.
- to have an idea about gene mapping and cloning and different type of biotic and abiotic stress.
- to know about protein engineering and different type of bioinformatics analysis.

MODULE I PLANT TISSUE CULTURE 9

Totipotency, organogenesis, somatic embryogenesis, artificial seed production, Micropropagation, somaclonal variation, Germplasm conservation and cryopreservation. Protoplast Culture and Somatic Hybridization Protoplast isolation- its culture and usage, Somatic hybridization and its applications.

MODULE II AGROBIOLOGY 9

Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer, Genetic Transformation Agrobacterium-mediated gene delivery, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; Screenable and selectable markers, Characterization of transgenics, Gene targeting.

MODULE III MOLECULAR MAPPING & MARKER ASSISTED SELECTION (MAS) 9

resistance, grain quality and grain yield, Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers; Construction of genetic and physical map, Gene mapping and cloning, strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.

MODULE IV MOLECULAR THERAPEUTICS 9

Basic concept of stem cell therapy, neutraceuticals, nanotechnology and clinical trials, revolution in diagnosis, changing approaches of therapy, FDA Organization chart and regulatory measures for drug discovery. Drug discovery - Overview,

rational drug design, combinatorial chemistry in drug development, computer assisted drug design, role of bioinformatics in genome based therapy, antisense DNA technology for drug designing. Stem cells in therapy.

MODULE V VACCINES 9

Biotechnological approaches to obtain blood products: Tissue plasminogen activator and erythropoietin, Vaccine technology: Subunit vaccines, drawbacks of existing vaccines, criteria for successful vaccine, peptide vaccine, minicells as vaccines, impact of genetic engineering on vaccine production, viral vector vaccines and AIDS vaccine chiral technology.

L – 45; Total Hours –45

REFERENCES:

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press, 2003
2. Edited by BR Jordan, 2nd Edition, The Molecular Biology and Biotechnology of Flowering, CABI, 2006.
3. Neil Wille, Phytoremediation: Methods and Reviews, 1st Edition, Humana Press, 2007.
4. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge University Press, 2007.

OUTCOMES :

On the completion of course student will be able to understand

- Understand the principle and concepts related to totipotency, embryogenesis, protoplast culture, applications of somatic hybridization, etc
- Get knowledge about agrobacterium mediated creation of transgenic plants.
- Understand the effect of biotic and abiotic stress components on different life forms and know the techniques to create plants that can circumvent such conditions
- The concept and application of stem cell,nanotechnology, pharmacology in treatment of disease
- Understand different classes of vaccines and the use of biotechnology in new vaccine development.

VALUE ADDED COURSE	L	T	P	C
	0	0	0	0

OBJECTIVES:

- To expose the latest technology / tools used in the industry and enable the students acquire knowledge and skill set in the same.

GENERAL GUIDELINES:

- Students should undergo any relevant certification course offered by theinstitutionor other institutions / universities / IIT / IISc etc. for a minimum of 40 hours.
- Selection and completion of value added course by the students shall be endorsed by Head of the Department.

OUTCOMES:

- Students should be exposed and gained knowledge in any one latest technology used in the industry

MOOC COURSE

L	T	P	C
0	0	0	0

OBJECTIVES:

- To learn the basics principles and concepts of the topic in which a project work is undertaken by the student.

GENERAL GUIDELINES:

- Students shall identify a MOOC course related to his/her project topic in consultation with the project supervisor.
- Student shall register for a MOOC course with minimum two credit offered by any recognized organization during the project phase I.
- Selection and completion of MOOC course by the students shall be endorsed by Head of the Department.

OUTCOMES:

Students will be able to

- Familiarize the basic principles and concepts related to the topic of his/her project work.
- Utilize the knowledge gained in the field of study to perform literature review with ease.
- Formulate the experimental / analytical methodology required for the project work

PROFESSIONAL ELECTIVE

LTDY 021	BIO-ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of the course is to

- To understand concepts and process involved with bio-entrepreneurship
- To make the students aware of the importance of entrepreneurship opportunities available in the society for the entrepreneur.
- Acquaint them with the challenges faced by the entrepreneur

MODULE I ACCOUNTING AND FINANCE 9

Taking decision on starting a venture; Assessment of feasibility of a given venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Plan for seeking loans from financial institution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management; Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping; Estimation of income, expenditure, profit, income tax etc.

