UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science and Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global institutions of excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through scientific enquiry, Applied research and Innovation

VISION AND MISSION OF THE SCHOOL OF LIFE SCIENCES

VISION

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

MISSION

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

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES
B.Tech BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES

- "This course will facilitate the graduates to be professionally competent in Biotechnology to solve the problems in environmental, food, biochemical and biomedical engineering.
- This course will offer students with a solid foundation in Chemical engineering and Biological Sciences, to enable them to work on engineering applications in biotechnology as per the requirement of the industries, and also will enable the students to pursue higher studies and research.
- This course will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology to enable them to understand basic concept in modern biology and help them to build their carrier in this field.
- This course will facilitate the students to acquire knowledge in fields such as genetic engineering, protein engineering, and Bioprocess engineering and associated downstream processing enabling their application through Bioprocess technology.
- This course will aid the students to learn the recent developments in the field of Genomics, Proteomics, Cancer Biology and modern drug discovery approaches. It will also empower the students to have advanced focus on the molecular basis of diseases and development of advanced therapeutics.
- This programme will teach students the importance of Bioethics, entrepreneurship, communication and management skills.
- This course will also offer the graduates to demonstrate their proficiency in theory and practice of bio-techniques through life-long learning and provide confidence to perform as an individual and / or member of a team with professional and ethical behavior.

PROGRAMME OUTCOMES

- Graduates of the course will have strong background in the interface of modern biology and advanced bioprocess technology and be able to use these tools in industry and/or institutes wherever necessary.

- Graduates will identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences.
- Graduates will demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Graduates of the course will have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
- Graduates of the course will function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Graduates of the course will communicate effectively on complex engineering activities with the engineering community and with the society at large.
- Graduates of the course will apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and technology practice.
- Graduates of the course will design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

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

REGULATIONS 2013
FOR
B.TECH. DEGREE PROGRAMMES

(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)

REGULATIONS - 2013 FOR
B.TECH. DEGREE PROGRAMMES
(With Amendments Incorporated Till June 2015)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech Degree Programme like Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, Engineering Graphics, Computer Practice, etc.,

iv) **"University"** means B.S.Abdur Rahman University.

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

vi) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S.Abdur Rahman University.

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

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight semester B.Tech. degree programme shall be required to have passed the Higher Secondary Examination of the (10+2) curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any university or authority accepted by the University as equivalent thereto.

2.1b) Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the University as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, the candidate shall also write an entrance examination prescribed by the University for admission. The entrance examination shall test the proficiency of the candidate in Mathematics, Physics and Chemistry on the standards prescribed for plus two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the University from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. degree programmes in various branches of Engineering and Technology, each distributed over eight semesters with two semesters per academic year.

B.TECH. DEGREE PROGRAMMES:

1. Aeronautical Engineering
2. Automobile Engineering
3. Civil Engineering
4. Computer Science and Engineering
5. Electrical and Electronics Engineering
6. Electronics and Communication Engineering
7. Electronics and Instrumentation Engineering
8. Information Technology
9. Manufacturing Engineering
10. Mechanical Engineering
11. Polymer Engineering
12. Biotechnology
13. Cancer Biotechnology
14. Food Biotechnology

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every Programme will have a curriculum with syllabi consisting of theory and practical courses such as,

i) Basic Sciences (BS)

ii) Humanities & Social Sciences (HS)

iii) Management Sciences (MS)

iv) Engineering Sciences Fundamentals (ESF)

v) Engineering Core Courses (EC)

vi) Professional Electives (PE)

vii) General Electives (GE)

viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

4.2 Each course is normally assigned certain number of credits : one credit per lecture period per week

one credit per tutorial period per week

one credit for two to three periods and two credits for four periods of laboratory or practical courses

one credit for two periods of seminar / project work per week

one credit for two weeks of industrial training

4.3 Each semester curriculum shall normally have a blend of lecture courses not exceeding seven and practical courses not exceeding four.

4.4 For the award of the degree, a student has to earn a minimum total credits specified in the curriculum of the relevant branch of study. This minimum will be between 175 and 185 credits, depending on the program.

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

5.0 DURATION OF THE PROGRAMME

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

5.2 Each semester shall consist of a minimum of 90 working days or 450 periods.

5.3 Semester end examination will normally follow immediately after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member will be nominated by the HOD as Class Advisor for the whole class (2nd to 8th semester).

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

However, for the first semester alone the class advisors and faculty advisors will be nominated by first year coordinator.

6.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment every semester.

7.0 COURSE COMMITTEE

Common course offered to more than one discipline or group, shall have a "Course Committee", comprising all the faculty members teaching the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs), depending on whether all the faculty members teaching the common course belong to the same department / different departments.

8.0 CLASS COMMITTEE

During first semester, a common Class Committee will be constituted for all branches by the Dean (Academic Affairs). During other semesters, separate Class Committees will be constituted by the respective Head of the Department of the students

8.1 The first semester Class Committee composition will be as follows:

i) The first semester Coordinator shall be the Chairman of the class committee

ii) Course coordinators of all common courses.

iii) Faculty members of all individual courses.

iv) One male and one female first semester student of each class of B.Tech, program to be nominated by the first semester coordinator

v) All first semester class advisors and faculty advisors

8.2 The composition of the class committee for each branch of B.Tech, from 2nd to 8th semester, will be as follows:

i) One senior faculty member preferably not teaching to the concerned class, appointed as Chairman by the Head of the Department

ii) Faculty members of individual courses

iii) Two students, (preferably one male and one female) of the class per group of 30 students or part thereof, to be nominated by the Head of the Department, in consultation with the faculty advisors.

iv) All faculty advisors and the class advisor of the class

v) Head of the Department

8.3 The class committee shall meet at least thrice during the semester. The first meeting will 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 will be decided for the first, second and third assessments. The second meeting will be held within a week after the date of first assessment report, to review the students' performance and for follow up action. The third meeting will be held within a week after the second assessment report, to review the students' performance and for follow up action.

8.4 During these three meetings the student members representing the entire class, shall meaningfully interact and express opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

8.5 The class committee, excluding the student members, shall meet within 10 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 the grades for students 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.

9.0 REGISTRATION AND ENROLMENT

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

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

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

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

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 15 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.

10.2 WITHDRAWAL FROM A COURSE

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

11.0 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

A student can avail a onetime temporary break of study covering the current semester and/or next semester period with the approval of the Head of the Institution at any time before the start of third assessment of current semester, within the maximum period of 14 or 12 semesters as the case may be. 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 availed break of study has to rejoin only in the same semester from where he left.

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 30 credits during a semester including redo courses.

12.2 The minimum credit requirement to move to the higher semester is

- Not less than a total of 20 credits, to move to the 3rd semester
- Not less than a total of 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than a total of 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

13.1 Every theory course shall have a total of four assessments during a semester as given below:

Assessment No.	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 4	1.5 hours	15%
Assessment 2	5 to 8	1.5 hours	15%
Assessment 3	9 to 12	1.5 hours	15%
Attendance #	-	-	5%
Semester End Exam	Full course	3 hours	50%

\# 76-80% - 1 Mark ; 81-85 – 2 Marks ; 86-90 – 3 Marks ; 91-95 – 4 Marks and 96-100 – 5 Marks

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

13.3 Every practical course will have 60% weightage for continuous assessment and 40% for semester end examination. However, a student should have secured a minimum of 50% marks in the semester end practical examination.

13.4 In the case of Industrial training, the student shall submit a report, which will be evaluated along with an oral examination by a committee of faculty members, constituted by the Head of the department. A progress report from the industry will also be taken into account for evaluation.

13.5 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(s), an oral examination (viva-voce) will be conducted as the semester end examination, for which one external examiner, approved by the Controller of Examinations, will be included. The weightage for periodic review will be 50% and remaining 50% for the project report and Viva Voce examination.

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

13.7 The continuous assessment marks earned for a course during his/her first appearance will be used for grading along with the marks earned in the semester-end examination / arrear examination for that course until he/she completes.

14.0 SUBSTITUTE EXAMINATIONS

14.1 A student who has missed, for genuine reasons, a maximum of one of the four assessments of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident, admission to a hospital due to illness, etc. by a committee constituted by the Dean of School for that purpose.

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

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

15.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the University 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. If the course is a core course, the candidate should register for and repeat the course when it is offered next.

15.2 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. Thereupon, the Dean (Academic Affairs) shall announce, course-wise, the names of such students prevented from writing the semester end examination in each course.

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

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

15.5 If a student with "U" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will be awarded "I" grade in that course.

15.6 The students who have not attended a single hour in all courses in a semester and awarded 'I' grade are not permitted to write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

16.0 SUMMER TERM COURSES

16.1 A student can register for a maximum of three courses during summer term, if such courses are offered by the concerned department during the summer term. Students may also opt to redo such courses during regular semesters.

16.2 The Head of the Department, in consultation with the department consultative committee may arrange for the conduct of a few courses during the summer term, depending on the availability of faculty members during summer and subject to a specified minimum number of students registering for each of such courses.

16.3 However, in the case of students who have completed eighth semester, but having arrears in the earlier semesters in a maximum of two courses, summer courses may be offered, even if less than minimum students may register for the course.

16.4 The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters except that there is no provision either for withdrawal from a summer term course or for substitute examination.

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

17.1 All assessments of a course will be made on absolute marks basis. However, the Class Committee without the student members shall meet within 10 days after the semester-end examination and analyze the performance of students in all assessments of a course and award letter grade. The letter grades and the corresponding grade points are as follows:

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

"W" denotes withdrawal from the course.

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

"U" denotes unsuccessful performance in the course. "AB" denotes absence for the semester-end examination.

17.2 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.

17.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department and declared by the Controller of Examinations.

17.4 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 courses, on payment of prescribed fee, through proper application to Dean (Academic Affairs), who shall constitute a revaluation committee consisting of Chairman of the class committee as convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

17.5 After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including Summer term (redo) courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the 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 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, including summer courses if any.

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

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

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

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

"U", “I”, "AB" and **"W"** grades will be excluded for calculating CGPA

17.6 After successful completion of the programme, the Degree will be awarded with the following classifications based on CGPA.

Classification	**CGPA**
First Class with Distinction	8.50 and above and passing all the courses in first appearance an completing the programme within the normal 8 or 6 (for lateral entry) semesters
First Class	6.50 and above and completing the programme within a maximum of 10 or 8 (for lateral entry) semesters.
Second Class	All others

However, to be eligible for First Class with Distinction, a student should not have obtained U and I grade in any course during his/her study and should have completed the U.G. programme within a minimum period covered by the minimum duration plus authorized break of study, if any (clause 11). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

18.0 ELECTIVE CHOICE: OPTION TO DO PROJECT ALONE IN FINAL SEMESTER

18.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of

study, with the approval of the Head of the parent department and the Head of the other department offering the course.

18.2 In the curriculum of eighth Semester, along with the project work, if two elective courses alone are listed, then the Dean (Academic Affairs) may permit a student, as per approved guidelines, on the recommendation of the Head of the department, to do a full semester major industrial project work. In such a case, the above two elective courses or any other two elective courses in lieu thereof have to be enrolled during any semester preceding or succeeding the project work, if offered.

19.0 PERSONALITY AND CHARACTER DEVELOPMENT

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

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

20.0 DISCIPLINE

20.1 Every student is required to observe disciplined and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

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

21.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study.

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him/her.

21.2 The award of the degree must have been approved by the University.

22.0 POWER TO MODIFY

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

SCHOOL OF LIFE SCIENCES (SLS)

B.TECH (BIOTECHNOLOGY)

REGULATIONS 2013 - 2014

COURSE DURATION: 4 YEARS (8 SEMESTERS)

CURRICULUM

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	ENB1181	English	3	0	0	3
2.	MAB1182	Fundamentals in Mathematics	3	1	0	4
3.	PHB1181	Physics	3	0	0	3
4.	CHB1181	Chemistry	3	0	0	3
5.	BTB 1101	Fundamentals in Biotechnology	4	0	0	4
6.	SSB 1181	Introduction to Economics	3	0	0	3
7.	PHB1182	Physics Laboratory	0	0	2	1
8.	CHB1182	Chemistry Laboratory	0	0	2	1
9.	GEB1103	Computer Programming & Applications Laboratory	2	0	2	3
		Total Credits				**25**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTB1211	Biochemistry	3	0	0	3
2.	BTB1212	Cell Biology	4	0	0	4
3.	BTB1213	Microbiology	3	0	0	3
4.	BTB1214	Bio-Organic Chemistry	3	0	0	3
5.	BTB1215	Biophysics	3	0	0	3
6.	SSB1182	Sociology, Ethics and Human Values	3	0	0	3
7.	BTB1216	Biochemistry – Lab	0	0	4	2

8.	BTB1217	Cell Biology– Lab	0	0	3	1
9.	BTB1218	Microbiology – Lab	0	0	2	1
10.	ENB2182	Communication Skills - Lab	0	0	2	1
			Total Credit			**24**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTB2101	Enzyme Technology	4	0	0	4
2.	BTB2102	Bioinformatics	3	0	0	3
3.	BTB2103	Fundamentals of Chemical Engineering	4	0	0	4
4.	BTB2104	Biostatistics	3	1	0	4
5.	BTB2105	Molecular Biology	3	0	0	3
6.	BTB2106	Basic Bioanalytical Techniques	3	0	0	3
7.	BTB2107	Bioinformatics- Lab	0	0	3	1
8.	BTB2108	Molecular Biology – Lab	0	0	3	1
9.	BTB2109	Bioanalytical Techniques – Lab	0	0	3	1
			Total Credit			**24**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTB2211	Genetic Engineering	4	0	0	4
2.	BTB2212	Immunotechnology	3	0	0	3
3.	BTB2213	Animal Biotechnology	3	0	0	3
4.	BTB2214	Plant Biotechnology	3	0	0	3
5.	BTB2215	Industrial Biotechnology	3	1	0	4
6.	GEB3201	Environmental Science and Engineering	3	0	0	3
7.	BTB2216	Genetic Engineering–Lab	0	0	3	1
8.	BTB2217	Immunology–Lab	0	0	3	1
9.	BTB2218	Animal and Plant cell culture- Lab	0	0	3	1
			Total Credit			**23**

SEMESTER V

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTB3101	Molecular Pathology	3	0	0	3
2.	BTB3102	Chemical and Bio Thermodynamics	3	0	0	3
3.	BTB3103	Food Biotechnology	4	0	0	4
4.	BTB3104	Bioprocess Engineering	4	0	0	4
5.	BTB3105	Protein Engineering	3	0	0	3
6.	BTB3106	Chemical Reaction Engineering	4	0	0	4
7.	BTB3107	Bioprocess Lab	0	0	3	1
8.	BTB3108	Chemical Reaction Engineering Laboratory	0	0	3	1
9.	BTB3109	Protein Engineering Lab	0	0	3	1
		Total Credit				**25**

SEMESTER VI

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTB3211	Structural Biology	4	0	0	4
2.	BTB3212	Tissue Engineering	4	0	0	4
3.	BTB3213	Developmental Biology	4	0	0	4
		Group 1 (Elective)	3	0	0	3
		Group 1 (Elective)	3	0	0	3
4.	BTB3214	Cancer Biology	3	0	0	3
5.	BTB3215	Gene Manipulation lab	0	0	3	1
6.	ENB2282	Confidence Building and Behavioural Skills	0	0	2	1
		Total Credit				**23**

SEMESTER VII

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTB4101	Biomedical Instrumentation	4	0	0	4
2.	BTB4102	Proteomics & Genomics	4	0	0	4
3.	BTB4103	Fermentation Technology	4	0	0	4
4.	BTB4104	Nano Biotechnology	4	0	0	4
5.		Group 2 (Elective)	3	0	0	3
6.		Group 2 (Elective)	3	0	0	3
7.	BTB4105	Fermentation- Lab	0	0	3	1
8.	BTB4106	Biomedical Instrumentation Lab	0	0	3	1
			Total Credit			**24**

SEMESTER VIII

Sl. No.	Course Code	Course Title	L	T	P	C
1.		Group 3 (Elective)	3	0	0	3
2.	BTB4211	Project work/Viva-voce	0	0	18	9
			Total Credit			**12**
			Total Credits			**180**

ELECTIVES (Group 1, Group 2 & Group 3)

Group 1 (Elective)

(Two to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTBX01	Pharmaceutical Biotechnology	3	0	0	3
2.	BTBX02	Medical Biotechnology	3	0	0	3
3.	BTBX03	Drug Design and Development	3	0	0	3
4.	BTBX04	Intellectual Property Rights	3	0	0	3
5.	BTBX05	Recombinant DNA Technology	3	0	0	3

Group 2 (Elective)

(Two to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTBX06	Bioreactor Design and Analysis	3	0	0	3
2.	BTBX07	Molecular & Cellular Diagnostics	3	0	0	3
3.	BTBX08	Biomedical Engineering	3	0	0	3
4.	BTBX09	Biosafety and Bioethics	3	0	0	3
5.	BTBX10	Healthcare Biotechnology	3	0	0	3

Group 3 (Elective)

(Two to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	BTBX11	Molecular Farming	3	0	0	3
2.	BTBX12	Stem Cells in Health Care	3	0	0	3
3.	BTBX13	Transport phenomena in Bioprocess	3	0	0	3

GENERAL ELECTIVES

1.	GEBX22	National Service Scheme	0	0	3	1

SEMESTER I

ENB1181	ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable students to use language appropriately and effectively
- To help learners improve their vocabulary and to enable them speak fluently and appropriately in different contexts.
- To help students develop listening skills for academic and professional purposes
- To develop reading comprehension skills and enhance their ability to read official documents.
- To develop their creative thinking and practice creative writing.

MODULE I BASIC LANGUAGE SKILLS AND GRAMMAR 4

Conducting a language proficiency test in the language laboratory to assess the use of various parts of speech, vocabulary, phrasal verbs and idiomatic expressions of students.

MODULE II LISTENING 8

Listening to BBC radio plays and VOA special lessons to teach Phonetics, accent and intonation of spoken English, Appreciation and critical review of popular movies like 'My Fair Lady', 'Sound of Music'. (Excerpts from the movies) - Historical/popular speeches made by Winston Churchill, Abraham Lincoln (Gettysberg's Address), Swami Vivekananda.

MODULE III SPEAKING 8

(a) Self introduction – pair work – introducing one another – short conversations – exchanging opinions – agreement /disagreement

(b) Short presentation (extempore speech) based on visuals – Personal narrations

MODULE IV READING 8

Newspaper articles, circular, notices – Note making – vocabulary extension – Critical review of newspaper articles, Science fiction- Issac Asimov's "The

Dead Past"(Abridged version) - Wings of Fire – Creative thinking – retelling a story with different ending; critical appreciation of plot and characters

MODULE V CREATIVE WRITING 8

(a) Writing slogans for Advertisements

(b) Writing descriptive paragraphs based on visuals

MODULE VI ENGLISH FOR ACADEMIC AND BUSINESS PURPOSES 9

(a) English for academic purpose: letters to the editor, letter seeking permission for industrial visit, letter inviting a dignitary for technical symposium

(b) English for Business purpose: Telephone etiquette – telephone conversations – taking and leaving phone messages.

Total: 45

REFERENCES:

1. Mohan, Krishna, Meera Bannerjee, 'Developing Communication Skills', Macmillan India Ltd. Chennai (2001).
2. Sen , Leena 'Communication Skills' Prentice Hall, New Delhi (2004).
3. Rutherford , Andrea J. 'Basic Communication Skills For Technology' Pearson Education Asia (2002).
4. Grant Taylor, ' English Conversation Practice' Tata Mcgraw Hill , New Delhi (2001)
5. P.K.Dutt, G. Rajeevan and C.L.N. Prakash, 'A Course in Communication Skills', Cambridge University Press, India (2007).

OUTCOME:

- After completion of the course, students will have the ability to communicate correctly and effectively in academic and professional contexts through exposure and practice in LSRW skills.

