

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 CANCER BIOTECHNOLOGY**

PROGRAMME EDUCATIONAL OBJECTIVES

- This course will facilitate the graduates to be professionally competent in Cancer Biotechnology and the industries associated with it.
- This course will offer students with a solid foundation in cancer biology and genetic engineering, to enable them to work on engineering applications in cancer biotechnology as per the requirement of the industries and the clinical researchers, 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 apply those basic knowledge in various fields of cancer research and development.
- This course will facilitate the students to acquire knowledge in fields such as applications of genetic engineering, protein engineering, and drug targeting and development in cancer research.
- This course will aid the students to learn the recent developments in the field of cancer research, anticancer therapeutics and drug designing.
- This programme will teach students the advanced knowledge of cancer diagnosis and prognosis.

PROGRAMME OUTCOMES

On completion of the programme the graduates will

- Graduates of the course should be able to understand the various applications of biotechnology in cancer research.
- Graduates will identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using principles of cell biology, microbiology, molecular biology and biochemistry.

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- Graduates will demonstrate knowledge and understand the significances of tumor microenvironment in cancer research.
- Graduates of the course should be able to describe the recent developments in cancer research.
- 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 should be able to apply proteomics, metabolomics and genomics in cancer research and development.
- Graduates of the course should be able to design effective safety assessment strategy for designing and developing treatment modalities through the application of genetic engineering.

**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.

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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,

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- 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

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- 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 than 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 C_i is the number of credits assigned for the i^{th} course and GPI is the Grade Point in the i^{th} course

$$GPA = \frac{\sum_{i=1}^n (C_i)(GPI)}{\sum_{i=1}^n C_i} \quad \text{Where } n = \text{number of courses}$$

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 and 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 (CANCER BIOTECHNOLOGY)
REGULATIONS 2013
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 and 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

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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.	CBB3101	Clinical Biochemistry	4	0	0	4
2.	CBB3102	Tumor Microenvironment	3	0	0	3
3.	CBB3103	Clinical Pathology	4	0	0	4
4.	CBB3104	Cancer Biology and Genetics	3	0	0	4
5.	CBB3105	Drug discovery and Applications in Cancer Research	3	0	0	3
6.	CBB3106	Traditional cancer therapies	3	0	0	4
7.	CBB3107	Clinical Biochemistry Lab	0	0	3	1
8.	CBB3108	Clinical Pathology Lab	0	0	3	1
9.	CBB3109	Cancer therapies – Lab	0	0	3	1
Total Credits						25

SEMESTER VI

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CBB3211	Stress Responses and Metabolism in Cancer	4	0	0	4
2.	CBB3212	Genome Sciences and Genomic Medicine	4	0	0	4
3.	CBB3213	Molecular Basis of Gene Therapy	4	0	0	4
4.		Group I (Elective)	3	0	0	3
5.		Group II (Elective)	3	0	0	3
6.	CBB3214	Apoptosis and Cancer	3	0	0	3
7.	CBB3215	Cancer Diagnostic lab	0	0	3	1
8.	GE202	Confidence Building and Behavioural Skills	0	0	2	1
Total Credits						23

SEMESTER VII

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CBB4101	New Technologies in Cancer Prevention, Assessing risk, diagnostics and Treatment	3	0	0	3
2.	CBB4102	Cancer Treatment-targeted therapy	3	0	0	3
3.	CBB4103	Cancer Immunology	3	0	0	3
4.	CBB4104	Cancer Epidemiology And Etiology	3	0	0	3
5.		Group I (Elective)	3	0	0	3
6.		Group II (Elective)	3	0	0	3
7.	CBB4105	Project Phase 1	0	0	12	6
						Credits 24

SEMESTER VIII

Sl. No.	Course Code	Course Title	L	T	P	C
1.		Group 3 (Elective)	3	0	0	3
2.	CBB4211	Project work/Viva-voce	0	0	18	9
						Total Credits 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.	CBBX01	Epigenetics	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.	BTBX10	Healthcare Biotechnology	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.	CBBX02	Stem Cell and Regenerative Medicine	3	0	0	3

Group 3 (Elective)

(One to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CBBX03	Cytogenetics	3	0	0	3
2.	BTBX04	Intellectual Property Rights In Biotechnology	3	0	0	3

GENERAL ELECTIVES

1.	GEBX22	National Service Scheme	0	0	3	1
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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 at 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 $\sin^n \phi$ and \cos^n in powers of \sin and \cos – Expansions of \sin^n and \cos^n in terms 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 THEORY 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.

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 – CO2 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 ULTRASONICS 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.
7. Arumugam M., "Engineering Physics", 5th Edition, Anuradha Agencies, 2003.