MODULE II MARKETING 9

Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/ Advertising; Services Marketing.

MODULE III NEGOTIATIONS/STRATEGY 9

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

MODULE IV INFORMATION TECHNOLOGY & HUMAN RESOURCE DEVELOPMENT 9

How to use IT for business administration; Use of IT in improving business

performance; Available software for better financial management; E-business setup, management. Human Resource Development (HRD)- Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up.

MODULE V ROLE OF KNOWLEDGE CENTRE AND R&D 9

Support mechanism for entrepreneurship in India; Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies.

L – 45; Total Hours –45

REFERENCES:

1. Roy Rajeev, Entrepreneurship Oxford Latest Edition
2. E. Gordon & K. Natarajan Entrepreneurship Development Himalaya 2008
3. Coulter Entrepreneurship in Action PHI 2nd Edition
4. P. C. Jain Handbook For New Entrepreneur .Oxford Latest Edition
5. S. S. Khanka Entrepreneurial Development S. Chand, Latest Edition
6. Thomas W. Zimmerer & Norman M. Scarborough Essentials of Entrepreneurshi and small business management, PHI 4th Edition
7. Dr. Vidya Hattangadi Entrepreneurship, Himalaya 2007
8. Vasant Desai Small Scale Industries and Entrepreneurship, Himalaya 2008
9. Dr. v. B. Angadi, Dr. H. S. Cheema & Dr. M. R. Das Entrepreneurship, Growth, and Economic Integration A linkage, Himalaya 2009.

OUTCOMES :

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

- understand the basic concepts of accounting and finance to be able to establish and plan a startup.
- Understand principles of marketing to find a way to market the products of the starup they establish
- Get the knowledge for negotiating and devising strategies to obtain financial support for their business plan
- They will also be trained to utilize the IT and human resources to manage the start up or business activities

LTDY022	INTELLECTUAL PROPERTY RIGHTS & PATENT LAW	L	T	P	C
		4	0	0	4

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 12

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 12

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 12

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 12

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 12

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.

L – 60; Total Hours –60

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 :

Students to complete this course will be able to

- Understand the IPR rights and laws, the need for IPR and national and international perspectives
- Get familiar witht the concept of Trademark, its registration, maintenance, claims, litigations, etc.
- Understand the meaning of copyrights, law pertaining to copyright, distributionlaws, disputes, limitations, etc.
- Get familiar to the atibutes of geographical indications with subject to registration, duration, protection and renewal, etc. of copyright laws
- Know the history, establishment of WIPO. Different case studies will help student to get better understanding of the importance of WIPO in IPR legislation and patenting

LTDY023	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.

L – 45; 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, 2008

OUTCOMES :

At the end of the course student will develop

- an undersanding of the legal, moral amd ethical issues encountered in biological research
- an awareness regarding the safety protocols that need to be designed and followed in the laboratory setup
- will get the knowledge regarding the biosafety assesment fort the use of the geneticically modified food crops through case studies
- get the knowledge for gaining information on ethical clearance and constitution of ethical committee for working on animal models
- get the knowledge for gaining information on ethical clearance and constitution of ethical committee for working on clinical trials and human trials

LTDY024	BIONANOTECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES:

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

MODULE I FUNDAMENTALS OF NANOSCIENCE 9

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

MODULE II CHARACTERIZATIONS IN BIONANOTECHNOLOGY 9

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

MODULE III APPLICATIONS OF BIONANOTECHNOLOGY 9

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

MODULE IV NANOMATERIALS AND DIAGNOSTICS 9

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

MODULE V NANOMATERIALS AND TOXICITY EVALUATION 9

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

L – 45; Total Hours –45

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

LTDY025 CLINICAL GENETICS & COUNSELLING

L	T	P	C
4	0	0	4

OBJECTIVES:

- To provide an introduction to clinical genetics & counselling
- To make the students understand about the genetic disorders.

MODULE I GENETIC DISORDERS **12**

Classification of genetic disorders; Single gene Disorders (Cystic Fibrosis, Marfan's syndrome); Multifactorial disorders (Diabetes, Atherosclerosis, Schizophrenia);

MODULE II MOLECULAR TECHNIQUES **12**

PCR-RFLP; ARMS-PCR; Multiplex-PCR; SSCP, CSGE, DGGE, DHPLC; MALDI-TOF; DNA Sequencing.