MAB1182 FUNDAMENTALS IN MATHEMATICS

L	T	P	C
3	1	0	4

OBJECTIVES:

The course is aimed a developing the skills in additional areas of Engineering Mathematics, necessary for grooming them into successful engineers. The topics introduced will serve as basic tools for specialized studies in many Engineering fields.

MODULE I MATRICES **12**

Eigenvalue Problems – Eigenvalues and Eigenvectors of a real matrix, Engineering Applications – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE II TRIGONOMETRY **12**

Expansions of $\sin^n\theta$ and $\cos^n$ in powers of sin and cos – Expansions of $\sin^n$ and $\cos^n$ interms of sines and cosines of multiples of – Hyperbolic and inverse hyperbolic functions – Logarithm of complex numbers – Separation of complex functions into real and imaginary parts – Simple problems.

MODULE III THEOR Y OF EQUATIONS **12**

Introduction - surds and irrational roots – simple problems – equations whose roots are in A.P, G.P and in H.P – Relations between the roots and coefficients – Symmetric functions – Formation of equations – Decreasing and Increasing the roots – Transformation of equation – Reciprocal equations.

MODULE IV DIFFERENTIAL CALCULUS **12**

Differentiation and Derivatives of simple functions – Successive Differentiation – Various forms of Algebraic and Trigonometric functions – Simple problems.

MODULE V INTEGRAL CALCULUS **12**

Various types of Integration – Reduction formula for $e^{ax}x^n$, $\sin^n x$, $\cos^n x$, $\sin^n x \cos^m x$ (without Proof) – Simple Problems.

Total: 60

REFERENCES:

1. Veerarajan.T., “Engineering Mathematics “(5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Grewal B.S., “Higher Engineering Mathematics” (42nd edition), Khanna Publishers, New Delhi, 2012.
3. Kreyszig, E., “Advanced Engineering Mathematics“, 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
4. Peter V. O'Neil, “Advanced Engineering Mathematics”, 7th edition, Cengage Learning, 2011.
5. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
6. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.
7. Ramana, B.V, “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
8. Venkataraman, M.K., “Engineering Mathematics”, Volume I, 2nd edition, National Publishing Co., Chennai, 2003.

OUTCOMES:

On completion of the course the students will be able to

- solve Eigenvalue and Eigenvector problems
- solve trigonometry problems
- use differential calculus and integral calculus for solving problems pertaining to Engineering applications.

PHB1181	PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basic physics concepts relevant to Engineering and Technology students.
- To get familiarize with solving problems in basic physics.
- To acquaint applications of physics for Engineering issues.

MODULE I PROPERTIES OF MATTER **7**

Elasticity – Stress strain diagram – Factors affecting elasticity – Twisting couple on a wire – Shaft – Torsion pendulum – Depression on a cantilever – Young's modulus by cantilever – Uniform and non-uniform bending – Viscosity.

MODULE II CRYSTAL PHYSICS **6**

Introduction – Space lattice – unit cell – Bravais lattices – Miller Indices for cubic crystals – Inter planar spacing in cubic lattice – Simple crystal structures – SC, BCC, FCC and HCP structures – Atomic radius, coordination number, Packing factor calculation – Crystal imperfections.

MODULE III QUANTUM PHYSICS **7**

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jeans law from Planck's theory – Compton effect – Theory and experimental verification – Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schroedinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box.

MODULE IV WAVE OPTICS **9**

Interference theory – Air wedge – Michelson interferometer – Diffraction – Fresnel and Fraunhofer diffraction - Polarization – Double refraction – Theory of plane polarized, circularly polarized and elliptically polarized light – Quarter wave plate, Half wave plate – Production and detection of plane, circularly and elliptically polarized lights – Photoelasticity – Photo elastic effect – Stress optic law – Effect of stressed model in a plane polariscope (qualitative) –Photo elastic bench.

MODULE V LASER & FIBER OPTICS **9**

Principle of spontaneous emission and stimulated emission - Characteristics of laser light -Einstein's A & B coefficients (derivation) – Population inversion - pumping - Nd:YAG laser – CO_2 laser – Applications – Material processing and holography (construction and reconstruction of hologram)- Optical fiber – Principle and propagation of light in optical fibers – Numerical aperture and acceptance angle – Types of optical fibers - applications – Fiber optic communication system (block diagram only)- Fiber optic sensors (displacement and pressure sensors (qualitative), Medical endoscope.

MODULE VI ULTROSONICS AND NDT **7**

Ultrasonics – Production – Magnetostriction and piezo electric methods – Properties of ultrasonic waves – Detection of ultrasonic waves – Applications –Ultrasonic interferometer- Acoustical grating – SONAR – Depth of sea – Measurement of velocity of blood flow – Non Destructive Testing (NDT) methods – Ultrasonic flaw detector – A,B & C scanning methods.

TOTAL: 45

REFERENCES:

1. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2003.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Uma Mukherji, "Engineering Physics", Narosa Publishing House, New Delhi, 2007.
4. Charles Kittel, "Introduction to solid state physics", 7th Edition, John Wiley & sons (ASIA) Pvt. Ltd, 2008.
5. Avadhanulu M.N., "Engineering Physics", 1st Edition, S.Chand & Company Ltd., New Delhi, 2007.
6. Schiff, "Quantum Mechanics", 3rd Edition, Tata McGraw-Hill Education, 2010.
7. Rajendran V. and Marikani A., "Applied Physics for Engineers", 3rd Edition, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2003.
8. William T. Silfvast, "Laser Fundamentals", 2nd edition, Cambridge University Press, 2004.

OUTCOMES:

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

- Apply the knowledge of properties of matter in Engineering Mechanics and Fluid Dynamics.
- Characterize Engineering materials
- Use Lasers for Fiber Optics Technology and Material Processing
- Do non-destrictive testing using Ultrasonic Techniques

CHB1181	CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To make students conversant with the

- Water quality for potable and industrial purposes.
- Different engineering materials, their physico-chemical properties and specific applications.
- Concept of electrochemistry, corrosion and theories of corrosion.
- Principles of spectroscopy and applications.
- Basic principles of green chemistry and the need for green processes in industries.

MODULE I WATER TECHNOLOGY **8**

Introduction – Impurities present in water – Hardness, Types of Hardness, Estimation of Hardness (EDTA method) (Problems) – Alkalinity, Estimation of Alkalinity – Disadvantages of hard water in industries – Conditioning methods: external treatment method: Ion exchange method – internal treatment: colloidal, phosphate, calgon, carbonate methods – drinking water standards (BIS) – treatment of domestic water: screening, sedimentation, coagulation, filtration, disinfection: by chlorination, UV treatment, ozonization – desalination and reverse osmosis (principle only).

MODULE II ENGINEERING MATERIALS **8**

Abrasives: Moh's scale of hardness – natural abrasives: diamond, corundum, emery, garnets and quartz – artificial abrasives: silicon carbide, boron carbide; Refractories: characteristics, classification – acidic, basic and neutral refractories, properties – refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling – general method of manufacture of refractories, properties and uses of high alumina bricks, magnesite and zirconia bricks; Nanomaterials: Definition – types of Nanomaterials; nanofilms, nanowires, carbon nanotubes, quantum dots and fullerenes (C60) – Size and shape dependent optical, electrical, thermal and mechanical properties; Synthesis of nanomaterials – Top down and bottom up approach; Applications of nanomaterials – Catalysis, Electronics and Telecommunication, Medicines, Composites and Energy.

MODULE III ELECTROCHEMISTRY AND CORROSION 9

Construction of a cell – Standard and single electrode potential – electrochemical series – EMF and its measurement – Nernst equation, application and problems – Types of electrodes: standard hydrogen electrode, calomel electrode, ion selective electrode - glass electrode and determination of pH using glass electrode – polarization, overvoltage, decomposition potential (statements only) – Conductometric and potentiometric titrations; Corrosion: Definition – Dry corrosion and Wet corrosion with mechanisms – Factors influencing corrosion.

MODULE IV CHEMISTRY OF POLYMERS 6

Monomers – functionality – polymer – degree of polymerization – classification – polymerization techniques: addition, condensation and co-polymerization with example – mechanism of polymerization: free radical, cationic and anionic mechanism – thermoplastics and thermosetting plastics with examples – compounding and moulding of plastics: injection moulding and compression moulding.

MODULE V SPECTROSCOPY 9

Electromagnetic spectrum – absorption of radiation – electronic, vibrational, translational and rotational – intensities of spectral lines – Beer-Lambert's Law (Problems) – Colorimetric analysis: estimation of concentration of a solution – Flame photometry: theory, instrumentation (block diagram only) and application – UV-Visible spectroscopy: Principles, instrumentation (block diagram only) and simple applications – IR spectroscopy – simple applications only.

MODULE VI GREEN CHEMISTRY 5

Introduction – Significance – Industrial applications of green chemistry; Green technology – Latest green laboratory technique for saving experimental resources and infrastructural framework; Principles of green chemistry – R4M4 model (Reduce, Reuse, Recycle, Redesign; Multipurpose, Multidimensional, Multitasking, Multi-tracking) – Life cycle analysis technique (cradle to grave approach)

TOTAL: 45

REFERENCES:

1. Jain P.C and Renuka Jain, 'Physical Chemistry for Engineers', Dhanpat Rai and Sons, New Delhi. (2001).
2. Paul T. Anastas, John C. Warner, 'Green Chemistry: Theory and Practice', Oxford University Press, (1998).
3. Bahl B.S., Tuli and Arun Bahl, 'Essentials of Physical Chemistry', S. Chand and Company Ltd., New Delhi, (2004).
4. Kuriacose J.C. and Rajaram J, 'Chemistry in Engineering and Technology', Volume1, Tata McGraw- Hill publishing company, New Delhi, (1996).
5. Puri B.R., Sharma L.R. and Madan S. Pathania, 'Principles of Physical Chemistry', Shoban Lal Nagin Chand and Co., Jalandhar, (2000).

OUTCOMES:

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

- Estimate the degree of hardness in water; solve related problems and treatment methods for potable water.
- Select materials for specific engineering applications.
- Use electrochemistry principles to understand the mechanism of corrosion.
- Analyze trace quantity of metals using instrumental methods.
- Realize the need of green practices in industries.

BTB1101 FUNDAMENTALS IN BIOTECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- Provide a breadth of knowledge of basic principles and concepts of biological sciences.
- Provide knowledge content across the full range of biology.
- Demonstrate knowledge of form, function, mechanism, organization, scale, hierarchy, diversity and evolution.

MODULE I INTRODUCTION TO BIOTECHNOLOGY **10**

Definitions, Historical perspectives, Scope and Importance, Commercial potential, An interdisciplinary challenge, A Quantitative approach, Classical vs. Modern concepts, Manufacturing quality control, Product Safety, Good manufacturing practices, Good laboratory practices, Marketing, Biotechnology in India and Global trends

MODULE II MICROBIAL CULTURE AND APPLICATIONS **10**

Introduction, Microbial Culture Techniques, Measurement and Kinetics of Microbial Growth, Scale up of Microbial Process, Isolation of Microbial Products, Strain Isolation and Improvement, Applications of Microbial Culture Technology, Bioethics in Microbial Technology.

MODULE III PROTEIN ENGINEERING **10**

Introduction to the world of Proteins, 3-D Shape of Proteins, Structure Function relationship in Proteins, Purification of Proteins, Characterization of Proteins, Protein based products, Designing Proteins, Proteomics.

MODULE IV BASICS OF RDNA TECHNOLOGY **10**

Introduction, Tools of rDNA Technology, Making Recombinant DNA, DNA Library, Introduction of Recombinant DNA into host cells, Identification of Recombinants, Polymerase Chain Reaction (PCR), DNA Probes, Hybridization Techniques, DNA Sequencing, Site-directed mutagenesis.

MODULE V GENOMICS AND PROTEOMICS **10**

Introduction, Genome Sequencing Projects, Gene prediction and Counting,

Genome similarity, SNPs and comparative genomics, Functional Genomics, History of Bioinformatics, Sequences and Nomenclature, Information Sources, Analysis using Bioinformatics tools.

MODULE VI PLANT AND ANIMAL CELL CULTURE AND APPLICATION 10

Introduction, Cell and Tissue Culture Techniques, Applications of Cell and Tissue Culture, Gene Transfer Methods in Plants, Transgenic Plants with Beneficial Traits, Animal Cell CultureTechniques, Characterization of Cell Lines, Scale-up of Animal Culture Process,Applications of Animal Cell Culture

TOTAL: 60

REFERENCES

1. Concepts in Biotechnology,C.F. Bryce,D. Balasubramanian,Universities Press.
2. Biotechnology by Smith, Cambridge Press.

OUTCOMES:

At the end of the course students will be able to

- Understand and apply fundamental biological principles from the major areas of biology (ecology, genetics, evolution, cell and molecular biology, and organism biology).
- Describe basic biological concepts and principles.
- Understand that biology has a chemical, physical, and mathematical basis.
- Explain the importance of the scientific method to understanding natural phenomena.

SSB1181 INTRODUCTION TO ECONOMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

Primarily to give an overview of fundamentals of economics to the engineering students in particular

- To introduce the basic concepts of demand, supply and equilibrium.
- To familiarize on National Income concepts.
- To provide fundamental concepts of money, banking and exchange.
- To give an idea on industrial sector, markets and trade.
- To give an overview on five year plans, budget, policies and taxation.
- To provide an overview of Indian economy and the role of engineers in economic development.

MODULE I INTRODUCTION **8**

Classification of economy – open and closed economy – sectors of economy – Basic principles of micro economics – supply, demand and equilibrium, elasticity of demand- pricing models.

MODULE II NATIONAL INCOME DETERMINATION **7**

National Income concepts – GNP, GDP, disposable Income; Aggregate demand and Aggregate supply, macroeconomic equilibrium - concepts of MPS, APS, MPC APC, Inflation – prices indices WPI, CPI and Inflation control.

MODULE III MONEY AND BANKING **7**

Monetary system - Role of Central Bank – Monetary policy – Commercial banks, Development banks; Money market – the role of money.

MODULE IV INDUSTRY, MARKET AND TRADE **7**

Public and private sectors – Contribution to the national economy, Industrial policy. Markets – labor, capital and debt market. Trade: domestic and International trade.

MODULE V BUDGET, POLICIES AND INDICATORS 8

Economic development – Five year plans, Macro-economic indicators; Central budget: Government revenue-tax and non-tax revenue, government expenditures-plan and non-plan expenditures – Fiscal policy – The impact of the budget on the economy.

MODULE VI ECONOMIC GROWTH AND THE ROLE OF ENGINEERS 8

India Economy – the role of market in the Indian economy – Development in the post independence era – Growth of the economy, Globalization and liberalization – reforms made and their effects, challenges and opportunities, Engineers – Engineers' contributions to the economic growth.

TOTAL: 45

REFERENCES:

1. Vanitha Agarwal, 'Macroeconomics: Theory and Practice', Pearson, (2010).
2. Dwivedi D.N, 'Macroeconomics: Theory and Policies', 3rd edition; McGraw Hill, (2010).
3. Samuelson,Paul A., 'Macroeconomics', 19th edition., TMH, (2009).
4. Gupta G.S, 'Macroeconomics: Theory and Applications', 3rd edition; TMH, (2007).

OUTCOMES:

- Students will have an exposure to the basic concepts of microeconomics and macroeconomics.
- Students will have gained knowledge in government budget, economic planning and its implementation, money, banking and trade.
- They will have learnt about the economic reforms introduced in Indian economy and the role of engineers towards the economic growth and development of the country.

PHB1182	PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the basic concepts of properties of matter, wave optics
- To understand the properties of ultrasonic and Laser.
- To understand the crystal growth technique.
- To correlate the experimental results with the theoretical values.

LIST OF EXPERIMENTS:

1. Torsional Pendulum- Determination of rigidity modulus of a given wire.
2. Determination of coefficient of viscosity of a liquid by Poiseuille's method.
3. Determination of Young's modulus of a beam using non – uniform bending method.
4. Determination of a thickness of a given wire – Air wedge.
5. Spectrometer- determination of wavelength of given source by using grating.
6. Determination of velocity of ultra sonic waves – Ultrasonic Interferometer.
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of particle size using Laser.
9. Growth of crystal by slow evaporation technique.
10. Determination of angle of divergence of Laser beam.
11. Photo electric effect experiment.

REFERENCE

Laboratory Manual

OUTCOMES:

On completion of this course, the student will know

- Properties of matter, wave optics and quantum physics
- Properties and application of Ultrasonic and Laser
- Principle and concept of crystal growth technique.

CHB1182	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

To make students conversant with the

- Estimation of hardness and TDS in water samples.
- Construction of cell and determination of EMF.
- Estimation of pH of solutions.
- Verification of Beer Lambert's law.

LIST OF EXPERIMENTS:

1. Estimation of hardness in domestic water.
2. Estimation of total dissolved solids (TDS) in domestic water
3. Construction and determination of emf of a cell.
4. Determination of single electrode potential.
5. Estimation of strong acid in the industrial effluents
6. Estimation of Fe2+ present in unknown sample – by Potentiometry
7. Verification of Beer-Lambert's law and estimation of Cu2+ present in unknown sample.
8. Estimation of Na and K present in the agricultural field – by flame photometry.
9. Study of effect of inhibitors in free radical polymerization (Demo)

REFERENCE

Laboratory Manual

OUTCOMES:

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

- Estimate the degree of hardness and TDS in water samples.
- Construct and calculate EMF of cell.
- Apply the concept of Beer lamberts law.

GEB1103	COMPUTER PROGRAMMING AND APPLICATIONS LABORATORY	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Expose fundamental concepts and techniques in programming
- Give coverage on application logic in programming
- Focus on solving practical problems based on analyzing, designing, and implementing computer programs

MODULE I FUNDAMENTALS OF COMPUTERS **5**

Evolution - Generations - Classifications - Applications - Computer organization -Hardware in a typical computer Identification - Booting - Booting error messages - Number system - Number system conversions

MODULE II BASIC PROGRAMMING AND DEBUGGING **5**

Software types - Types of Operating systems - Software development steps - Information technology and internet - The programming tool - Structure of a basic program - Hello world program - Debugging it - Character set - Delimiters - Keywords, identifiers - Constants - Variables -- Tools and help features - Comments in a program

MODULE III INPUT AND OUTPUT **5**

Data types - Type conversions - Input/Output: Formatted functions - Unformatted functions - Library functions - Debugging the code - Systems software: Compiler - interpreter- linker - loader - Finding the correct answer given a code snippet and justifying it

MODULE IV PROBLEM SOLVING **5**

Problem solving techniques: Algorithm, flowchart - Pseudo-code - Examples of simple problems in algorithms and flowcharts - Sorting and Searching - Characteristics of a good program - Generations of programming language

MODULE V OPERATORS AND DECISION STATEMENTS **5**

Properties of operators - Priority of operators - Arithmetic relational logical and bitwise operators - If -if else- nested if else- goto- switch case - nested switch case - for loops - nested for loops - while loop - do-while loop - break and continue statement

MODULE VI ARRAYS AND LOOP CONTROL STATEMENTS 5

Arrays - Initialization - Definition - Characteristics - One dimensional array - Two dimensional arrays - Multi dimensional arrays - Predefined streams - Operation with arrays - Sorting and searching - Structures - Operations on structures

LIST OF EXPERIMENTS:

1. Computer organization -Hardware in a typical computer Identification - Booting - error messages and what it means
2. Types of Operating systems - Windows and Linux
3. Structure of a basic program - Hello world program - Debugging it
4. Data types Type conversions
5. Input/Output: Formatted functions - Unformatted functions - Library functions
6. Properties of operators - Priority of operators - Arithmetic relational logical and bitwise operators
7. If - if else- nested if else- goto- switch case - nested switch case - for loops - Nested for loops - while loop - do-while loop - break and continue statement
8. Arrays - Operation with arrays
9. Sorting and searching

REFERENCES:

1. Ashok N Kamthane, "Computer Programming", 2nd Edition, Pearson Education, 2012.
2. Paul J. Deitel, Deitel& Associates, "C How to Program", 7th Edition, Pearson, Education, 2012.

OUTCOMES:

Students who complete the course will be able to

- Understand Modular design, logic flow, data abstraction
- Describe basic programming constructs, functions and I/O
- Write down programs for sorting and searching Algorithms
- Write down programs for developing cycle for different applications
- Debug programs while solving practical problems in programming.

SEMESTER- II

BTB1211 BIOCHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a stem/branch lecture series and a research project.

MODULE I AMINO ACIDS, CARBOHYDRATES AND LIPIDS 7

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

MODULE II NUCLEIC ACIDS AND VITAMINS 7

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

MODULE III METABOLISM OF AMINO ACIDS 8

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

MODULE IV METABOLISM - NUCLEIC ACIDS, POLYSACCHARIDES AND LIPIDS 8

Biosynthesis of nucleotides - de novo and salvage pathways for purines and pyrimidines - Regulatory mechanisms - Degradation of nucleic acid by exo and endo nucleases - Biosynthesis and degradation of starch and glycogen -

Biosynthesis and degradation of Lipids -Fatty acid synthesis and oxidative degradation - Triacylglycerol and phospholipid biosynthesis and degradation - Cholesterol biosynthesis and regulation and targets and action of cholesterol lowering drugs.

MODULE V BIOMEMBRANE, TRANSPORT AND ELECTRICAL CONDUCTIVITY 8

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

MODULE VI BIOCHEMICAL ENERGETICS 7

Energy Yielding and Energy Requiring Reactions, Calculations of Equilibrium Concentrations, Oxidation-Reduction Reactions, Metabolism and ATP Yield. Photosynthetic Phosphorylation, Active Transport, Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy.

TOTAL : 45

REFERENCES:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Lehninger. McMillan publishers
3. Biochemistry by Zubey. Wm. C. Brown publishers

OUTCOMES:

At the end of the course students will be able to

- demonstrate broad knowledge of the biomolecules, machinery and information flowwithin living cells, and an appreciation of how these underpin all biological processes, in both normal and diseased states
- demonstrate knowledge of key facets of modern biochemistry including: proteins andstructural biology, bioinformatics, advanced molecular biology, cell organisation,signal transduction and its role in diseases such as cancer; and the identification of drug targets

- demonstrate proficiency in core biochemical laboratory techniques, understandingboth the principles and applications of these methods within the molecular biosciences.
- demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment.
- collect, organise, analyse, evaluate and interpret biochemical data using appropriate quantitative, technological and critical thinking skills.

BTB1212 CELL BIOLOGY L T P C
4 0 0 4

OBJECTIVES:

This course seeks to achieve the following goals: introduce the four basic areas of cell biology. A successful student will gain an in-depth knowledge about cell organelles, structure and functions.

MODULE I INTRODUCTION TO CELL & ITS COMPONENTS 12

Basic properties of cell, different classes of cell: Prokaryotic and eukaryotic cell, their characterstics, cell wall, composition, function of bacterial cell wall. Physical structure of the cell-brief introduction to the Cell Membrane

MODULE II CELL PHYSIOLOGY 12

Transport of substances through cell membrane- osmosis, diffusion and its types, Active transport (sodium pump) and passive transport; membrane potential, measuring membrane potential, action potential, electrocardiogram (ECG), electromyography (EMG), electroencephalography (EEG).

MODULE III CELL ORGANELLE 12

Cellular organelles - structure and function of cell wall, plasma membrane nucleus, Mitochondria, Chloroplast, Nucleus, lysosomes, peroxisomes, golgi bodies, and transport across membranes.

MODULE IV CYTOSKELETON 12

Eukaryotic cytoskeleton - Actin - Myosin - Actin polymerization - Acto-myosin complexes - Mechanism of myosin ATPase activity - Excitation-contraction coupling and relaxation - Microtubules - Microfilaments - Intermediate filaments and their role in organelle movements - Prokaryotic cytoskeleton - FtsZ - MreB - ParM - Crescentin.

MODULE V DNA REPLICATION, TRANSCRIPTION AND TRANSLATION 12

DNA replication- Prokaryotic and eukaryotic DNA replication, mechanism of replication. Transcription - Prokaryotic and eukaryotic Transcription; Translation- Genetic code- Prokaryotic and eukaryotic translation- translational machinery- Mechanism of initiation- elongation and termination.

TOTAL: 60

REFERENCES:

1. Molecular Biology of Cell by Albert et.al. John Wiley & Sons
2. The Cell by Cooper. ASM Press
3. Cell and Molecular Biology by Karp. John Wiley & Sons

OUTCOMES:

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

- Define components of a cell
- Understand cellular structure and functions
- Understand the mechanisms of DNA replication and protein synthesis

BTB1213 MICROBIOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I MICROBES AND FUNCTIONAL ANATOMY 7

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

MODULE II OBSERVING MICROORGANISMS THROUGH A MICROSCOPE 7

Types of Microscopy, Light, electron, scanned-probe, microscopy. Confocal Microscopy, Simple, differential and special stains.

MODULE III CATABOLIC & ANABOLIC REACTIONS 8

Enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, bacterial identification and photosynthesis. Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism.

MODULE IV MICROBIAL GROWTH 9

Growth requirements, culture media, obtaining pure cultures and preservation of cultures, growth of bacterial cultures, Control of Microbial Growth, Action of microbial control agents, physical and chemical methods of microbial control. domain bacteria, proteobacteria, nonproteobacteria Gram-ve and Gram+ve bacteria. Bacterial diversity. lichens, algae, protozoa, helminthes, arthropods as vectors. viral structures, isolation, cultivation and identification of viruses, viral multiplication.

MODULE V APPLIED & INDUSTRIAL MICROBIOLOGY 7

Industrial fermentation, primary and secondary metabolites, Role of

microorganisms in the production of industrial chemicals and pharmaceuticals, Microbes as alternative energy sources and as industrial products.

MODULE VI MICROBIAL GENETICS 7

Recent advances in molecular genetics of viruses and bacteria. Transformation, conjugation and transduction, complementation.

TOTAL: 45

REFERENCES:

1. Microbiology: An Introduction: Tortora, Funke & Case. 7th edition, 2001
2. Microbiology: Davis, Dulbecco, Eisen and Ginsburg.
3. Introduction to Microbiology: Ross
4. General Microbiology: Stainier, Adelberq and Ingraham.

OUTCOMES:

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

- demonstrate a broad understanding of the diversity and range of microorganisms, the interactions between humans and microorganisms, the role of microorganisms in industrial and environmental processes, and their role in the development of the techniques that underpin modern molecular biology
- demonstrate proficiency in a set of core microbiological and molecular biologicaltechnical methods, including both an understanding of the principles of the methods and their utilisation in laboratory settings
- demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment
- collect, organise, analyse, evaluate and interpret experimental data using appropriate quantitative, technological and critical thinking skills
- critically evaluate relevant scientific data and literature and comprehend the natureand scope of the scientific literature in microbiology and related areas
- communicate microbiological principles and information effectively to diverse audiences, using a variety of formats

BTB1214 BIO ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

The course aims to develop skills of Students in the area of Organic Chemistry and its applications in Biology.

MODULE I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; Stereochemistry - R,S notation - re-si faces - e,z isomerism-conformers- ethane - cyclopean - reactivates- mechanisms of sn1 sn2 reactions, e1 e2 reactions - ester formation and hydrolysis, reaction rates - hammond's postulate - h/d effects. Catalysis - general acid - base and covalent catalysis.

MODULE II ENZYME KINETICS 9

Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics - Stereospecific enzymatic reactions - Stereochemistry of nucleophilic reactions - chiral methyl group - chiral phosphate.

MODULE III ENZYME IMMOBILIZATION & CASE STUDIES 9

Physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages. Case studies include dehydrogenases, proteases - lysozyme- stability of proteins

MODULE IV PROTEIN FOLDING 9

Kinetics of single substrate reactions; estimation of Michelis - Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models -substrate, product - folding of peptides.

MODULE V FOLDING PATHWAYS & ENERGY LANDSCAPES 9

Folding of ci2 - nucleation condensation mechanism - folding of barnase - time resolution - insights from theory - optimization of folding rates - molecular chaperones. Production and purification of crude enzyme extracts from plant,

animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

TOTAL : 45

REFERENCES:

1. Structure and Mechanism In Protein Science: A Guide To Enzyme Catalysis and Protein Folding; A. R. Fersht, W.H. Freeman, 1999.
2. Bioorganic Chemistry; H. Dugas, Springer Verlag, 1999.

OUTCOMES:

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

- Understand enzyme actions
- Understand enzyme kinetics
- Understand the mechanisms of protein folding

BTB1215 **BIO-PHYSICS** **L T P C**
3 0 0 3

OBJECTIVES:

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

MODULE I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 7

Intermolecular bonds - Covalent - Ionic and hydrogen bonds -Biological structures -General features - Water structure - Hydration - Interfacial phenomena and membranes - Self assembly and molecular structure of membranes.

MODULE II CONFORMATION OF NUCLEIC ACIDS 7

Primary structure -Bases, sugars , phosphodiester bonds - Double helical structure, A,B and Z forms - Properties of circular DNA - Topology - Polymorphism and flexibility of DNA - Structure of ribonucleic acids - Hydration of nucleic acids - Thermodynamics of DNA denaturation - Changes in nucleic acid structures during biochemical processes.

MODULE III CONFORMATION OF PROTEINS 7

Conformation of the peptide bond - Secondary structures - Ramachandran's plots - Use of potential functions - Tertiary structure - Dynamics of protein folding - Hydration of proteins - Hydropathy index - Effect of amino acids on the structure of proteins - Energy status of a protein molecule - Helix coil transformation of proteins.

MODULE IV CELLULAR PERMEABILITY AND ION - TRANSPORT 8

Ionic conductivity - Transport across ion channels - Mechanism - Ion pumps - Proton transfer - Nerve conduction - Techniques of studying ion transport and models.

MODULE V ENERGETICS AND DYNAMICS OF BIOLOGICAL SYSTEMS 8

Concepts in thermodynamics - Force and motion - Entropy and stability -

Analyses of fluxes - Diffusion potential - Basic properties of fluids and biomaterials - Laminar and turbulent flows.

MODULE VI METHODS IN BIOPHYSICS **8**

Fractionation of proteins using: PAGE, PAPER electrophoresis, TLC: Amino acids/ sugars/ fruit juice/oil, Column chromatography for protein /pigment, study of conformational changes in biomolecules using Ostwald viscometer Refractoemetry: study of sugars/proteins/amino acids.

TOTAL : 45

REFERENCES :

1. Cantor, C.R. and Schimmel, P.R., Biophysical Chemistry, W.H Freeman and Company, Press, New York, 4th Edition, 1999.

2. Glaser, R., Biophysics, Springer Verlag, London, 2nd Edition, 2004.

OUTCOMES:

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

- Develop a conceptual framework for understanding the system by identifying the key physical principles, relationships, and constraints underlying the system.
- If required, develop a physical experiment to analyze the system withint h e framework which includes : designing the experiment; making basicorder-of-magnitude estimates; working with standard data-measuringd e v i c e s such as oscilloscopes, digital multi-meters, signal generators, etc.;
- Identify and appropriately address the sources of systematic error and statistical error in their experiment.

SSB1182 SOCIOLOGY, ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give an overview of the fundamental of sociology.
- To expose how society developed in India, classes and impact.
- To introduce sociological aspects relating to industry
- To provide some basic concepts on ethics and human rights.
- To stress the role of engineer to the society, environment and sustainability.

MODULE I FUNDAMENTALS OF SOCIOLOGY **7**

Sociology - definition, evolution - scope - basic concepts - social process, sociological theories, social institutions, culture and social stratification - family - economic - politics - religion - education, state and civil society - social control.

MODULE II SOCIOLOGY IN INDIAN CONTEXT **7**

Development - Institutions, classes - women and society - impact of social laws, social change in contemporary India - secularism and communalism - social exclusion and inclusion.

MODULE III INDUSTRIAL SOCIOLOGY **7**

Definition and perspectives - industry in India - social groups in industry, behaviour pattern - group dynamics - focus groups - team - enhancing group behaviour.

MODULE IV INDUSTRIAL - SOCIETY INTERFACE **8**

Perspectives - social responsibilities - sociological effect on industrialization - urbanization, child labour, psychological impact, Impact of technology, modernization - globalization - challenges - role of engineers.

MODULE V ETHICS AND HUMAN VALUES **8**

Ethics and values - organizational values - personal worth, ethical behavior, professional ethics, whistle blowing, international ethics, corruption.

MODULE VI ENGINEERS AND SOCIETY **8**

Quality of life and society - engineer in economic development, technology development - invention, innovation and diffusion - appropriate technology - engineer's contribution, ecology and environment - sustainability - role of engineers.

TOTAL: 45

REFERENCES:

1. Samir Das Gupta and Paulomi Saha, An Introduction to Sociology, Pearson, Delhi, 2012.
2. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
3. Vidya Bhushan and D.R. Sachdeva, Fundamental of Sociology, Pearson, Delhi, 2012.
4. Deshpande, Satish, Contemporary India : A Sociological view, Viking (2002)
5. Thopar, Romila, Early India, Penguin (2003).
6. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996.

OUTCOMES:

At the end of the course students will

- Have an exposure to the fundamentals and basic concepts of Sociology.
- Gain knowledge in Industrial Sociology.
- Have gained knowledge about the impact of technology, modernization, globalization and their contribution towards society.

BTB1216 BIOCHEMISTRY LABORATORY L T P C
0 0 4 2

OBJECTIVES :

Provides opportunities to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner. The students should be able to understand and develop their skills in

- Accuracy and Precession of analysis
- Qualitative testing of Carbohydrates
- Identification of amino acids and proteins
- Quantitative analysis of nucleic acids and enzymes.

LIST OF EXPERIMENTS

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

BOOKS:

Laboratory Manual

OUTCOMES

Students will learn about the biomolecules, estimation of biomolecules and analytical techniques including spectrophotometer and chromatography.

BTB1217	CELL BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

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

LIST OF EXPERIMENTS:

1. Microscopic study of cell and cell organelles
2. Cell fractionation
3. Fixation, Dehydration, embedding and sectioning of tissues
4. Histology of extracellular matrix
5. Isolation of microtubules
6. Isolation of actin and Myosin filaments
7. Isolation of Mitochondria
8. Nuclear staining

REFERENCE:

Laboratory Manual

BTB1218 MICROBIOLOGY LABORATORY L T P C
0 0 2 1

OBJECTIVES:

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

- Understand explicitly the concepts
- Develop their skills in the preparation, identification and quantification of microorganisms

LIST OF EXPERIMENTS:

1. Sterilization techniques
2. Media preparation
3. Microscopy and Micrometry
4. Isolation, enumeration and purification of microbes from a given sample
5. Staining Techniques (Simple, Gram staining, spore staining)
6. Motility test by Hanging drop method
7. Biochemical Characterization of Bacteria Oxidation/Fermentation Test, Catalase, Oxidase and Urease Tests, IMViC test, Hydrogen Sulfide Test and Nitrate Reduction Test. Casein and Starch Hydrolysis
8. Antibiotic Assay - Antimicrobial Sensitivity Test (Disc Diffusion Method)
9. Growth Kinetics (Bacterial Growth Curve)
10. Isolation of antibiotics producing bacteria
11. Isolation and characterization of plant microbes

REFERENCE:

Laboratory Manual

OUTCOME:

Students will learn about

- Basic methods in microbiology
- Characterization and isolation of bacteria isolated from various sources
- Growth kinetics of Bacteria

ENB2182 COMMUNICATION SKILLS LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To help the students acquire efficiency in Spoken English with due importance to Stress, Accent and Pronunciation
- To enable them to make Presentation effectively
- To prepare them for Interviews and Group Discussions
- To train them in writing official letters , resume'writing and reports.

MODULE I **4**

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

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

MODULE II **6**

Theory:

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

(ii) Prepared presentations and extempore presentations

Lab: viewing Presentation Tips, Interviews Skills

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

MODULE III **4**

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

Lab: Negotiating Skills, Expressing Opinion

MODULE IV **4**

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

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

Lab: Viewing Group Discussion

MODULE V **8**

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

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

MODULE VI **4**

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

TOTAL : 45

REFERENCES:

1. Anderson, Kenneth & et.al. "Study Speaking : A Course in Spoken English for Academic Purposes" (Second Edition). Cambridge University Press, UK. 2004.
2. Sharma, R.C. & Krishna Mohan, "Business Correspondence and Report Writing". Tata MacGraw – Hill Publishing Company Limited, New Delhi. 2002.
3. Hurlock, B. Elizabeth. "Personality Development". Tata McGraw Hill, New York. 2004.
4. M. Ashraf Rizvi 'Effective Technical Communication". Tata McGraw – Hill Education, 2005.
5. 6.Gerson, Sharon & Steven M. Gerson, " Technical Writing : Process and Product" Pearson Education, New Delhi, 2004.
6. Riordan & Pauley. 'Report Writing Today'. 9th Edition. Wadsworth Cengage Learning, USA. 2005.

OUTCOME:

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

SEMESTER-III

BTB2101 ENZYME TECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

The course aims to present the current methods of enzyme characterization, detailing the structures and kinetic properties of the enzymes, the biotechnological strategies to improve the stability and activity of the enzymes and to study the applications of enzyme technology.

MODULE I ENZYMES AND STRUCTURE 10

Enzymes, brief history of enzymes, nomenclature and classification of enzymes.Chemical nature of Enzymes: amino acids, the building blocks of protein, Levels of protein Structure: Primary, secondary, tertiary and quaternary structure, Specificity of Enzymes: Types of specificity, the Koshland “induced fit” hypothesis,Strain or transition – state stabilization hypothesis.

MODULE II ENZYME CATALYSIS AND KINETICS 12

Factors affecting the rate of chemical reactions, kinetics of uncatalyzed chemical reactions, kinetics of enzyme-catalyzed reaction, methods for investigating the kinetics of enzyme-catalyzed reactions, nature of enzyme catalysis, inhibition of enzyme activity,The identification of binding sites and catalytic site, three dimensional structure of active site, mechanism of catalysis, mechanism of reaction catalyzed by enzyme without cofactors, metal-activated enzyme and metalloenzyme, coenzymes in enzyme catalyzed reactions.

MODULE III IMMOBILIZATION OF ENZYMES 8

Concept, methods of immobilization, Kinetics of immobilized enzymes, effect of solute partition and diffusion on kinetics of immobilized enzymes, use of immobilized enzymes, bioreactors using immobilized enzyme. Prediction of enzyme structure, design and construction of novel enzymes.

MODULE IV INDUSTRIAL USES OF ENZYMES 10

Industrial enzymes: Sales value of industrial enzymes, traditional (non-recombinant) sources of industrial enzymes, The impact of genetic engineering on enzyme production, Engineered enzymes, Extremophiles: hyperthermophiles, enzymes from hyperthermophiles, enzymes from additional extremophiles, enzymes in organic solvent.

MODULE V INDUSTRIAL ENZYMES PROTEASES AND CARBOHYDRASES **10**

Proteolytic enzymes: Carbohydrases, Lignocellulose degrading enzymes, Pectin and pectic enzymes, Lipases, Penicillin acylase, Amino acylase and amino acid production, cyclodextrins and cyclodextrin glycosyl transferase, enzymes in animal nutrition, Oxidoreductases, Enzymes in molecular biology.

MODULE VI BASIC TOXICOLOGY **10**

Introduction to Toxicology, Definition of toxicology, toxicant, toxicity, LC50, LD50; Measurements of toxicants and toxicity, Class of chemicals of toxic importance, Sources of toxic compounds, Absorption and distribution of toxicants, Routes of absorption in mammals, Distribution of a Toxicant, Toxicodynamics, Metabolism of toxicants, Applications of toxicology, Toxicity studies of liver in animals.