MODULE III DISEASE IDENTIFICATION AND GENETIC TESTS FOR FOLLOWING DISORDERS **12**

Thalassemia, Fanconi anemia, Sickle Cell anemia, Fragile-X syndrome, Alzheimer's disease; Duchenne Muscular Dystrophy/Becker's Muscular Dystrophy, Huntington's disease;Allelic susceptibility test for multifactorial disorders (Neural Tube Defect, Cleft Lip and Palate, Cardio Vascular Disorder, Male infertility); Molecular basis of cancer .

MODULE IV GENETIC COUNSELING **12**

Principles of genetic counseling; Causes and factors for seeking counseling; Dysmorphology; Ethical and legal issues in genetic counseling; Risk evaluation (Mendelian risk, empirical risk);

MODULE V PRENATAL AND PRE-IMPLANTATION DIAGNOSIS **12**

Non-invasive: Triple test, Ultrsonography (USG) Invasive: Amniocentesis (AC), chorionic villi sampling (CVS), Fetal blood sampling (FBS) Population screening for genetic disorders Treatment and management of genetic disorders.

L – 60; Total Hours –60

REFERENCES:

1. J. S. Fitzsimmons, A Handbook of Clinical Genetics, Elsievier, 1980.
2. R. K. Marwaha, Inusha Panigrahi, Ashotosh Haldar, Handbook on Medical Genetics and Genetic Counselling, Noble, 2013.

OUTCOMES :

After the completion of course the students will

- Have complete knowledge of various human geneic disorders and their causes
- Will learn about the techniques and principles for the diagnosis of the human geetic disorders
- Gain knowledge on molecular basis of Thalessemia, male infertility, etc
- disorders and applications of clinical genetics & counselling in various field including medical, prenatal and pre-implantation diagnosis etc.
- learn about pre-natal and pre-implantation diagnosis of genetic disorders at early stage

LTDY 026 MOLECULAR DIAGNOSTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Developing the basic concept of molecular diagnostics
- Understanding the common procedures and which are used in disease diagnosis
- To be familiar with various types of diseases diagnosis methods and progression of diagnosed disease.

MODULE I INTRODUCTION TO MOLECULAR DIAGNOSTICS 9

Collection, preservation and storage of clinical samples, biopsy, Principles, application and limitations of Biological assays used in diagnosis- PCR, ELISA, FISH, gene sequencing, microarrays, protein arrays. GLP, SOP and ethics in molecular diagnostics.

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. 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. Diagnosis of chicken guinea and swine flu.

MODULE III CLINICAL GENETICS 9

Chromosomes chemistry and packaging, Cytogenetic, Structural and numerical abnormalities of chromosomes, Chromosome bands, banding techniques , mutation and polymorphism analysis, human genome project, cancer genetics- oncogenes, tumor suppressor genes- gene therapy, genetic counseling, nucleic acid hybridization techniques, Disease linked with mitochondrial DNA Genetic linkage and chromosome and genetic mapping in human diseases, Prenatal.

MODULE IV 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, flocytometer.

MODULE V FORENSIC SCIENCE 9

Introduction to Forensic Science, DNA fingerprinting / DNA Profiling / DNA Testing in Forensic Science.; Ethics, Rules and Procedures in DNA analysis. Autopsy and toxicological diagnosis. Determination of Paternity- Human identification and sex determination. semen analysis , Case study.

L – 45; Total Hours –45

REFERENCES:

1. Carl A. Burtis, Edward R. Ashwood, Tietz Textbook of Clinical Chemistry, eds. Philadelphia, PA: WB Saunders, 1998
2. Lisa Anne Shimeld , Anne T. Rodgers, Essentials of Diagnostic Microbiology, Delmar Cengage Learning; New edition edition, 1998
3. John Crocker, David Burnett, The Science of Laboratory Diagnosis, Wiley, 2005

OUTCOMES :

At the end of the course the students will be

- Familiar with the theoretical working princlles of clinical biochemistry.
- Understand the causes and spread of infection and design strategy to stop their spread.
- Understand the aspects of genetic disease, their causes and design strategy to diagnose them at earlier stages.
- Learners will be able to define basic terminology and describes basic concepts in molecular diagnostics
- will know the importance and the relevance of molecular diagnostic techniques and applications of molecular diagnostics in various field including medical, forescenic, etc.