TOTAL : 60

REFERENCES:

1. Enzymes by Palmer (2001): Horwood Publishing Series.
2. Fundamentals of Enzymology by Price and Stevens (2002): Oxford University Press.
3. Enzyme Technology by Helmut uhling (1998): John Wiley
4. Introduction to Proteins Structure by Branden and Tooze (1998): Garland Publishing Group.

OUTCOMES:

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

- Discuss enzyme properties, enzyme nomenclature, enzyme mechanism as well as kinetics of enzyme-catalysed reactions
- Describe the methods for production and purification of recombinant enzymes as well as discuss how enzymes can be utilized in the laboratory and industrially
- Conduct experimental work to assay enzymatic activity as well as carry out protein purification of an enzyme
- Evaluate the current application of enzymes in the field of biotechnology

BTB2102 BIOINFORMATICS L T P C
3 0 0 3

OBJECTIVES:

The course aims to provide the students with an experimental and computational knowledge to embrace a systems biology approach and experience authentic systems genetics research by designing and conducting independent research projects.

MODULE I INTERNET AND BIOINFORMATICS 7

Internet basics, FTP, Gopher, World-wide web, Information Retrieval from Biological Databases: Retrieving database entries, integrated information retrieval: The entrez system, sequence databases beyond NCBI, Medical Databases.

MODULE II DATABASES 8

Introduction, Primary & Secondary database, Format vs content: computer vs humans, GenBank Flat File dissection, GCG, ACDEB. Introduction, SeqIDS, Bioseq: Sequences, Bioseqsets: Collections of sequences, Seq. Annot: Annotating the sequence, Seqdiscr: Describing the sequence, Structure Databases: Introduction to structures, PDB, MMDB, Structure file formats, Visualizing structural information, Database structure viewers.

MODULE III SEQUENCE ALIGNMENT AND DATABASE SEARCHING 8

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

MODULE IV PHYLOGENETIC ANALYSIS 7

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

MODULE V PREDICTIVE METHODS **8**

Framework, marking repetitive DNA, Database search, Codon bias detection, Detecting function sites in the DM, Integrated gene passing, Finding tRNA genes, Protein identity based on composition, Propsearch, Physical properties based on sequences, secondary structure and folding classes, spread sopma, Specialized structures of features, Tertiary structure.

MODULE VI ADVANCED BIOINFORMATICS **7**

Further applications on the design of new molecules 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries-generation and utility.

TOTAL: 45

REFERENCES:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.

2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

OUTCOMES

At the end of the course students will be

- Familiar with principles used in modelling dynamic phenomena in cells and methods that are used to analyze computational models
- Able to understand basic research methods in bioinformatics
- Able to understand the data structure (databases) used in bioinformatics and interpret the information (especially: find genes; determine their functions), understand and be aware of current research and problems relating to the area of their research project, to be able to critically evaluate the literature and identify the most important body of work
- Aware of the range of technologies available to computer scientists in bioinformatics
- Able to carry out data mining gene and protein expression patterns and modelling cellular interactions and processes

BTB2103 FUNDAMENTALS IN CHEMICAL ENGINEERING **L T P C**
4 0 0 4

OBJECTIVES:

- to prepare students for challenging careers in the chemical, petroleum, petrochemical, pharmaceutical, food and other related industries, and in the emerging areas such as biotechnology, microelectronics, energy and nanomaterials processing;
- to provide students with an appreciation of the role of chemical technology in society, and the skills of analyzing and solving related industrial problems;
- to prepare students for graduate study in chemical engineering and related
- disciplines; and
- to nurture engineer leaders with a global outlook.

MODULE I OVERVIEW OF PROCESS INDUSTRY **10**

Mass and energy conservation – Process automation – Environment – SI Modules – Conservation factors – Applied mathematics for experimental curve fitting – Numerical differentiation – Integration.

MODULE II MATERIAL BALANCES **10**

Overall and component balances – Material balances without and with chemical reactions – Degrees of freedom – Steady and unsteady state – Module operations – Recycle and by pass – Humidity calculations.

MODULE III FIRST AND SECOND LAWS OF THERMODYNAMICS **10**

Energy balances – Sensible heat – Latent heat – Vapour pressure – Steady and unsteady state calculations.

MODULE IV FLUID MECHANICS **10**

Fluids – Fluid statics and applications in chemical engineering – Fluid flow – Laminar – Turbulent – Pressure drops – Compressible fluid flow concepts – Multiphase flow concepts.

MODULE V FLOW THROUGH PACKED COLUMNS **10**

Fluidization – Centrifugal and piston pumps – Characteristics – Compressors – Work.

MODULE VI REACTORS **10**

Batch Reactors, Continuous reactors and Fed batch Reactors, Kinetics of Reactions and Scale-up of Reactors.

TOTAL : 60

REFERENCES:

1. Bhatt, B.I. and Vora S.M., "Stoichiometry", 4th Edition, Tata McGraw-Hill, 2004.
2. McCabe W.L., Smith J.C. and Harriot P., "Module Operations in Chemical Engineering", 7th Edition, McGraw-Hill Professional, 2005.
3. Geankoplis C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall, 2007.
4. Coulson J.M. and Richardson J. F., "Coulson and Richardson's Chemical Engineering", Vol-I, 3rd Edition, Butterworth – Heinemann Publishers, 2004.
5. Venkataramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall, 2004.

OUTCOMES:

At the end of the course students will be able to demonstrate good knowledge and understanding of

- Mathematics, science and engineering principles (including ITC), relevant to the Process Industries.
- Economic evaluation principles relevant to engineering and engineers.
- The essential concepts, principles and theories in subjects of the student's own choice.
- The role of the engineer in society and as a team player, and the constraints within which their engineering judgement will be exercised.
- The professional and ethical responsibilities of engineers.

BTB2104 **BIOSTATISTICS** **L T P C**
3 1 0 4

OBJECTIVES:

This course aims to provide students with fundamental knowledge of the design and analysis of clinical trials and epidemiological studies, of statistical issues arising in biomedical research, and of important methods for the analysis of biostatistical data, including data from microarray experiments.

- 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 INTRODUCTION **10**

Introduction, Exploratory Data Analysis-Motivation, Population vs. Sample, "Scientific Method"- Definitions, Examples, Medical Study Designs - Graphical Displays: Dotplots, Stemplots, Histograms- Summary Statistics: Measures of Center - Summary Statistics: Measures of Spread.

MODULE II DATA MEASURE AND LOCATION **10**

Frequency distribution, graphical presentation of data by histogram,frequency curve and cumulative frequency curves,Mean, Medium, Mode and their simple properties(without derivation) and calculation of median by graphs: range, mean deviation,Standard deviation, Coefficient of variation.

MODULE III PROBABILITY AND DISTRIBUTION **10**

Random distributions, events-exhaustive, mutually exclusive and equally likely, definition of probability (with simple exercises), definition of binomial, Poisson and normal distributions and their inter-relations, Simple properties of the above distributions (without derivation).

MODULE IV CORRELATION AND REGRESSION **10**

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

MODULE V SAMPLING **10**

Concept of population and sample, Random sample, Methods of taking a simple random sample, Tests of Significance: Sampling distribution of mean and standard error, Large sample tests (test for an assumed mean and equality of two population means with known S.D.);small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent, Paired and unpaired t-test for correlation and regression coefficients, T-test for comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit and homogeneity of samples.

MODULE VI EXPERIMENTAL DESIGNS **10**

Principles of experimental designs, Completely randomized, Randomized block and latin square designs, Simple factorial experiments of 22, 23, 24 and 32 types, Confounding in factorial experiments (mathematical derivations not required); Analysis of variance (ANOVA) and its use in the analysis of RBD.

TOTAL : 60

REFERENCE:

1. Statistical methods in biology by Norman T.J. Bailey (3rd Edition), Cambridge University Press (1995).

OUTCOMES:

At the end of the course students will be able to

- Explain how the Central Limit Theorem applies in inference
- Interpret the meaning of con?dence intervals in context
- Interpret the results of hypothesis tests
- Make an informed decision, based on the results of inferential procedures

BTB2105 MOLECULAR BIOLOGY L T P C
3 0 0 3

OBJECTIVE:

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

MODULE I DNA REPLICATION AND REPAIR 9

Mechanism of Prokaryotic and Eukaryotic DNA replication, Enzymes and accessory proteins involved in DNA, replication, DNA repair Mechanism.

MODULE II TRANSCRIPTION 9

Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements.

MODULE III MODIFICATIONS IN RNA 9

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

MODULE IV TRANSLATION 9

Prokaryotic and Eukaryotic translation, the translation Machinery; Mechanisms of initiation, elongation and termination, regulation of translation, co-and post-translational modifications of proteins.

MODULE V REGULATION OF GENE EXPRESSION & ANTISENSE TECHNOLOGY 9

Lac operon, Ara operan, regulation in Eukaryotes; Molecular mechanism of antisense molecules, inhibition of spilicing, polyadenylation and translation, disruption of RNA structure and capping,

TOTAL : 45

REFERENCES:

1. Lodish H. F.Cell and Molecular Biology. W.H. Freeman & Co Ltd, 2000.
2. Cooper G. M. Cell: a Molecular Approach.Sinauerassociates,USA2000.
3. Lewin B. Gene VIII. Prentice Hall, USA 2003.
4. Jeremy M Berg, John L Tymoczko, and LubertStryer. Biochemistry 5th edition

OUTCOMES:

On the completion of the above objectives student will be able to get the overview of classes Molecular Biology and understand the process involved in replication, transcription and translation and regulation of gene expression.

BTB2106 BASIC BIOANALYTICAL TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I CALORIMETRY AND SPECTROSCOPY 9

Properties of electromagnetic radiations, interaction with matter. Ultraviolet spectroscopy: Origin of UV spectra, types of transition, chromophore & related terms, choice of solvent, instrumentation and applications Infra-red spectroscopy: Origin of infra-red spectra, modes of vibrations, instrumentation, sampling technique and applications; Nuclear magnetic resonance spectroscopy: Mass Spectroscopy: Origin, Instrumentation, types of ions produced, interpretation and applications of mass spectra GCMS, LCMS & MSMS.

MODULE II CENTRIFUGATION AND MICROSCOPY 9

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

MODULE III ELECTROPHORESIS 9

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

MODULE IV RADIOISOTOPE TECHNIQUES 9

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

MODULE V CHROMATOGRAPHY 9

Introduction: Chromatography theory and practice. Paper chromatography. Thin layer chromatography. Ion exchange chromatography. Affinity

chromatography. Partition chromatography. Adsorption chromatography. Introduction to gas chromatography and HPLC. Permeation.

TOTAL : 45

REFERENCES:

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

OUTCOME:

- At the end of the course, the students will have sufficient scientific understanding of the basic concepts of molecular biology.
- Good understanding of protein synthesis and gene expression

BTB2107	BIOINFORMATICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To understand the sequence of protein and nucleic acids
- To understand the structural prediction of protein primary secondary, tertiary and quaternary structures.

LIST OF EXPERIMENTS

1. Study of internet resources in Bioinformatics
2. Internet protocols
3. Basic programming tags with XML, HTML and CML.
4. Algorithm used in data base
5. BLAST
6. FASTA
7. Prediction of DNA sequence
8. Prediction of protein sequence
9. Perl
10. Bioperl

DEMO (OPTIONAL)

1. Phylogenetic analysis
2. Shell Programming

REFERENCE:

Laboratory Manual

OUTCOME:

Students will get complete knowledge about sequence alignment, structure prediction, Phylogeny and algorithms

BTB2108 MOLECULAR BIOLOGY LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS **30**

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

REFERENCE:

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

OUTCOMES:

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

BTB2109 BIOANALYTICAL TECHNIQUES LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Preparation of Acetate, Tris and Phosphate Buffer systems and validation of Henderson-Hasselbach equation.
2. Reactions of amino acids – Ninhydrin, Pthaldehyde, Dansyl chloride – measurement using colorimetric and fluorimetric methods.
3. Differential estimations of carbohydrates – reducing vs non-reducing, polymeric vs oligomeric, hexose vs pentose
4. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect Separation of lipids by TLC.
5. Enzyme Kinetics: Direct and indirect assays – determination of Km, Vmax and Kcat, Kcat/ Km
6. Restriction enzyme – Enrichment and Module calculation
7. Ion-exchange Chromatagraphy – Purification of IgG and Albumin
8. Gel filtration – Size based separation of proteins
9. Affinity chromatography – IMAC purification of His-tagged recombinant protein
10. Assessing purity by SDS-PAGE Gel Electrophoresis
11. Chemical modification of proteins – PITC modification of IgG and Protein immobilization

REFERENCES:

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

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

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

OUTCOME:

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

SEMESTER-IV

BTB2211 GENETIC ENGINEERING

L	T	P	C
4	0	0	4

OBJECTIVES:

The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

MODULE V PRINCIPLES OF PLANT BREEDING **9**

Objectives, Selfing and crossing techniques, Male sterility,Incompatability, Hybrid vigour.

MODULE VI HUMAN GENOME PROJECT **9**

Genetic diseases in humans, Genetics and society

TOTAL : 60

REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart, Freeman and Company.
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
3. Concepts of Genetics, Klug & Cummings, Prientice Hall.
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory

OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic material
- Describe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

BTB2212 IMMUNOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION TO IMMUNOLOGY 8

Properties of immune response, Innate and acquired immunity, active and passive immunity, Cells & Tissues of Immune System: Lymphocytes, Classes of lymphocytes, antigen presenting cells, NK Cells, Mast Cells, Dendritic Cell, Organs of the Immune System,Bone marrow, Thymus, Lymph node, Spleen, CALT, MALT.

MODULE II MOLECULAR IMMUNOLOGY 8

Molecular structure of antibody, Classification, Isotypes, Synthesis assembly and expression of immunoglobulin molecules, Nature of antigens, function and diversity, Generation of anti-body diversity, Antigens: Different characteristics of antigens, mitogens, Hapten, Immunogen, Adjuvants.

MODULE III MHC 8

Discovery of MHC complex, Role of MHC, Structure of MHC molecule, Binding of peptides to MHC molecules, MHC restriction, Effector Mechanism of Immune Response: Cytokines, T- cell receptors, cell activation, complement system, antigen processing and presentation, regulation of immune response.

MODULE IV IMMUNOLOGICAL TECHNIQUES 7

Antigen- antibody reactions, Immuno diffusion, immunoelectrophoresis, ELISA, RIA, fluorescence activated cell sorter.

MODULE V APPLIED IMMUNOLOGY 7

Immune system in health and disease, autoimmunity, hypersensitivity,tumor immunity, tissue and organ transplant, Synthetic vaccines.

MODULE VI HYBRIDOMA TECHNOLOGY **7**

Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their application.

TOTAL: 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

- describe and explain the fundamental principles of modern immunology
- understand and apply related immunological techniques in medical laboratory profession
- relate and apply medical laboratory science knowledge to immunological changes in healthy and disease contexts

BTB2213 ANIMAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

The course aims to provide the students with the theoretical basis of the main mechanism of cell, tissues, organs and apparatus functionality and the current methods of animal cell culture and its application in research.

MODULE I INTRODUCTION TO ANIMAL TISSUE CULTURE 8

Background, Advantages, Limitations, Application, Culture Environment, Cell Adhesion, Cell Proliferation, Differentiation. Planning, Construction, Layout, Essential Equipments, Aseptic Technique, Objectives, Elements, Sterile Handling, Safety, Risk Assessment, General Safety, Fire, Radiation, Biohazards.

MODULE II MEDIA 7

Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Serum-Free Media, Disadvantages of Serum, Advantages of Serum-Free media, Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell line designations, Routine maintenance

MODULE III CHARACTERIZATION & QUANTITATION OF CELL LINE 7

Need for characterization, Morphology,Chromosome Analysis, DNA Content, RNA and Protein, Enzyme Activity, Antigenic Markers, Transformation, Immortalization, Aberrant Growth Control, Tumorigenicity, Cellcounting, DNA content, Protein, Rates of Synthesis, Cell Proliferation, Plating Efficiency, Labeling Index, Generation Time.

MODULE IV CRYOPRESERVATION 8

Need of Cryopreservation, Preservation, Cell banks, Transporting Cells, Cytotoxicity: Introduction, In vitro limitations, Nature of assay, Viability assay, Survival assay, Microtitration assay, Transformation assay, In Vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involvedin IVF, Fertilization by means of micro insemination, PZD, ICSI, SUZI, MESA

MODULE V TRANSGENIC ANIMALS **7**

Methodology, Embryonic Stem Cell method, Microinjection method, Retroviral vector method, Applications of transgenic animals.

MODULE VI GENE THERAPY **8**

Ex-vivo gene therapy, In vivo gene therapy, Viral gene delivery system, Retrovirus vector system, Adenovirus vector system, Adeno-Associated virus vector system, Herpex simplex virus vector system, Non-viral gene delivery system, Prodrug activation therapy, Nucleic acid therapeutic agents

TOTAL: 45

REFERENCES:

1. Animal Cell Culture by John R.W. Masters Oxford University Press
2. Introduction to Cell and Tissue Culture by Jennie P. Mather and Penelope E. Roberts, Plenum Press, New York and London
3. Molecular Biotechnology: Primrose.
4. Animal Cell Biotechnology: R.E. Spier and J.B. Griffiths (1988), Academic press.

OUTCOMES:

At the end of the course students will be able to

- Apply biotechnological methods for basic research;
- Apply bimolecular methods to veterinary pharmacology, to the design, correct use and traceability of medicines;
- Apply reproduction methods with particular reference to gamete and embryo manipulation techniques, production of transgenic animals and cloning;
- Apply biomolecular techniques for the diagnosis and study of epidemiology andetiopathogenesis of infective and parasitic animal diseases, as well as for the production of biotechnological vaccines for veterinary use;

BTB2214 PLANT BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

The purpose of the course is to provide training in the science behind plant biotechnology, an appreciation of the current scope and limits to its industrial application, and the implications of modern methods of genetic modification for plant industries.

MODULE I HISTORY AND IMPORTANCE 7

Important events in the history of plant tissue culture, Cellular Totepotency: Introduction, cyto-differentiation, orgemogenic differentiation, loss of morphogenic potential in long-term cultures, practical applications of cellular totipotency.

MODULE II TISSUE CULTURE MEDIA 8

Introduction, media constituents, media selection, media preparation, Cell and Suspension Culture: Introduction, isolation of single cells, suspension cultures, culture of single cells, plant cell reactors, applications of cell culture, Proloplast Culture: Proloplast isolation, culture and regeneration.

MODULE III SOMATIC EMBRYOGENESIS 8

Introduction, some examples of formatic embryogenesis, factors affecting somatic embryogenesis, induction and development, maturation, Haploid Production: Introduction, techniques, factor affecting androgenesis, ontogeny ofandrogenic haploids, plant regeneration from pollen embryos, gynogeresis, haploidproduction through disport hybridization idiptridization to raise homozygous diploids,applications, limitations, Triploid Production: Introduction, callusing, histology and cytology of cells, organogenesis,applications of endosperm culture.

MODULE IV EMBRYO CULTURE 8

Introduction, techniques, culture requirements role of the suspensor in embryo culture, precocious germination, morphogenesis in the culture of seeds with partially differentiated embryos, micronugical experiments, embryo and seed culture of parasitic angiosperms, morphogenic potential of the embryo callus,

practial applications. In-vitro pollination and fertilization: Introduction, terminology, in vitro pollination, in vitro fertilization, applications.

MODULE V MICROPROPAGATION 7

Introduction, techniques, applications, production of pathogen free Plants, Production of secondary metabolites-Introduction, strategies used to optimize product yield, commercial aspects

MODULE VI GERMPLASM STORAGE 7

Introduction, long-term storages, short or medium term storage

TOTAL: 45

REFERENCES:

1. Experiments in Plant Tissue Culture by John H. Dodds & Lorin W. Robert.
2. Plant tissue Culture : Theory and Practice by S.S. Bhojwani and M.K. Razdan (1996) Elsevier, Amsterdam.
3. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002

OUTCOMES:

At the end of the course the students will acquire:

- An understanding of the theoretical background knowledge in molecular, biochemical and plant sciences needed for an understanding of plant biotechnology.
- A working knowledge of laboratory techniques used in plant biotechnology.
- An appreciation of the issues associated with growing and using transgenic plants as food crops.
- An understanding of the aims and needs of industrial enterprises using plant biotechnology techniques to develop new products.
- A capacity to undertake research in plant biotechnology

BTB2215 INDUSTRIAL BIOTECHNOLOGY

L	T	P	C
3	1	0	4

OBJECTIVES:

This course helps the students to provide biologically trained students with appropriate academic studies and industrial experience to enable them to contribute to the field of biotechnology.

- To update students knowledge of new developments in biology of industrial relevance.
- To give students a broad understanding and experience, of technological processes involved in biotechnological industries.

MODULE I INTRODUCTION TO BIOTECHNOLOGY 10

Biotechnology, An interdisciplinary pursuit, A three-component central core, Product safety, Public perception of biotechnology, Biotechnology and the developing world.

MODULE II BIOCHEMICAL ENERGETICS 10

Energy Yielding and Energy Requiring Reactions, Calculations of Equilibrium Concentrations, Oxidation-Reduction Reactions, Metabolism and ATP Yield. Photosynthetic Phosphorylation, Active Transport, Second Law of Thermodynamics, Enthalpy and Entropy, Activation Energy.

MODULE III METABOLIC STRATEGIES 10

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

MODULE IV ENZYME TECHNOLOGY & BIOPHARMACEUTICALS 10

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

MODULE V APPLICATIONS **10**

Introduction, Fermentation, Food processing, Sweeteners, Food wastes, Rapid diagnostics, Public acceptance & safety, Plant biotechnology, Forestry, Biological control, Animal biotechnology, Diagnostics in agriculture, Bioremediation. IPR, Safety, Social, moral and ethical aspects of Biotechnology

MODULE VI PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 10

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant andanimal cell culture.

TOTAL : 60

REFERENCES:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Lehninger. McMillan publishers
3. Biochemistry by Zubey. Wm. C. Brown publishers
4. Biotechnology, John E. Smith
5. Bioprocess Engineering Principles, Pauline M. Doran

OUTCOMES:

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

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

GEB3201 ENVIRONMENTAL SCIENCE AND ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

To impart the basic scientific knowledge on the environment and human impacts on various elements of environment and assessment tools.

MODULE I PHYSICAL ENVIRONMENT **8**

Earth's surface - the Interior of Earth - Plate Tectonics - Composition of the Crust: Rocks - formation and types, Soils - formation and components - soil profile. Atmosphere - structure and composition - weather and climate - tropospheric airflow; Hydrosphere - water budget - hydrological cycle - Rainwater and precipitation, River Water and solids, Lake Water and stratification, Seawater and solids, soil moisture and groundwater. Bioelement cycling - The Oxygen cycles - the carbon cycle - the nitrogen cycle - the phosphorous cycle - the sulfur cycle sodium, potassium and magnesium cycles.

MODULE II BIOLOGICAL ENVIRONMENT **7**

Cellular basis of life - prokaryotes and eukaryotes - cell respiration - photosynthesis - DNA and RNA - genetically modified life, Population dynamics - population - population growth - survival and growth curves - population regulation - future of human population, Biological communities - Five major interactions: competition, predation, parasitism, mutualism and commensalism - Concepts of habitat and niche - natural selection - species richness and species diversity - ecological succession and climax. Ecosystem and Biomes - Food Chains and food webs - biomagnifications - ecological pyramids - Trophic levels - Energy flow in ecosystem - ecosystem stability - Terrestrial and aquatic biomes.

MODULE III IMPACTS ON NATURAL RESOURCES AND CONSERVATION **9**

Biological resources - nature and importance - direct damage - introduced species - Habitat degradation, loss and fragmentation - Values of biodiversity - hotspots of biodiversity, threats to biodiversity- endangered and endemic species of India- conservation of biodiversity, in-situ and ex-situ conservation; Land Utilization - past patterns of land use - Urban and Industrial development

- deforestation, salinisation, soil erosion, and desertification - Modern Agriculture and Impacts; Waste management - types of solid wastes: domestic, municipal, industrial and e-wastes - disposal options - reduce, recovery, reuse - waste minimization, cleaner production technology.

MODULE IV IMPACTS ON WATER AND AIR AND CONSERVATION 8

Water pollution - organic oxygen demanding wastes - anthropogenic phosphate and eutrophication - Ground water contamination - Usage of fertilizer and pesticides- acid rain -acid mine discharges - toxic metals - organochlorines - endocrine disrupting substances- treatment process - Rain water harvesting and watershed management- manmade radionuclide's - thermal pollution; Atmospheric pollution - primary and secondary pollutants - anthropogenic, xenobiotic, synergism, sources and sink, residence time, levels and impacts of major pollutants - processes leading to smog, acid rain, global warming, stratospheric ozone depletion - Noise pollution and abatement.

MODULE V IMPACTS ON ENERGY AND CONSERVATION, ENVIRONMENTAL CRISIS 8

Energy - Renewable and non renewable energy resources - thermal power plants - nuclear fuels, fossil fuels, solar energy, wind energy, wave energy, tidal energy, ocean thermal energy, hydropower, geothermal energy, biomass energy; Environment crisis - state of environment in developed and developing countries- managing environmental challenges for future - disaster management, floods, earthquake, cyclone and landslides.

MODULE VI ENVIRONMENTAL IMPACT ASSESSMENT AND SUSTAINABILITY 5

Environmental Impact Assessment - Impacts: magnitude and significance - steps in EIA - methods - precautionary principle and polluter pays principle - role of NGOs and Public - value education - Environment protection act (air, water, wild life) and forest Conservation act; Concept of Sustainability - Sustainable Development - Gaia Hypothesis - Traditional Knowledge for sustainability.

TOTAL: 45

REFERENCES:

1. Environmental Science (The Natural Environment and Human Impact), Andrew R. W. Jackson and Julie M. Jackson, Pearson Education Limited, Harlow, Essex, England, 2000.
2. Environmental Science (Working with the Earth), G Tyler Miller, Jr., Thomson Brooks/Cole, 2006.
3. Physical Geology, Earth Revealed, David McGeary and Charles C Plummer, WCB McGraw Hill, 1998.
4. Sustainability: A Philosophy of Adaptive Ecosystem Management, Bryan G. Norton, 2005.
5. Environmental Impact Assessment, Larry W. Canter, McGraw-Hill, 1996.
6. The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity, James Lovelock, Penguin UK, 2007.

OUTCOME:

Students will be able to gain the basic scientific knowledge on the environment, human impacts on various elements of environment and their assessment tools.

BTB2216 GENETIC ENGINEERING LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

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

- Isolation of plasmid DNA, genomic DNA and RNA
- Electrophoresis and restriction digestion of DNA
- Phage titration

LIST OF EXPERIMENTS:

1. Preparation of Agarose Gel
2. Isolation of Plasmids
3. Isolation of Genomic DNA from blood, plant cell and bacteria
4. Isolation of RNA
5. Formaldehyde gel electrophoresis of RNA
6. Polyacrylamide gel electrophoresis of DNA
7. Restriction digestion of DNA
8. Ligation of digested of DNA
9. UV mutation
10. Phage Titration

REFERENCE:

Sambrook et al, "Molecular Cloning-A laboratory Manual"

OUTCOME:

Students will learn about

- Isolation of DNA, RNA,
- digestion and ligation of nucleic acids,
- mutation and phage titration

BTB2217	IMMUNOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

- Antigen - Antibody interaction
- Electrophoresis techniques

LIST OF EXPERIMENTS:

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

REFERENCE:

Laboratory manual

OUTCOME

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

BTB2218	ANIMAL AND PLANT CELL CULTURE LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

- Understand explicitly the concepts
- Develop their skills in the animal and plant cell culture techniques

LIST OF EXPERIMENTS:

1. Preparation of culture media and sterilization
2. Fibroblast culture.
3. Study of effect of anti cancer agent in cell culture.
4. Live cell counting
5. Callus Induction
6. Shoot tip culture
7. Embryo / Endosperm Culture

REFERENCE:

Laboratory Manual

OUTCOME:

On the completion of the above objectives student will be able to explorethemselves about pre -requisites for animal as well as plant tissue culture.They will be able to understand cell cycle and alsotechnical applications of cell culture.

SEMESTER-V

BTB3101 MOLECULAR PATHOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to provide the students with the theoretical basis of the main mechanism of cell, tissues, organs and apparatus functionality and the current methods of animal cell culture and its application in research.

MODULE I INTRODUCTION TO MOLECULAR BASIS OF DISEASE 9

Mechanisms of cell death, apoptosis, necrosis, pathways to apoptosis, acute and chronic inflammation, infection and host response, neoplasia

MODULE II MOLECULAR BIOLOGY AND GENETICS 9

Structure and organization of human genome, human genome project, genetic diseases, gene expression profiling, microarrays-applications in basic research and translational medicine

MODULE III PRINCIPLES OF MOLECULAR PATHOLOGY 9

History of approaches to disease, current practice and future prospect, pathogenesis of Hepatitis C, Acute myeloid leukemia and cystic fibrosis

MODULE IV MOLECULAR BASIS OF HUMAN DISEASES 9

Cardiovascular diseases-atherosclerosis, ischemic heart diseases, cardiomyopathies; lymphoid and myeloid diseases; diseases of immune system, major syndrome, pulmonary diseases, diseases of gastrointestinal tract, neuropathological disorders

MODULE V MOLECULAR THERAPEUTICS 9

Pharmacogenetics, SNPs, cytochrome P450 system, High throughput screening techniques, Gene therapy, Immunotherapy, recombinant drugs, embryonic stem cells.

TOTAL: 45

REFERENCES:

1. Animal Cell Culture by John R.W. Masters Oxford University Press
2. Introduction to Cell and Tissue Culture by Jennie P. Mather and Penelope E. Roberts
3. Plenum Press, New York and London
4. Molecular Biotechnology: Primrose.
5. Animal Cell Biotechnology: R.E. Spier and J.B. Griffiths (1988), Academic press.

OUTCOMES:

At the end of the course students will be able to

- Apply biotechnological methods for translational research;
- Apply bimolecular methods to pharmacology, to the design, correct use and traceability of medicines;

BTB3102 CHEMICAL AND BIO-THERMODYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims at making the students understand the fundamental principles and concepts of chemical and bio thermodynamics.

MODULE I THERMODYNAMIC PROPERTIES OF FLUIDS 7

Volumetric properties of fluids exhibiting non ideal behavior – Residual properties – Estimation of thermodynamic properties using equations of state – Calculations involving actual property exchanges – Maxwell's relations and applications.

MODULE II SOLUTION THERMODYNAMICS 7

Partial molar properties – Concepts of chemical potential and fugacity – Ideal and non-ideal solutions – Concepts and applications of excess properties of mixtures – Activity coefficient – Composition models – Gibbs Duhem equation.

MODULE III PHASE EQUILIBRIA 7

Criteria for phase equilibria – VLE calculations for binary and multi component systems – Liquid-liquid equilibria (LLE) and solid-solid equilibria (SLE).

MODULE IV CHEMICAL REACTION EQUILIBRIA 8

Equilibrium criteria for homogeneous chemical reactions – Evaluation of equilibrium constant – Effect of temperature and pressure on equilibrium constant – Calculation of equilibrium conversion and yields for single and multiple reactions.

MODULE V THERMODYNAMIC ANALYSIS OF PROCESSES 8

Concept of lost work – Entropy generation – Calculation of real irreversible processes – Power cycle – Liquefaction.

MODULE VI BIOCHEMICAL THERMODYNAMICS 8

Energetics of metabolic pathways energy coupling (ATP and NADH), stoichiometric and energetic analysis of cell growth and product formation-elemental balances, degree of reduction concepts-available –electron balance,

yield coefficients, oxygen consumption and heat evolution in aerobic cultures, thermodynamics efficiency of growth.

TOTAL : 45

REFERENCES

1. Smith, J.M., Van Ness H.C. and Abbott M., "Introduction to Chemical Engineering Thermodynamics", 6th Edition, Tata McGraw- Hill, 2001.
2. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall India, 2001.
3. Sandler, S.I., "Chemical, Biochemical and Engineering Thermodynamics", 4th Edition, John Wiley and Sons Inc., 2006.
2. Haynie, D.T., "Biological Thermodynamics", 2nd Edition, Cambridge University Press, 2008.
3. Nicholls, D.G. and Ferquson, S.J., "Bioenergetics 3", 2nd Edition, Elsevier Science Ltd., 2002.

OUTCOMES:

At the end of the course the students will be well versed with the behavior of fluids under PVT conditions and also apply them for practical purpose, aim advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

BTB3103 FOOD BIOTECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

The course aims to

- Provide a programme of education which can enable its graduates to enter a career in the food industry as technologists capable of ensuring the production and marketing of safe and quality foods.
- Provide a broadly based technological education whose graduates can also enter into employment in other sectors of the food chain, or related technical sectors, where they can apply their technological skills.
- Allow individuals to develop their capacity to undertake research into problems relating to the production and marketing of safe and quality foods.

MODULE I HISTORICAL BACKGROUND 12

History of Microorganisms in food, Historical Developments, Taxonomy, role and significance of microorganisms in foods. Intrinsic and Extrinsic Parameters of Foods that affect microbial growth, Microorganisms in fresh meats and poultry, processed meats, seafood's, fermented and fermented dairy products and miscellaneous food products, Starter cultures, cheeses, beer, wine and distilled spirits, SCP, medical foods, probiotics and health benefits of fermented milk and foods products.

MODULE II FERMENTATION 10

Brewing malting, mashing, hops, primary & secondary fermentation: Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl. Beer, wine and distilled spirits.

MODULE III NUTRITIONAL BOOSTS AND FLAVOR ENHANCERS 10

Emerging processing and preservation technologies for milk and dairy product, Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms,Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods.

MODULE IV FOOD PRESERVATION 10

Food Preservation Using Irradiation, Characteristics of Radiations of Interest

in Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Processing of Foods for Irradiation, Application of Radiation, Radappertization, Radicidation, and Radurization of Foods Legal Status of Food Irradiation, Effect of Irradiation of Food constituents.

MODULE V STORAGE 9

Stability Food Preservation with Low Temperatures, Food Preservation with HighTemperatures, Preservation of Foods by Drying, Indicator and Food-borne Pathogens, Other Proven and Suspected Food-borne Pathogens.

MODULE VI FOOD QUALITY AND CONTROL 9

Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination.

TOTAL: 60

REFERENCES:

1. Modern Food Micro-Biology by James M. Jay, (2000), 6th edition, An Aspen Publication, Maryland, USA.
2. Food Microbiology: Fundamentals and frontiers by M.P. Doyle, L.R. Beuchat and Thoma J. Montville, (2001), 2nd edition, ASM press, USA.
3. Food Science and Food Biotechnology by G.F.G. Lopez & G.V.B. Canovas (2003), CRCPress, Florida, USA.

OUTCOMES:

At the end of the course students will be able to

- Integrate the scientific disciplines relevant to food
- Apply and communicate technological knowledge to meet the needs of industry andthe consumer for the production and marketing of safe and quality foods.

BTB3104 BIO PROCESS ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

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

MODULE I INTRODUCTION TO ENGINEERING CALCULATION, PRESENTATIONS AND ANALYSIS OF DATA 7

Physical variables, dimensions, Modules, errors in data and calculations, testing mathematical models, process flow diagram

MODULE II MATERIAL & ENERGY BALANCES 10

Thermodynamics Law of conservation of mass, types of material balance products, electron balances, biomass yield, theoretical oxygen demand. Problems, Basic concepts, General Energy balance equations, Enthalpy calculations, Enthalpy changes in non-reactive processes, Types of energy balance calculations, Types of heat reactions, problems.

MODULE III UNSTEADY STATE MATERIAL AND ENERGY BALANCES 10

Material balance equation for CSTR, Energy balance equations, solving differential equations, solving mass balances, solving energy balances, problems.

MODULE IV FLUID FLOW AND MIXING 10

Classification of fluids, Reynolds number, Momentum transfer, Non – Newtonian fluids, Two-Parameter models, rheological properties of fermentation broths, mixing, power requirements for mixing, scale-up of mixing systems, role of shear in stirred fermentors, problems.

MODULE V HEAT& MASS TRANSFER 10

Equipments, mechanism of heat transfer, conduction, heat transfer between fluids, design equation for heat transfer systems, applications of design equations, problems, Mass transfer: Molecular diffusion, role of diffusion in

bio-processing, film theory, convective mass transfer, oxygen uptake and transfer in cell cultures, kLa determination, problems.

MODULE VI REACTOR ENGINEERING **13**

Bioreactor configurations, practical considerations for bioreactor construction, monitoring and control of bioreactors, ideal reactor operations, batch operation of a mixed reactor, case study of penicillin production. Homogeneous reactions: Basic reaction theory, calculation of reaction rates, general reaction kinetics for biological systems, yields in cell culture, cell growth kinetics,production kinetics, kinetics of cell death, problems, Heterogeneous reactions: Concentration gradients and reaction rates in solid catalysts,internal mass transfer and reaction, the Thiele modulous and effectiveness factor, external mass transfer, problems

TOTAL: 60

REFERENCES:

1. Bioprocess Engineering - Basic concepts by M. L. Schuler & F. Kargi, Entice Hall 1992.
2. Bioprocess Engineering Principles by Pauline M. Doran, Academic Press 1995.
3. Fermentation & Biochemical Engineering Hand Book (1983), Principles, Process
4. Design and Equipment. HC Vogel, Noyes.
5. Principal of Microbe & Cell Cultivation (1975), SJ Prit, Blackwell Scientific co.).
6. Bioprocess Computations in Biotechnology (Vol. 1) TK Ghose, Ellis howard Ltd.

OUTCOMES:

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

- Understand the basic role of engineering in bio-processing applications
- Obtain a basic understanding of how cells work and become familiar with theenvironmental conditions (i.e. nutrients, pH, etc.) required for applications ofbiological components (cells or enzymes) to bio-processing systems.

- Understand and model enzyme kinetics and apply the models for analysis of immobilized enzymatic bioreactors.
- Utilize material balances to evaluate cell growth and substrate/product utilization in bioreactors.
- Design bioreactors to achieve desired results (i.e. specified cell concentration, production rates, etc.).
- Understand and apply scale-up methods for designing bioreactors.
- Become familiar with principles of recovery and purification techniques of bioprocesses.

BTB3105 PROTEIN ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

The course aims to provide the students with a knowledge on the biosynthesis, structure and function of proteins and furthermore, the techniques associated with gene cloning and the expression of recombinant proteins. To provide knowledge about the design of proteins with specific properties.

MODULE I PROTEIN STRUCTURE 7

Introduction, Overview of protein structure, Higher level structure, Protein post-translational modification, Protein stability and folding, Protein Sources: Introduction, Microorganisms as sources of proteins, Proteins from plants, Animal tissue as a protein source, Direct chemical synthesis, Conclusion.

MODULE II PROTEIN PURIFICATION AND CHARACTERIZATION 8

Introduction, Initial recovery of proteins, Removal of whole cells and cell debrisConcentration and primary purification, Column chromatography, Protein inactivation and stabilization, Protein characterization, Large-Scale Protein Purification: Some general principles, Therapeutic protein production: some special issues, Range and medical significance of impurities potentially present in protein-based therapeutic products, Labelling and packing of finished products.

MODULE III THERAPEUTIC PROTEINS 8

Introduction, Blood products, Haemophilia A and B, Anticoagulants, Thrombolytic agents, Additional blood-related products, Vaccine technology, Vaccines for AIDS, Therapeutic Antibodies and Enzymes: Introduction, Antibodies for in vivo application, Therapeutic enzymes.