LTDY 027 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.

MODULE 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.

MODULE 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.

MODULE 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.

MODULE 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.

MODULE V DAIRY 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.

L – 45; 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; 1997, Hindustan Pub Corp.
13. Robinson RK; 1993; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.
14. Milk & Milk Processing; Herrington BL; 2000, McGraw-Hill Book Company.
15. Fox PF; Applied Science Pub Ltd. Outlines of Dairy Chemistry, De S; Oxford.

OUTCOMES :

On the completion of the course the students will,

- Know the equipments and their preliminary operations in food processing
- Understand the physical principles involved in the food processing techniques and the equipments used.
- Equip themselves to trouble shoot the problems arises in drying process to preserve the foods
- Familiarize with preservation of foods at low temperature
- Know the unit operations involved in processing of solid and liquid foods

LTDY028 INDUSTRIAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To obtain knowledge on wide-ranging topics related to applications of biotechnology in industries.
- To learn about bioprocess technology and its applications
- To get familiar with enzymes and microbes used for industrial purposes

MODULE I FERMENTATION & PROCESSING **7**

Introduction to fermentation technology: Upstream and downstream processing of biomolecules. Isolation, Preservation and Improvement of Industrial Micro-Organisms; Medium requirements for fermentation process; Criteria for good medium; Sterilization - batch and continuous heat sterilization of liquid media, filter sterilization of liquid media and Air. Design of sterilization equipment.

MODULE II KINETICS OF SUBSTRATE UTILIZATION, PRODUCT FORMATION AND BIOMASS PRODUCTION **10**

Phases of cell growth in batch cultures - transient growth kinetics, Simple unstructured kinetic Models for microbial growth, Growth of filamentous organisms; Environmental conditions affecting growth kinetics, substrate and product inhibition on cell growth and product formation; structured kinetic Models, segregated kinetic Models of growth. Production of primary and secondary metabolites. The production of some commercially important Organic acids, amino acids and alcohols, study of production processes for various classes of low molecular weight secondary metabolites: Antibiotics, quinones, aromatics, Vitamins and Steroid.

MODULE III BIOPROCESSING **9**

Industrial use of micro organisms; Microbes exploited commercially-Saccharomyces, Lactobacillus, Penicillium, Acetobactor, Bifidobacterium, Lactococcus, Streptococcus etc; Fermentation-process, media and systems; Upstream and downstream processing; Product development; Dairy fermentation and fermented products.

MODULE IV BIOREACTORS 9

Animal Cells as bioreactors, characteristics of bioreactors , expression and over production of targeted proteins –human growth hormones – production of α and β interferon's . Good manufacturing practice bio safety issues bioethics , Intellectual Property patenting issues.

MODULE V INDUSTRIAL APPLICATION OF ENZYMES 10

Immobilized enzymes - principles & techniques of immobilization - commercial production of enzymes; amylases, proteases, cellulose, artificial enzymes, industrial applications, fermentation, enzymes Modification, site directed mutagenesis; immobilized enzyme in industrial processes. Structure and function of coenzyme - reactions involving TPP, pyrodoxal phosphate, nicotinamide, flavin nucleotide, coenzyme A and biotin. Industrial utilization of enzymes, food, detergents, energy, waste treatment, pharmaceuticals and medicine.

L – 45; Total Hours –45

REFERENCES:

1. Maheshwari, D. K. et. al., Biotechnological applications of microorganisms, IK . International, New Delhi, 2006.
2. Stanbury, P. F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995.
3. Waites, M. J. et. al., Industrial Biotechnology: An Introduction, Blackwell publishing, UK, 2007.

OUTCOMES :

After the completion of the course the student will

- Have clear concept of upsteam and downstream processes, the use of fermentation technology in the industrial production of antibiotic, vitamins,amino acids,etc
- Will get thorough understanding of microbial cultures, different types of growth media,cultures, etc
- Get knowledge to utilize different microorganism in dairy, pahrmacetical industry
- Understand the principle and applications of bioreactors
- Understand techniques, like enzyme immobilization, site directed mutagenesis, waste treatment, detergent production, etc