MODULE IV HORMONES AND GROWTH FACTORS USED THERAPEUTICALLY 8

Introduction, Insulin, Glucagon, Gonadotrophins, Growth hormone, Erythropoietin, Other growth factors, Thyrotrophin, Corticotrophin, Prolactin, Peptide Regulatory Factor, Interferons, Interleukins and Additional Regulatory Factors: Regulatory factors; cytokines versus hormones, Interferons, Interleukins, Tumour necrosis factors, Colony stimulating factors, Cytokine toxicity.

MODULE V PROTEINS USED FOR ANALYTICAL PURPOSES 7

Introduction, Enzymes as diagnostic/analytical reagents, Biosensors, Antibodies as analytical reagents.

MODULE VI NON-CATALYTIC INDUSTRIAL PROTEINS 7

Introduction, Functional properties of proteins, Milk and milk proteins, Animal and microbial proteins, Sweet and taste modifying proteins.

TOTAL: 45

REFERENCES:

1. Proteins: Biochemistry and Biotechnology by Gary Walsh. (2002): John Wiley & Sons Ltd.
2. Fundamentals of Protein Biotechnology: Edited by Stanley Stein (1990): Marcel Dekker, Inc.

OUTCOMES:

This Course will provide theoretical and methodological knowledge in Protein Engineering. In particular, the student will get acquainted with enzyme kinetics, rational protein engineering, and directed evolution of enzymes. In addition, expertise in enzyme immobilization and in enzymology in non conventional media will also be credited.

BTB3106 CHEMICAL REACTION ENGINEERING

L	T	P	C
4	0	0	4

OBJECTIVES:

To impart knowledge to design different types of chemical reactors. Students gain knowledge on different types of chemical reactors, the design of chemicalreactors under isothermal and non-isothermal conditions

MODULE I REACTION KINETICS **10**

Rate equation, elementary, non-elementary reactions, theories of reaction rate andtemperature dependency; Design equation for constant and variable volume batch reactors,analysis of experimental kinetics data, integral and differential analysis.

MODULE II DESIGN OF CONTINUOUS REACTORS **10**

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors,combination of reactors, size comparison of reactors.

MODULE III MULTIPLE REACTIONS **9**

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factorsaffecting choice, optimum yield and conversion, selectivity, reactivity and yield.

Module IV KINETICS OF COMPLEX REACTIONS **11**

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchangesfor different reactors, design for constant rate input and constant heat transfer coefficient,operation of batch and continuous reactors, optimum temperature progression.

MODULE V RESIDENCE TIME DISTRIBUTION **10**

The residence time distribution as a factor of performance; residence time functions andrelationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

MODULE VI CHEMICAL REACTOR DESIGN **10**

Transient and steady state analysis, Optimal design of reactors, Multiphase

reactors: fixed, fluidized, trickle bed, slurry etc, Non-ideal continuous flow reactors.

TOTAL: 60

REFERENCES:

1. Levenspiel O, "Chemical Reaction Engineering", Wiley Eastern Ltd., IInd Edition, 2000.
2. Smith, J.M, "Chemical Engineering Kinetics", McGraw Hill, IIIrd Edition, 1981.
3. Fogler.H.S., "Elements of Chemical Reaction Engineering", Prentice Hall of India Ltd.,IIIrd Edition, 2000.
4. Froment. G.F. & K.B.Bischoff, "Chemical Reactor Analysis and Design",John Wiley andSons, 1979

OUTCOMES:

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

- Develop rate laws for use in reactor design based on reaction data from a reactor or set of reactors.
- Make comparisons of ideal reactor types (batch, plug flow, mixed flow, etc.) and be able to determine the best choice for simple objectives when using a single reactor or a set of reactors.
- Predict reactor performance in situations where a reacting gas has a significantly changing density, including the case of variable pressure within an ideal plug flow reactor.
- Determine optimal ideal reactor design for multiple reactions for yield or selectivity.
- Predict reactor performance for reactors when the temperature is not uniform within the reactor.
- Predict reactor performance in situations where the observed reaction rate is significantly influenced by internal mass transfer in porous heterogeneous catalysis (the iso-thermal effectiveness factor).

BTB3107	BIOPROCESS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

Enables the student to develop their skills in the field of enzyme isolation its assay, enzyme kinetics and microbial fermentation. The students will be able to

- Develop their practical skills in enzyme isolation and purification.
- Evaluate enzyme kinetics
- Carry out enzyme immobilized reaction and microbial culture
- Develop practical skill in submerged and solid state fermentation.

LIST OF EXPERIMENTS:

1. Isolation of proteolytic organism from soil sample
2. Glucose assay by DNS method
3. Evaluations of enzyme kinetic parameters
4. Enzyme activity calculation
5. Determination of optimum pH for enzyme
6. Determination of optimum temperature for an enzyme
7. Enzyme immobilized by alginate gel method
8. Hydrolysis of starch by immobilized method
9. Effect of substrate concentration on biomass yield
10. Solvent extraction techniques for product recovery

REFERENCE:

Laboratory Manual

OUTCOMES:

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

BTB3108 CHEMICAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

This course helps the students to experimentally verify the theoretical concepts they learnt in the course. To make the students to experimentally

- Determine the percentage extraction .
- Determine overall stage efficiency of a continuous counter current leaching unit.
- Verify the applicability of Freundlich equation for adsorption of acetic acid on activated carbon.
- Verify Rayleigh's equation.

LIST OF EXPERIMENTS:

1. Simple distillation
2. Steam distillation
3. Leaching
4. Batch adsorption
5. Diffusion
6. Air drying
7. Continuous absorption
8. Extraction
9. Vacuum drying
10. Infra red drying

REFERENCE:

1. Laboratory Manual

OUTCOMES:

At the end of the syllabus student will be able to understand the fundamentals of chemical engineering techniques. Students will be familiar with techniques involved in chemical engineering by performing distillations, adsorption and drying experiments.

BTB3109 PROTEIN ENGINEERING LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

Course aims to provide a detail understating of the concepts in protein engineering by providing hands on exposure to the methods in protein engineering.

LIST OF EXPERIMENTS:

1. Production of protein hydrolysates using enzymes.
2. Amino Acid Analysis by Precolumn Derivatization with 1-Fluoro-2,4-Dinitrophenyl-5-L-Alanine Amide.
3. Estimation of Disulfide Bonds Using Ellman's Reagent.
4. Quantitation of Cysteine Residues and Disulfide Bonds by Electrophoresis.
5. Protein Ladder Sequencing.
6. Isolation of Proteins Cross-linked to DNA by Formaldehyde
7. Chemical Methods of Analysis of Glycoproteins.
8. Monosaccharide Analysis by Gas Chromatography (GC)
9. Performic Acid Oxidation.
10. Modification of Arginine Side Chains with p-Hydroxyphenylglyoxal.
11. Amidation of Carboxyl Groups.
12. Modification of Sulfhydryl Groups with DTNB.
13. Chemical Cleavage of Proteins at Methionyl-X Peptide Bonds.
14. Chemical Cleavage of Proteins at Cysteinyl-X Peptide Bonds.
15. Enzymatic Digestion of Proteins in Solution and in SDS Polyacrylamide Gels.

REFERENCE:

The protein protocols hand book, 2nd edition by John M. Walker

OUTCOME:

On the completion of the above objectives student will be able to explore themselves about chemical methods to modify protein of interest. They will be able to understand techniques involved in qualitative and quantitative analysis of protein.

SEMESTER VI

BTB3211 STRUCTURAL BIOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

The course aims to provide the students with a detailed understanding of the behavior of proteins in solution and how their properties may be altered by changing the physical surroundings. To provide an understanding of the theory and practical techniques involved in developing a purification process.

MODULE I METHODS FOR STRUCTURE DETERMINATION 10

Diffraction methods, X-ray crystallography, crystallization, resolution, temperature factors, electron density maps, NMR methods for protein structure determination

MODULE II PROPERTIES OF MACROMOLECULES IN CRYSTALLINE STATE 10

Protein crystal, physical properties, chemistry of crystalline proteins, enzymatic and biological activities, structural heterogeneity in protein crystals

MODULE III STRUCTURAL STATES OF PROTEINS 14

Secondary structure, chemical nature of polypeptide chains, beta structure, collagen triple helix, prediction of secondary structure, helical protein structures, quaternary structures, oligomeric enzymes, biological implications of quaternary structure, surface accessibility.

MODULE IV CONFORMATIONAL STATES AND HYDROGEN BONDS 13

Oxygenation of hemoglobin: two crystal conformation, hydrogen bonds and water molecules in crystalline proteins, hydrogen bonding positions, distribution of protein bound water, water networks in crystalline proteins

MODULE V PROTEIN COMPLEXES 13

Protein and nucleic acid complex, DNA binding motifs, helix-turn-helix, leucine zipper, metalloproteins, membrane protein structure by electron microscopy and X ray methods

TOTAL: 60

REFERENCES:

1. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)
2. Foundations of Structural Biology by Leonard J. Banaszak (2000) Academic Press.

OUTCOMES:

At the end of this course, students will be able to understand methods to determine and study protein structures

BTB3212 TISSUE ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

The course aims to provide the students with an experimental knowledge to embrace a cell culture approach and experience authentic systems genetics research by designing and conducting independent research projects.

MODULE I INTRODUCTION 10

Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

MODULE II CELL CULTURE 11

Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

MODULE III MOLECULAR BIOLOGY ASPECTS 12

Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

MODULE IV SCAFFOLD AND TRANSPLANT 13

Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells: introduction, hepatopoiesis.

MODULE V CASE STUDY AND REGULATORY ISSUES 14

Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TOTAL : 60

REFERENCES:

1. Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick, Academic press (2007).

2. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press (2006).

OUTCOMES

At the end of the course students will be

- Familiar with principles used in generating cell culture models as well as in manipulation of the same for basic and translational research

BTB3213 DEVELOPMENTAL BIOLOGY L T P C
4 0 0 4

OBJECTIVES:

This course aims to provide a thorough grounding in animal and plant developmental biology with particular emphasis on the role of cell-cell interactions.

Three major themes are highlighted in the lecture

- The genetic regulation of cell behaviour as the main determinant of development.
- The molecular mechanisms by which cells interact and are recruited to achieve complex morphogenesis.
- The significant role of post-embryonic regulation and environmental signals in the control of plant development.

MODULE I HISTORY & BASIC CONCEPTS 10

The origins of developmental biology, Concepts in development – Developmental signals in cell division & differentiation, Role of gene expression in development, Identifying developmental genes, Cell commitment & differentiation, Determination & induction of cell fate, Concept of morphogen & positional information.

MODULE II AN INTRODUCTION TO MODEL SYSTEMS 12

Model vertebrate organisms: X. laevis, Chicken, Mouse, Zebrafish, Model invertebrate organisms: D. melanogaster, C. elegans, Model plant: A. thaliana, Germ Cells & Sex, Genotypic & phenotypic sex-determiantion in mammals, D. melanogaster and C. elegans, Structure & Formation of germ cells, Fertilization, Patterning the Vertebrate Body Plan : Axes & Germ Layers, Setting up the body axes, The origin & specification of the germ layers, The Mesoderm & Early Nervous System, Somite formation & Patterning, Role of the organizer region & neural induction

MODULE III DEVELOPMENT OF THE DROSOPHILA 12

Body Plan, Specification of body axes & role of maternalgenes, Polarization of body axes during oogenesis, Patterning of early embryo & role of zygotic genes, Segmentation & role of pair-rule genes, Compartments & role of segment polarity genes, Selector & Homeotic genes, Development of Nematodes &

Cellular Slime Molds: Developmental axes determination in C. elegans, Cell-fate specification in C. elegans, Larval development in C. elegans, Vulva development in C. elegans, Patterning of the slug in slime mold, Cell differentiation in slime mold, Aggregation.

MODULE IV MORPHOGENESIS 9

Kinds of cleavage & blastulation, Types of tissue movement in gastrulation, Gastrulation in amphibians & mammals, Neural tube formation & neural crest migration.

MODULE V CELL DIFFERENTIATION & ORGANOGENESIS 8

Models of cell differentiation, Insect imaginal disc & wing development.

MODULE VI MOLTING & METAMORPHOSIS 9

Amphibian metamorphosis, Insect metamorphosis,Plant Development: Pattern development in early embryogenesis of angiosperms, Floral development.

TOTAL: 60

REFERENCE:

1. Developmental Biology, by Scott F. Gilbert (1997), Sinauer Associates, Inc.

OUTCOMES

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

- Describe how regulation of gene expression is fundamental in cell differentiation.
- Describe developmental processes in animal model systems and recognise the importance of cell-cell interactions.
- Recognize the interplay between development and evolution.
- Describe the life cycle and particular advantages of using Arabidopsis thaliana as a model species for studying plant development.
- Recognize embryonic polarity systems and the importance of cell lineage and position in embryonic pattern formation.
- Describe genetic approaches to study plant development and molecular techniques used to localize gene expression.
- Recognize the ways in which analysis of plant morphogenesis is being used to manipulate the growth and development of crop plants.

BTB3214 CANCER BIOLOGY L T P C
3 0 0 3

OBJECTIVES:

This course will cover the origins of cancer and the genetic and cellular basis for cancer. It will examine the factors that have been implicated in triggering cancers; the intercellular interactions involved in cancer proliferation; current treatments for cancer and how these are designed; and future research and treatment directions for cancer therapy.

MODULE I FUNDAMENTALS OF CANCER BIOLOGY 7

Regulation of cell cycle, mutations that cause changes in signal molecules - Effects on receptor, signal switches, tumour suppressor genes - Modulation of cell cycle in cancer, different forms of cancers, diet and cancer.

MODULE II CANCER SCREENING METHODS 7

Cancer screening and early detection, detection using biochemical assays, tumor markers - Molecular tools for early diagnosis of cancer.

MODULE III PRINCIPLES OF CARCINOGENESIS 7

Theory of carcinogenesis - Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation - Mechanisms of radiation carcinogenesis.

MODULE IV PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 8

Signal targets and cancer, activation of kinases - Oncogenes, identification of oncogenes, retroviruses and oncogenes – Detection of oncogenes, oncogenes and proto oncogene activity – Growth factors related to transformation - Telomerases.

MODULE V PRINCIPLES OF CANCER METASTASIS 8

Clinical significances of invasion, heterogeneity of metastatic phenotype - Metastatic cascade, basement membrane disruption - Three step theory of invasion, proteinases and tumour cell invasion.

MODULE VI NEW MOLECULES FOR CANCER THERAPY 8

Different forms of therapy - Chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, use of signal targets towards therapy of cancer - Gene therapy

TOTAL: 45

REFERENCES:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of the Cell 5Edition, Garland Science; 2008.
2. Robert A. Weinberg. The Biology of Cancer 2nd Edition Garland Science, 2013

OUTCOMES:

At the end of the course students will be able to

- Explain how scientists Hippocrates and Galen coined the terms cancer and oncology.
- Describe how surgeon John Hunter and microscopic researcher Rudolf Virchow connected their observations to the pathology and treatment of cancer.
- List the common theories used to describe the cause of cancer.
- Overview the impact that the discovery of DNA by scientists Watson and Crick had on the cancer community.
- Discuss the finding of Nobel Prize winner Peyton Rous, that certain viruses can cause cancer.
- Differentiate between carcinoma, sarcoma, leukemia, and lymphoma and how these terms are used to name cancer types.
- Summarize why it is important to understand basic biology in the study of cancer.
- Name the six hallmarks of cancer.
- Outline how cancer starts and how it spreads.
- Identify common causes of cancer.

BTB3215	GENE MANIPULATION LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVE:

To provide an opportunity to experimentally verify the theoretical concepts of genetic engineering already studied. it also helps in understanding the theoretical principles in a more explicit and concentrated manner.

LIST OF EXPERIMENTS:

1. Isolation and Restriction enzyme digestion of bacterial genomic DNA
2. Purification of digested DNA
3. Ligation of DNA fragment with cloning vector
4. Preparation of competent cells
5. Transformation in E.coli with recombinant vector
6. Isolation of recombinants and confirmation of insert DNA in vector

OUTCOME:

The student will be able to understand and develop the concept of recombinant DNA technique.

ENB2282 CONFIDENCE BUILDING AND BEHAVIOURAL SKILLS **L T P C**
0 0 2 1

OBJECTIVES:

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

TOPICS OUTLINE:

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

LAB ACTIVITIES:

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

ASSESSMENT:

The assessment will be continuous and portfolio based. The students must produce the record of the work done through the course of the semester in the individual classes. The portfolio may consist of a) the individual task outline and activities, b) worked out activities c) Pre-designed sheets which may be provided by the Faculty member. The portfolio will be used by the Faculty member for assessment. The course coordinator in consultation with the course committee shall decide at the beginning of the semester, the number of exercises, method of assessment of each and the weightage for the end semester assessment.

OUTCOMES :

The students should be able to:

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

SEMESTER VII

BTB4101 BIOMEDICAL INSTRUMENTATION L T P C
4 0 0 4

OBJECTIVES:

- To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Biomedical applications of different transducers used.
- To introduce the student to the various sensing and measurement devices of electrical origin. To provide awareness of electrical safety of medical equipments
- To provide the latest ideas on devices of non-electrical devices.
- To bring out the important and modern methods of imaging techniques.
- To provide latest knowledge of medical assistance / techniques and therapeutic equipments.

MODULE I PHYSIOLOGY AND TRANSDUCERS 13

Cell and its structure – Resting and Action Potential – Nervous system: Functional organisation of the nervous system – Structure of nervous system, neurons - synapse –transmitters and neural communication – Cardiovascular system – respiratory system – Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers – Temperature measurements - Fibre optic temperature sensors.

MODULE II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 13

Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms. Electrical safety in medical environment: shock hazards – leakage current- Instruments for checking safety parameters of biomedical equipments.

MODULE III NON-ELECTRICAL PARAMETER MEASUREMENTS 12

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography,

Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements.

MODULE IV MEDICAL IMAGING 12

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems.

MODULE V ASSISTING AND THERAPEUTIC EQUIPMENTS 10

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

TOTAL : 60

REFERENCES:

1. R.S. Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.

2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', IInd edition, Pearson Education, 2002 / PHI.

OUTCOMES:

The course will help the student to acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance.

BTB4102 PROTEOMICS & GENOMICS

L	T	P	C
4	0	0	4

OBJECTIVES:

This course offers advanced level training on gene expression and gene therapy by covering topics such as genome mapping, proteomic techniques and new targets for drug discovery. To familiarize and expose the students to the Principle of gene expression, Concepts of functional genomics in biopharmaceutical industry, Application of gene therapy, Principles of proteomics and the role of models in genetic disorder.

MODULE I OUTLINE ABOUT GENOME 10

Genome organization (prokaryotes and Eukaryotes) – Physical mapping of genome - Whole genome sequencing - Various strategies of sequencing - Mass spectroscopy – Shotgun - Automation in sequencing finding genes and mutations - Genome sequence annotation.

MODULE II FUNCTIONAL GENOMICS 10

Construction and screening of cDNA libraries, PCR, yeast two hybrid systems - Serial analysis of gene expression (SAGE) – SAGE adaptation fro down sized extracts (SADE) – Pharmacogenomics.

MODULE III PROTEOME 10

Introduction - Methods exists to tackle the proteome complexity - Imaging mass spectroscopy - Protein chip array - Methods for protein interaction analysis - Multi dimensional chromatography.

MODULE IV PROTEIN STRUCTURAL GENOMICS 10

Determining gene function by sequence comparison – Determining gene function through conserved protein structure - Approaches to protein structural genomics.

MODULE V PROTEOMICS IN DRUG DEVELOPMENT 10

Role of Proteomics in Drug Development - Diagnosis of disease by Proteomics - Separation and identification techniques for protein analysis - Development of antibody based protein assay for diagnosis

MODULE VI ADVANCE TOPICS **10**

Proteomics in vaccine discovery from genome sequence to vaccine discovery, the case study, omics approaches of discovery

TOTAL: 60

REFERENCES:

1. Saccone, C., Pesole, G., Hand book of Comparative Genomics – Principles and Methodology, John Wiley and Sons Publication, New Jersey, 1st Edition, 2003.
2. Lesk, A.M., Introduction to Protein Science. Architecture, Function and Genomics, Oxford University press, New York, 2nd Edition, 2004.
3. Creighton, T.E., Protein Structure – A Practical Approach, Oxford University Press, New York, 4th Edition, 2004.
4. Brown, T.A., Genomes III, Garland Science, Taylore and Francis Group, New York, 3rd Edition, 2007.

OUTCOMES:

At the end of the course students will be able to

- Describe DNA sequencing technologies and recent advances for high throughput genomic sequencing.
- Compare and contrast different methods for functional genomic analysis.
- Provide examples of how genomics technologies have been applied to improve our understanding of biological systems.
- Compare and contrast classical approaches to understanding protein structure and function with recent proteomic approaches.
- Describe proteomic approaches and techniques used to investigate protein structure and function.
- Explain how specific proteomics techniques can contribute to understanding of biological systems.

BTB4103 FERMENTATION TECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

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

MODULE I PILOT PLANT FERMENTATION 10

Microbial fermentation, Mammalian cell culture system, Plant cell tissue and organ cultures.

MODULE II FERMENTATION DESIGN 11

Fermentation department, equipment and space requirements, the design of large fermenters (based on aeration), Statistical Methods for Fermentation Optimization.

MODULE III ENVIRONMENTAL CONCERNS ABOUT FERMENTATION 13

Environmental regulations and technology, laws and regulations, Technology (waste water), Waste water treatment strategy, Air (emissions of concerns), Selecting a Control Technology, Inorganics, and volatile Organic Compound Emission Control.

MODULE IV ANAEROBIC DIGESTERS 12

An overview of aerobic and anaerobic fermentation. Substrates, Products and Biogas, Operational Conditions, Types of anaerobic digesters.

MODULE V BIOREACTOR FOR PLANT CELL CULTURE 14

Biochemical Engineering of the Production of Plant – specific Secondary metabolites by Cell Suspension Cultures, Gas Concentration Effects on Secondary Metabolite Production by Plant Cell Cultures, Integrated Bioprocessing for Plant Cell Cultures and Large – Scale plant micro propagation.

TOTAL : 60

REFERENCES:

1. Fermentation and biochemical engineering handbook by Henry C. Ogal, 2nd edition, Noyes Publications.
2. Advances in Biochemical Engineering Biotechnology by T. Sceper and J.J Zhong; Springer Publication.
3. The Microbiology of anaerobic digesters by Michael H. Gerardi, A John Wiley & Sons, Inc., Publication, 2003.

OUTCOMES:

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

BTB4104 NANO-BIOTECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

The course aims at introducing the underlying principles and applications of the emerging field of nanotechnology and nanoscience intended for a multidisciplinary audience with a variety of backgrounds. Introduces tools and principles relevant at the nanoscale dimension and discusses current and future nanotechnology applications in engineering, materials, physics, chemistry, biology, electronics and energy.

MODULE I INTRODUCTION 10

Technological impact of nano-scale systems, Micro and nano-systems and technologies - Overview of nano-devices and techniques.

MODULE II NANOSCALE MATERIALS 10

Strategies for nano architecture (top down and bottom up approaches) - Fabrication technologies and characterizations – Selfassembly systems, some aspects of nanofluidics- Surfactants, polymers, emulsions and colloids.

MODULE III INORGANIC NANOSCALE SYSTEMS FOR BIOSYSTEMS 10

Nano-structured materials, fullerenes - Properties and characteristics, carbon nanotubes - Characteristics and applications quantum dots and wires, gold nanoparticles and nanopores.

MODULE IV APPLICATIONS OF NANO-MOLECULES IN BIOSYSTEMS 10

Molecules of life - Proteins, lipids, RNA and DNA – Nanoscale elements for delivery of materials into cells, peptides coupled nanoparticles - DNA based artificial nanostructure proteins as components in nanodevices.

MODULE V APPLICATION OF NANO-BIOTECHNOLOGY IN DRUG DELIVERY 10

Nanoscale devices for drug discovery Micelles for drug delivery protein targeting - Small molecule - Protein interactions, microarray and genome chips.

MODULE VI NANOTECHNOLOGY FOR CANCER DIAGNOSIS 10

Nanobiosensors and nanobiochips, Nanomedicines, Drug targeting, Nanotechnology for cancer diagnosis and treatment – tumour targeted drug delivery system –nanotechnology for imaging and detection .Nanotechnology for cell destruction

TOTAL : 60

REFERENCES:

1. Mick Wilson, Kamali Kannangra, Geoff Smith., Nanotechnology, Oversees Press India Private Ltd, New Delhi, 2nd Edition, 2005.
2. Jain, K.K., Nanobiomolecular Diagnostics: Current Techniques and Application, Taylor and Fransis Publishers, New York, 1st Edition, 2006.
3. Kimball Nill., Glossary of Biotech and Nanobioterms, CRC Publisher, California, 4th Edition, 2005.

OUTCOMES:

At the end of the course students will be able to

- Use knowledge of nano science and mathematics to: Follow protocols, Conduct science or engineering procedures, Fabricate products, Make conclusions about results, Troubleshoot, Discover
- Function effectively in a laboratory environment using complex instrumentation machinery and protocols
- Independently seek out innovations in the rapidly changing field of nano-technology
- Compile and analyze data and draw conclusions at the nano level.
- Design, implement and document experiments
- Collaborate and communicate effectively in a high tech environment

BTB4105 FERMENTATION LABORATORY L T P C
0 0 3 1

OBJECTIVES:

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

- Develop the skills of large scale production of secondary metabolites.
- Identify the growth factors
- Study the batch and continuous culture growth
- Evaluate the temperature effect on culture growth

LIST OF EXPERIMENTS:

1. Temperature effect on growth-estimation of energy of activation and Arrhenius constant for microorganisms. Batch, fed batch and continuous cultures a) Estimation of Monod parameters b) Pure and mixed cultures.
2. Production of secondary metabolite by plant cells in a photobioreactor. Production of secondary metabolites in synthetic and complex industrial media.
3. Production of wine by yeast.
4. Production of Aminoacid.
5. Screening of process variables single dimensional search, Plackett Burman design, design expert etc.
6. Study of rheology of fermentation broth and power determination.

REFERENCE:

Laboratory manual

OUTCOMES:

On the completion of the above objectives student will be able to perform production and analysis fermented products.

BTB4106 BIOMEDICAL INSTRUMENTATION LABORATORY **L T P C**
0 0 3 1

OBJECTIVES:

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

LIST OF EXPERIMENTS **30**

1. Blood pressure measurement
2. Determination of percentage Transmittance, Absorbance & Concentration of given solutions using Spectrophotometer
3. Demonstration of direct agglutination reactions
4. Estimation of Haemoglobin content by Sahli's method
5. Erythrocyte sedimentation rate – Wintrobe's method
6. Packed cell volume
7. ELISA
8. Blood group mapping
9. Slide and tube agglutination reaction
10. SDS-PAGE and Immunoblotting

REFERENCE:

1. Laboratory Manual

OUTCOME:

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

BTBX01 PHARMACEUTICAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to provide the students with the important principles and techniques that are used in the design and analysis of biopharmaceutical engineering processes.

MODULE I INTRODUCTION **7**

Development of drug and pharmaceutical industry – Therapeutic agents, their use and economics Regulatory aspects.

MODULE II DRUG METABOLISM AND PHARMACOKINETICS **7**

Drug metabolism - Physico chemical principles - Radio activity - Pharma kinetic action of drugs on human bodies.

MODULE III IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS **7**

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

MODULE IV MANUFACTURING PROCESSES **8**

Compressed tablets, wet granulation - Dry granulation or slugging -Direct compression - Tablet presses, coating of tablets, capsules, sustained action dosage forms -Parental solution - Oral liquids – Injections – Ointment - Topical applications – Preservation -Analytical methods and test for various drug and pharmaceuticals - Packing techniques -Standard of hygiene and GMP.

MODULE V PHARMACEUTICAL PRODUCT AND THEIR CONTROL **8**

Therapeutic categories - Vitamins, laxatives, analgesics, nonsteroidal contraceptives - External antiseptics - Antacids and others, antibiotics, biological hormones - Quality management and control.

MODULE VI DRUG MANUFACTURE AND MARKET SPECIFICATIONS **8**

Principles of monoclonal antibodies production, design and development of ELISA kit. Monoclonal antibodies in diseases detection and treatment. Role of PCR in microbial, plant and animal cell/ virus detection. Principles of drug

manufacture- solutions, suspensions and emulsions. Topical application of ointments, creams, suppositories. Solid dosage forms-powders, granules, capsules, coating of tablets, aerosols. Preservation, packing techniques. Indian pharmacopoeia, Guide to good manufacturing practice. Preclinical and clinical trials, Role of regulatory agencies.

TOTAL : 45

REFERENCES:

1. Leon Lachman., Theory and Practice of Industrial Pharmacy, Lea and Febiger, USA, 3rd Edition, 1986.
2. Remington., Pharmaceutical Science, Mark Publishing and Company, 2nd Edition, 1990.
3. Katzung, B.G., Basic and Clinical Pharmacology, Prentice Hall, New Delhi, 10th Edition, 2006.

OUTCOMES:

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

- describe the principles underlying the discovery, development and application of drugs of the future integrate the knowledge in explaining and evaluating the impact of biotechnology on modern medicine.
- discuss ideas and reach an agreement to the current and future prospect of pharmaceutical biotechnology and drug development in the global market

BTBX02 MEDICAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

The course aims to build on previous study and, through team-based research, student-led journal clubs and critical evaluation of scientific literature, challenge you to investigate new developments in selected, medical applications of biotechnology.

MODULE I SIMPLE PROTEINS AND THERAPEUTIC AGENTS 8

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins - Engineering human interferons and human growth hormones - Regulatory aspects of therapeutic proteins - Enzymes as therapeutic agents - Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis.

MODULE II MONOCLONAL ANTIBODY AS THERAPEUTIC AGENT 8

Production of monoclonal antibodies - Human monoclonal antibodies, its scope and limitations - Hybrid human – Mouse antibodies - Production of antibodies in E. coli -Approaches for producing HIV therapeutic agents.

MODULE III HUMAN DISEASES 8

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

MODULE IV VACCINES 7

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

MODULE V APPLICATION OF GENETIC ENGINEERING IN HEALTH CARE 7

Production of Recombinant Proteins having therapeutic and diagnostic applications, recombinant vaccine.

MODULE VI DIAGNOSIS AND KIT DEVELOPMENT 7

Use of enzymes in clinical diagnosis - Use of biosensors for rapid clinical analysis - Diagnostic kit development for microanalysis

TOTAL : 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

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

BTBX03 DRUG DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to provide the students with an understanding of all aspects of the drug design concepts: genomics, bioinformatics, drug target selection, structural biology, molecular modeling, intellectual property and marketing.

MODULE I DRUG DISCOVERY AND DEVELOPMENT 9

Organized drug discovery and development – Pharmacology -Microbial, recombinant - Biochemical and molecular level screeningsystems and their construction strategies - Alternative strategies inlead identification - Lead optimization.

MODULE II DRUG DESIGNING 9

Rational basis of drug designing, criteria for synthesizing drugs -Drug designing approaches - Pharmacophore based drug design -Lead and target tissues - Lead finding and lead optimization - Action and reaction, structure based drug design process of structure based design - Receptor based design - Drug designing using known receptor structure - Design of energy inhibitors.

MODULE III COMPUTATION FOR DRUG DESIGNING 9

Overview of computer based tools for drug designing - Ludi, Ludi/CAP, auto dock, GRAMM, CAMD tools - Scoring and Docking mode-QSAR principles and methods in drug designing -Current research in drug designing , a case study - Drug design by receptor site fit, active site simulations using PDB structure data and homology modeling - Concept of perturbation free energy and its practical applications - Rational design of enzyme inhibitors - Enzyme catalytic principles - Recapitulation affinity labels - Illustrative examples - Principle of suicide inactivation – Design strategies - Scope and limitations.

MODULE IV MIMICING IN DRUG DESIGNING 9

Principles and practice of transition state mimicry – Illustrative examples - ACE, renin and HIV protease inhibitors – Collected substrate analog inhibitors and design strategies, illustrative examples - Combinatorial approach to compound libraries

MODULE V CURRENT STATUS AND FUTURE PROSPECTS 9

Synthetic peptide libraries - Peptide libraries through phage display - Applications in epitope and agretope mapping, synthetic vaccine design - Artificial combinatorial - Peptides, bezodiazepines and other current examples - Selection strategies and screening methodologies - Perspectives in gene therapy

TOTAL : 45

REFERENCES:

1. Walsh, G., Biopharmaceuticals-Biochemistry and Biotechnology, Wiley, Singapore, 2nd Edition, 2003.
2. Perun, T. J. and Propst, C. L., Computer Aided Drug Design, Dekker, 1st Edition, 1989.
3. Scolnick, J., Drug Discovery and Design, Academic Press, London, 1st Edition, 2001.

OUTCOMES:

At the end of the course students will be able to

- Effectively and critically evaluate each stage of the drug development process and predict future bottlenecks
- Critically evaluate validation of drug targets
- Manage and develop complex work situations related to drug discovery and development
- Critically evaluate chemical process development projects
- Independently initiate and carry out discipline-specific and interdisciplinary collaboration related to drug development
- Initiate, plan, implement and assume professional responsibility for drug development projects from discovery to clinical trials and registration
- Organise the elements of a drug development programme
- Liaise and communicate professionally, using scientific terminology, with other specialist groups within the drug development industry
- Take independent responsibility for own professional development.

BTBX04 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
4	0	0	4

OBJECTIVES:

This course creates awareness on the Biosafety, bioethics, Intellectual property rights and patenting of biotechnological processes. It introduces the biosafety regulations and ethical concepts in biotechnology and emphasizes on IPR issues and need for knowledge in patents in biotechnology.

MODULE I WTO **9**

As an international agency controlling trade among nations. WTO with refernce to biotechnological affairs, TRIPs.

MODULE II GENERAL INTRODUCTION TO PATENT **9**

Patent claims, the legal decision – making process, ownership of tangible and intellectual property. Basic Requirements of Patentability, Patentable subject matter, novelty and the public domain, non obviousness.

Module III SPECIAL ISSUES IN BIOTECHNOLOGY PATENTS **9**

Disclosure requirements, Collaborative research, Competitive research, plant, Plant biotechnology Indian patents and Foreign patents, Plant variety protection act, The strategy of protecting plants.

MODULE IV PATENT LITIGATION **9**

Substatritive aspects of patent litigation, Procedural aspects of patent litigation, different Doctrines, Recent Developments in Patent System and Patentability of biotechnological inventions.

MODULE V IPR ISSUES IN INDIAN CONTEXT **9**

Role of patent in pharmaceutical industry, computer related innovations, Case studies Rice, Haldi, neem, etc. and challenges ahead

TOTAL : 45

REFERENCES:

1. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.

2. Intellecutla property rights – Ganguli – Tat McGrawhill

3. Intellectual property right – Wattal – Oxford Publishing House.

OUTCOMES:

At the end of the course students will be able to

- Communicate in depth knowledge on selected topics within the area of biotechnology
- Identify current technical problems within the area of biotechnology
- Describe the relationship between patenting and scientific discovery
- Describe the patenting process and how it relates to the international patent authorities and organizations.
- Understand patents as strategic tools in business development
- Understand how intellectual property rights relates to and handles genetic sequences and other biological material

BTBX05 RECOMBINANT DNA TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

The aim of the course is to enable students:

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

MODULE I TOOLS OF GENETIC ENGINEERING 7

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

MODULE II METHODS OF GENE TRANSFER 7

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

MODULE III ANALYSIS AND EXPRESSION OF CLONED GENE IN HOST CELLS 8

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

MODULE VI GENE LIBRARIES 8

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

MODULE V MODIFYING GENES 7

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

MODULE VI APPLICATION OF RDNA TECHNOLOGY 8

Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

TOTAL : 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

- Define recombinant DNA technology and explain how it is used to clone genes.
- Compare and contrast different types of vectors and describe practical features of vectors and their applications in molecular biology.
- Discuss how DNA libraries are created and screened to clone a gene of interest.
- Describe how agarose gel electrophoresis, restriction enzyme mapping, and DNA sequencing can be used to study gene structure.
- Explain common techniques used to study gene expression.
- Be familiar with RNA interference (RNAi) as a powerful new technique for silencing gene expression.
- Understand potential scientific and medical consequences of the Human Genome Project, and discuss its ethical, legal, and social issues.
- Define bioinformatics and explain why this new field is important.

BTBX06 BIOREACTOR DESIGN AND ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

The course imparts advanced knowledge on bioreactor design for efficient utilization of the principles in bioprocess technology. To familiarize the Basic concepts of bioreactor design , Bioreactor instrumentation and control, Methods and strategies for fermentation control, Modelling and simulation of fermentation processes and Plant and animal cell bioreactors.

MODULE I REACTION KINETICS **8**

Definitions of rate constant, reaction order - Elementary and nonelementary reactions - Mechanisms and kinetics - Reactions with constant volume and variable volume-Conversion yield - Kinetics of chemical reactions - Elementary and non - elementary reactions, nth order kinetics - Rate equations with multiple rate constants, shifting - Order kinetics, interpretation of batch reactor data for simple and complex reactions, dependence of reaction rate on environmental conditions – Arrheniu's equation.

MODULE II IDEAL REACTORS **7**

Introduction to ideal reactors - Performance equations for ideal reactors and non-isothermal reactors - Rate data analysis – Multiple reactors and multiple reactions -Polymerization reactions, enzymatic reactions, microbial growth and bioreactors.

MODULE III NON-IDEALITY IN REACTORS **7**

RTD studies - Dispersion effects, models for non-ideal reactors – Non isothermal reactors - External diffusion effects on heterogeneous reactions - Diffusion and reaction in porous catalysts.

MODULE IV BIOREACTOR **7**

Definition of bioreactor, basic principles of bioreactor – Interaction of heat and mass transfer in the microbial processes – Classification of bioreactors and their configurations - Analysis of batch, continuous, fed batch and semi-continuous bioreactors, non-ideal effects, mechanical design of bioreactors and its components

MODULE V BIOREACTOR SCALE – UP **8**

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors - Microbial oxygen demands, methods for the determination of mass transfer coefficients, mass transfer correlations - Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed.

MODULE VI SIMULATION AND OPTIMIZATION OF BIOPROCESSES **8**

Simulation techniques (Numerical Methods): Programs based on numerical methods like algebraic equations, Newton-Raphson method for algebraic convergence, interpolation, arbitrary function generation (FUN1, FUN2 subroutines). Programs based on solution of differential equations: Euler method for 1st and 2nd order integration, subroutines INT and INTI; Fourth order Runga –Kutta method: stability of numerical integration variable slip size method. Case studies, Numerical problems

TOTAL : 45

REFERENCES:

1. Levenspiel, O., Chemical Reaction Engineering, Wiley Easter Ltd, New York, 5th Edition, 1999
2. Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice Hall Pvt Ltd, 4th Edition, 2006
3. Smith, J.M., Van Ness, H.C., Abbott, M. M., Introduction to Chemical Engineering Thermodynamics , McGraw Hill, New York, 6th Edition, 2001

OUTCOMES:

At the end of the course students will be able to

- Design reactors with mass transfer between two ideally mixed fluid phases, for continuous, fed-batch, batch operation.
- Design reactors with mass transfer between an ideally mixed fluid phase and a fluid phase moving in ideal plugflow, for continuous, fed-batch, batch operation design reactors with mass transfer between two ideally mixed fluid phases and an ideal plugflow compartment with conversion, for continuous, fed-batch, batch operation.
- Design reactors with diffusion into cell aggregates surrounded by an ideally

mixed fluid phase which exchanges mass with a second ideally mixed fluid phase. The equation for the penetration depth of the rate-limiting reactant/ product is given; its derivation is not included. Continuous, fed-batch, and batch operation are included.

- Design reactors with diffusion into cell aggregates surrounded by one fluid phase moving in ideal plugflow. The equation for the penetration depth of the rate-limiting reactant/product is given; its derivation is not included. Only continuous, operation is included.
- Design photo-bioreactors with mass transfer between two ideally mixed fluid phases and an ideal plugflow compartment with conversion, only for continuous reactors in steady state.

BTBX07 MOLECULAR AND CELLULAR DIAGNOSTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to provide the students with an understanding on the principles and modern day applications of molecular diagnostics in a biotechnology based industry.

MODULE I GENERAL LABORATORY TECHNIQUES & PROCEDURE 8

Chemical & Related substrates, volumetric analysis, Balancing & Weighing, Concept of solute & solvent, Units of measurement, Specimen Collection & Processing: Specimen collection (Blood, urine, spinal fluid,saliva synovial fluid, Amniotic fluid), Preservation, transportation, Selection & Interpretation of Lab. Procedure: Classification of BIAS, Sensitivity and specificity, Receiver Operator Characteristics, Interpretation a test, Quality Management: Fundamentals of total quality management, Element of QAP,External quality assessment and proficiency testing programme.

MODULE II CLINICAL ENZYMOLOGY 7

Principle of diagnostic enzymology, Liver, cardiac and skeletal enzyme, Digestive enzyme, Miscellaneous enzyme, General Function Tests: Liver function test, Cardiac Function Test, Renal Function Test, Thyroid Function test, Reproductive endocrine function test.

MODULE III IMMUNODIAGNOSTICS 7

Introduction, Antigen-Antibody Reactions, Conjugation Techniques, Antibody Production, Enzymes and Signal Amplification Systems, Separation and Solid-Phase Systems, Case studies related to bacterial, viral and parasitic infections.

MODULE IV PRODUCT DEVELOPMENT 7

Immunoassay Classification and Commercial Technologies, Assay Development, Evaluation, and Validation, Reagent Formulations and Shelf Life Evaluation, Data Analysis, Documentation, Registration, and Diagnostics Start-Ups.

MODULE V DNA BASED DIAGNOSTICS 8

PCR, RFLP, SSCP, Microarrays, FISH, In-situ hybridization, Case studies

related to bacterial, viral and parasitic infections, Cell based diagnostics: Antibody markers, CD Markers, FACS, HLA typing, Bioassays.

MODULE VI BIOSENSORS **8**

Concepts and applications, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, Introduction to Nanotechnology.

TOTAL : 45

REFERENCES:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, HarcourtBrace & Company Aisa Pvt. Ltd.
2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
3. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld. Diagnostic Microbiology, Balley & Scott's.
4. Tietz Text book of Clinical Biochemistry, Burtis & Ashwood.
5. The Science of Laboratory Diagnosis, Crocker Burnett.

OUTCOMES:

At the end of the course students will be able to

- List the key historical developments in the field of molecular diagnostics
- Identify the role and importance of molecular diagnostics such as real-time PCR, epidemiological genotyping, microfluidics, bio-imaging and sequencing technologies
- Assess the benefit of research and development practices within a biotechnology company
- Incorporate both in silico and lab based techniques as part of a combined molecular diagnostics strategy.
- Perform selected laboratory techniques, interpret results and prepare reports.

BTBX08 BIOMEDICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims to provide education that prepares students to lead, innovate, and self-educate throughout their careers in bioengineering and biomedical professions and industries.

MODULE I INTRODUCTION **8**

Introduction to cell structure and components, protein structure, cell membranes, chromosomes, cytoskeleton, actin filaments, microtubules, cell signaling and ECM, biomembrane and action potentials - Transducers and electrodes, types of transducers and their selection for biomedical applications - Biosensors based on electrochemical transducers.

MODULE II MOLECULAR BASIS OF METABOLIC DISORDERS **7**

Biochemistry and molecular basis of different disorders related to carbohydrate, protein fat and nucleic acids, In-born errors of metabolism, Clinical manifestations and their precautions by nutritional management.

MODULE III CARDIAC SYSTEMS AND ITS FUNCTION **8**

Cardiovascular systems, the heart and other cardiac systems, circulation and blood flow, blood pressure, cardiac output, cardiac rate, cardiac shock and response to exercise, magnet cardiography, cardiac pacemaker, computer applications - Measurement of electrical activities in muscles and brain - Electromyography, electro encephalographs and their interpretation.

MODULE IV BIOSYSTEM MODELING **7**

Electrical impedance encephalography, biotelemetry, Biosignal analyzer, biosystem modeling.

MODULE V BIOMEDICAL TESTS **8**

Biomedical tests - measurement of sugar, pH, sodium potassium ions, haemoglobin, oxygen and carbondioxide concentration in blood, medical imaging, ultrasound imaging, radiography, biophysics of signal transmission and reception of biological signals, telemedicine.

MODULE VI ULTRASOUND IN DIAGNOSIS **7**

Ultrasound in diagnosis, limb prosthetics and Orthotics, sensory aids for the blinds, assisting the heart and kidney, ECG, EEB, physiological equipments

TOTAL : 45

REFERENCES:

1. Atilla Hincal, A., Suheylakas, H., Biomedical Science and Technology, Plenum Press, New York, 1st Edition, 2001.
2. Khandpur, R.S., Handbook of biomedical Instrumentation, McGraw Hill, USA, 1st Edition, 2004
3. Manz and Becker., Microsystem technology in Chemistry and Life Sciences, Springer Verlag, London, 1st Edition, 1999.

OUTCOMES:

At the end of the course students

- Will have in-depth knowledge of the analysis techniques applied to complex biological systems, assessing the most appropriate mathematical and simulation tools and suitable data and signal processing techniques.
- Will know the techniques and instruments used to design conventional and innovativebiomedical equipment, image processing techniques, advanced methods for the design and use of prostheses.
- Will be able to interact with doctors and biologists to analyse complex problems,recommend the correct management of equipment, and provide advice on the innovative use of diagnostic systems and equipment.
- Will be able to participate autonomously in biomedical experimentation, research and development activities.
- Will be able to skilfully participate in the sale of biomedical equipment together with sales staff, suggesting improvements and adaptations, taking autonomous initiatives and competently interpreting the needs of the purchaser in order to transform them into appropriate design specifications.

BTBX09 BIOSAFETY AND BIOETHICS L T P C
3 0 0 3

OBJECTIVES:

The aim of this course is to teach biosafety issues, biosafety and biotechnological applications, biosafety in laboratory, waste management, registration, national and international regulations, bio-ethical issues in medicine, environment and genetics, related regulations and laws.

MODULE I BIOTECHNOLOGY AND SOCIETY 7

Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.

MODULE II BIOETHICS 8

Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc, Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and their global biotech issues.

MODULE III BIOSAFETY CONCEPTS AND ISSUES 7

Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world.

MODULE IV BIOSAFETY IN THE LABORATORY INSTITUTION 8

Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution, Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad

MODULE V BIOTECHNOLOGY AND FOOD SAFETY 7

The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.

MODULE VI ECOLOGICAL SAFETY ASSESSMENT 8

Recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton), Biosafety assessment of biotech pharmaceutical products such as drugs/vaccinesetc, International dimensions in biosafety: Catagena protocol on biosafety, bioterrorism and convention on biological weapons

TOTAL : 45

REFERENCES:

1. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
2. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed). ASM Press, Washington.
3. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.
4. Encyclopedia of Bioethics

OUTCOMES:

At the end of the course students will be able to

- Explain the international and national controls with regards to biosafety, biosecurity and bioethics applicable to facilities and associated scientists handling pathogens.
- Apply a framework for risk assessment to biosafety, biosecurity and dual-use risks and hazards associated with pathogens.
- Analyse the ethical and social responsibilities of life scientists with reference to the responsible conduct of research and other work
- Integrate dual-use biosecurity, biosafety and bioethical issues and concerns into their program.
- Contribute to the development and implementation of relevant country-specific and institutional mechanisms, guidelines, regulations and legislation.

- Explain the key components of administrative controls that a facility has to put in place to mitigate biosafety and biosecurity risks.
- Develop a strategy for the implementation of a biosafety management program in a facility handling pathogens
- Organize and synthesize ideas and questions on dual-use bio-security, biosafety and bioethics relevant to the conduct of research and other work with pathogens.

BTBX10 HEALTHCARE BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To introduce the underlying principles and applications in the emerging field of Health care biotechnology
- To analyze the key concepts used in the debate about health and its issues.
- To list the properties that defines a therapeutic agent and human diseases.
- To list the common and extrapolated potential clinical uses and applications of various modules of health care.

MODULE I SIMPLE PROTEINS AND THERAPEUTIC AGENTS 8

Proteins as therapeutic agents - Choice of expression systems and optimizing gene expression - Applications, delivery and targeting of therapeutic proteins - Engineering human interferons and human growth hormones - Regulatory aspects of therapeutic proteins - Enzymes as therapeutic agents - Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis.

MODULE II MONOCLONAL ANTIBODIES AS THERAPEUTIC AGENTS 8

Production of monoclonal antibodies - Human monoclonal antibodies, its scope and limitations - Hybrid human – Mouse antibodies - Production of antibodies in E. coli -Approaches for producing HIV therapeutic agents.

MODULE III HUMAN DISEASES 8

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

MODULE IV VACCINES 7

Bacterial polysaccharides, proteins and toxins as vaccines -Recombinant vaccines- subunit, attenuated and vector vaccines -Multivalent vaccine

development against AIDS - Commercial and regulatory aspects of vaccine production and its distribution.

MODULE V ENDOCRINE DISORDERS 7

Disorders of pituitary, adrenal, pancreas, gonads, thyroid and their metabolic effects. Possible and respective clinical manifestations.

MODULE VI APPLICATION OF GENETIC ENGINEERING IN HEALTH CARE 7

Production of Recombinant Proteins having therapeutic and diagnostic applications, recombinant vaccine

TOTAL : 45

REFERENCES:

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

OUTCOMES:

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

- Search and read current health care literature and apply to a particular problem
- Classify various diseases and treatment strategies.
- Outline how therapeutic agents are currently being used in the clinic and what kinds of future treatments lie on the horizon.
- To demonstrate an interdisciplinary understanding of central concepts in tissue engineering, biomaterials and health care, and critically evaluate different methods and techniques used.

BTBX11 MOLECULAR PHARMING L T P C
3 0 0 3

OBJECTIVES:

- To introduce molecular pharming.
- To create complete knowledge about the recombinant protein production.
- To create awareness about the production of pharmaceutical proteins in plants.

MODULE I INTRODUCTION AND FOREIGN PROTEIN EXPRESSION 9

Introduction, foreign protein production systems- plant tissue culture, suspended cultures, hairy root cultures, shoot teratoma cultures. Strategies for improving FP production in tissue culture, expression systems, modifications to existing expression constructs, secretion of foreign proteins, foreign protein stability, stability inside the cells.

MODULE II NOVEL SPROUTING TECHNOLOGY FOR RECOMBINANT PROTEIN PRODUCTION 9

Biology of sprouting, dicotyledonous seeds, germination, sprout, rubisco synthesis, rubisco promoters, inhibition of endogenous gene expression, expression cassette design, sprouting- equipments, conditions, sterilization, time and temperature, light, inhibition of endogenous gene expression, growth regulators, nitrogen fertilizer, seed production, quality and environmental aspects.

MODULE III MONOCOT AND PLANT VIRAL EXPRESSION SYSTEMS 10

Cereal production crops, Technical aspects, cereal transformation, expression construct design, Prodigene and Maize. Recombinant proteins expressed in Rice, Wheat, Barley. Plant RNA viruses as expression vectors- TMV, PVX, CPMV, AIMV. Biological activity of target molecules, efficacy of plant virus antigens, vaccine antigens- particle based.

MODULE IV CHLOROPLAST DERIVED ANTIBODIES, BIOPHARMACEUTICALS AND EDIBLE VACCINES 10

Introduction, expression of therapeutic and human proteins in plants, transgenic chloroplast system, chloroplast derived human antibodies, biopharmaceuticals, Human Serum Albumin, Human insulin like growth factor-1, Human interferon,

Antimicrobial peptides, chloroplast derived vaccine antigens, cholera toxin B subunit, Bacillus anthracis protective antigen, Yersinia pestis F1-V fusion antigen, Canine Parvovirus VP2 protein.

MODULE V DOWNSTREAM PROCESSING OF PLANT DERIVED RECOMBINANT THERAPEUTIC PROTEINS 7

Similarities and differences in the processing of pharmaceutical proteins from different sources, process scale, individual steps of a Downstream process, Initial processing and extraction, chromatographic purification, regulatory requirements for downstream processing of plant derived products.

TOTAL : 45

REFERENCE:

1. Molecular Farming – Plant-made Pharmaceuticals and Technical Proteins, Rainer Fischer and Stefan Schillberg. Wiley.VCH Verlag GmbH and Co. KGaA. 2004.

OUTCOME:

The student will be aware about the basics of molecular farming

BTBX12 STEM CELLS IN HEALTHCARE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the underlying principles and applications in the emerging field of Stem Cell Technology
- To analyze the key concepts used in the debate about stem cell research
- To list the properties that define a stem cell and explain hoe stem cells are derived for scientific research
- To list the common and extrapolated potential clinical uses of stem cells

MODULE I INTRODUCTION **7**

Stem Cell Biology, Fate Mapping of Stem Cell, Stem Cell Pattern, differentiated parental DNA chain causes stem cell pattern of cell type switching in Schizosaccharomyces pombe.

MODULE II CELL CYCLE CONTROL **7**

Checkpoints, and Stem Cell Biology, Senescence of Dividing Somatic Cells, The Drosophila Ovary, An In Vivo Stem Cell System, Male Germ-line Stem Cells.

MODULE III PRIMORDIAL GERM CELLS **8**

Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Embryonal Carcinoma Cells as Embryonic Stem Cells, Trophoblast Stem Cells.

MODULE IV HEMATOPOIETIC STEM CELLS **8**

Repopulating Patterns of Primitive Hematopoietic Stem Cells,Molecular Diversification and Developmental Interrelationships, Hematopoietic Stem Cells:Lymphopoiesis and the Problem of Commitment Versus Plasticity, Hemangioblast, Mesenchymal Stem Cells of Human Adult Bone Marrow.

MODULE V TYPES OF STEM CELLS **7**

Stem Cells and Neurogenesis, Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

MODULE VI APPLICATIONS OF STEM CELLS 8

Cell based therapy, organ factories, drug discovery and development, understanding developmental biology, Medical applications in Leukemia, Immune deficiencies, diabetes, liver diseases, cardiovascular diseases, Neurological disorders

TOTAL : 45

REFERENCES:

1. Developmental Biology, 6th Edition, Scott F. Gilbert
2. Hematology, William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. Lichtman
3. Molecular Biology of the Cell, 3rd Edition, Bruce Alberts, Dennis Bray, Julian Lewis,
4. Martin Raff, Keith Roberts, James D. Watson
5. Stem Cell Biology by Marshak, 2001, Cold Spring Harbar Symposium Pulblication.

OUTCOMES:

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

- Search and read current stem cell technology literature applied to a particular problem domain (To treat Parkinsons Disease etc.)
- Classify tumor stem cells which give rise to metastases and treatment-resistant remnant cells that cause relapse, and how this impacts on the development of future cancer treatment strategies.
- Outline how stem cells are currently being used in the clinic and what kinds of future treatments lie on the horizon. Students will also be exposed to current Norwegian projects lying at the frontier of stem cell research.
- To demonstrate an interdisciplinary understanding of central concepts in tissue engineering, biomaterials and stem cell science, and critically evaluate different methods and techniques used.

BTBX13 TRANSPORT PHENOMENA IN BIOPROCESS

L	T	P	C
4	0	0	4

OBJECTIVES:

The course aims to provide the students with an introduction to the multidisciplinary nature of biotechnology and how bioprocesses are planned, organised and how they develop from basic cell structure and function through bioreactor to DSP.

MODULE I BIOREACTORS **7**

Introduction to bioreactor systems - Principles and practices of fermentation - Fermentation organisms - Basic bioreactor design

MODULE II FLUID RHEOLOGY **7**

Rheology - Review of fluid rheology - Experimental viscometry of biofluids- Effects of cell morphology on broth rheology

MODULE III BUBBLES AND DROPS **7**

Bubbles and drops - Bubble formation, break-up and coalescence - Bubble rise velocities - Interfacial area and hold-up in agitated and non-agitated systems - Behaviour of bubbles in beverages – Drop dispersion

MODULE IV SCALE UP OF BIOREACTORS **9**

Aeration and Agitation - Achieving mixing and mass transfer in bioreactors - Specification of equipment - Flow regimes – Power requirements - Oxygen mass transfer in bioreactors – Microbial oxygen demands - Methods for the determination of mass transfer coefficients - Mass transfer correlations - Scale-up of stirred tank bioreactors - Principle of similarity - Criteria for scale-up in biological systems

MODULE V HEAT TRANSFER **7**

Heat generation and heat transfer in bioreactors - Sources of heat generation - Heat removal - Specification of heating and cooling systems - Heat transfer coefficients in agitated systems.

MODULE VI PROCESS DESIGN **8**

Process design of distillation columns, extraction equipments and tray dryers.

Mechanical design of pressure vessels under internal pressure, Mechanical design of stirred batch fermenter.

TOTAL : 45

REFERENCES:

1. Van Den Akker, H.E.A., Heijnen, J.J.C., Leach, K., Mudde, R.F., Bioprocess Technology, Modelling and Transport Phenomena (Biotol Series), 1st Edition, 1990

2. Byron, R.Bird., Warren, E. Stewart., and Edwin, N. Lightfoot., Transport Phenomena, John Wiley and Sons, New York, 1st Edition, 2000

3. Sissom, L.E. and Pitts, D.R., Elements of Transport Phenomena, McGraw Hill, New York, 2nd Edition, 1972

4. Brodkey, R.S. and Hershey, H.C., Transport Phenomena – A Moduleed Approach, McGraw Hill, New York, 1st Edition, 1987

OUTCOMES:

At the end of the course students will be able to

- Have the information about recognition and modelling of bioprocesses.
- Identify problems faced with bioprocess applications, have the knowledge and ability of analyzing and solving those problems.
- Gain knowledge about management of bioprocess waste.
- Able to design of a bioprocess.
- Develop the ability of written and oral communication, preparing technical design report.

GEBX22 NATIONAL SERVICE SCHEME L T P C
(Paper: 01 - As per Ministry of Youth Affairs and Sports) 0 0 3 1

OBJECTIVES:

- understand the community in which they work
- understand themselves in relation to their community
- identify the needs and problems of the community and involve them in problem-solving
- develop among themselves a sense of social and civic responsibility
- utilise their knowledge in finding practical solutions to individual and community problems
- develop competence required for group-living and sharing of responsibilities
- gain skills in mobilising community participation
- acquire leadership qualities and democratic attitudes
- develop capacity to meet emergencies and natural disasters and
- practise national integration and social harmony

MODULE I INTRODUCTION AND BASIC CONCEPTS OF NSS 4

History, philosophy, aims & objectives of NSS – Emblem, flag, motto, song, badge, etc. – Organizational structure, roles and responsibilities of various NSS functionaries.

MODULE II NSS PROGRAMMES AND ACTIVITIES 10

Concept of regular activities, special camping, Day Camps – Basis of adoption of village/slums, Methodology of conducting Survey – Financial pattern of the scheme – Other youth programme/schemes of GOI – Coordination with different agencies – Maintenance of the Diary.

MODULE III UNDERSTANDING YOUTH 5

Definition, profile of youth, categories of youth – Issues, challenges and opportunities for youth – Youth as an agent of social change.

MODULE IV COMMUNITY MOBILISATION **9**

Mapping of community stakeholders – Designing the message in the context of the problem and the culture of the community – Identifying methods of mobilisation – Youth-adult partnership.

MODULE V VOLUNTEERISM AND SHRAMDAN **7**

Indian Tradition of volunteerism – Needs and importance of volunteerism – Motivation and Constraints of Volunteerism – Shramdan as a part of volunteerism.

Total Hours: 35