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-destructive testing using Ultrasonic Techniques

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 Culture Techniques, 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 edn; McGraw Hill, (2010).
3. Samuelson, Paul A., 'Macroeconomics', 19TH edn., TMH, (2009).
4. Gupta G.S, 'Macroeconomics: Theory and Applications', 3rd edn; 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.

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.

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

TOTAL : 30

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 – Carrier-mediated and active transport – Ion-selective channels – Transmembrane 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 flow within living cells, and an appreciation of how these underpin all biological processes, in both normal and diseased states
- demonstrate knowledge of key facets of modern biochemistry including: proteins and structural biology, bioinformatics, advanced molecular biology, cell organisation, signal transduction and its role in diseases such as cancer; and the identification of drug targets

B.Tech. Cancer Biotechnology

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

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 characteristics, 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

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, Adelberg 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 biological/technical 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 nature and scope of the scientific literature in microbiology and related areas
- communicate microbiological principles and information effectively to diverse audiences, using a variety of formats

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 – cyclohexane - reactants- mechanisms of sn_1 sn_2 reactions, e_1 e_2 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 Michaelis - 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 ci_2 – 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

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 Refractometry: 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 within the framework which includes : designing the experiment; making basic order of-magnitude estimates; working with standard data-measuring devices 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.

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.

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 Precision 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

REFERENCE:

Laboratory Manual

OUTCOMES:

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

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. Isolation of microtubules
4. Isolation of actin and Myosin filaments
5. Isolation of Mitochondria
6. Nuclear staining

REFERENCE:

Laboratory Manual

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

B.Tech. Cancer Biotechnology

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

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 : 30

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. 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 uhlung (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.

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.

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 2³² types, Confounding in factorial experiments (mathematical derivations not required); Analysis of variance (ANOVA) and its use in the analysis of RBD.

TOTAL : 60

REFERENCES:

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 confidence 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 operon, regulation in Eukaryotes; Molecular mechanism of antisense molecules, inhibition of splicing, 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. Sinauer associates, USA 2000.
3. Lewin B. Gene VIII. Prentice Hall, USA 2003.
4. Jeremy M Berg, John L Tymoczko, and Lubert Stryer. 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 Ed., Human Press, 1999.
3. Murphy D. B. Fundamental of Light Microscopy & Electron Imaging. 1st Ed., 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.

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

OBJECTIVES:

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

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 Cloning- A laboratory manual. Cold spring harbor laboratory press, 2012.

OUTCOME:

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

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 K_m , V_{max} and K_{cat} , K_{cat}/K_m
6. Restriction enzyme – Enrichment and Module calculation Ion-exchange Chromatography – Purification of IgG and Albumin
7. Gel filtration – Size based separation of proteins
8. Affinity chromatography – IMAC purification of His-tagged recombinant protein
9. Assessing purity by SDS-PAGE Gel Electrophoresis
10. 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

B.Tech. Cancer Biotechnology

Biochemistry, 2nd Edition, Irwin H. Segel, 1976 John Wiley & Sons Publishers, Inc,

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

OUTCOMES:

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

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 and 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

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 Riol- 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

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 involved in 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, Herpes 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 biomolecular 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 and etiopathogenesis of infective and parasitic animal diseases, as well as for the production of biotechnological vaccines for veterinary use;

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 Totipotency: 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 of androgenic 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,

practical 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
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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 and animal 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.

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.

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:

1. 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

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
- Electrochoresis Techniques

LIST OF EXPERIMENTS:

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

REFERENCE:

Laboratory manual

OUTCOMES:

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

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

OUTCOMES:

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

SEMESTER-V

CBB3101

CLINICAL BIOCHEMISTRY

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OBJECTIVES:

- Overview of various disorder due to defect in the metabolism of biomolecules.
- To know about Electrolytes and acid base balance
- To learn in detail about hormonal disbalance.

MODULE I DISORDERS OF CARBOHYDRATE AND LIPID METABOLISM

10

Disorders of carbohydrate metabolism: Diabetes mellitus, glycohemoglobins, hypo glycemias, galactosemia and ketone bodies. Various types of glucose tolerance tests. Glycogen storage diseases. Physiology of lipids/lipoproteins. Lipidosis. Clinical inter-relationships of lipids (sphingolipidosis and multiple sclerosis), lipoproteins and apolipoproteins. Diagnostic tests for HDL-cholesterol, LDL-cholesterol and triglyceride disorders. Inborn errors of metabolism.

MODULE II DISORDERS OF AMINO ACID AND LIPID METABOLISM

10

Phenylalanemia, homocystinuria, tyrosinemia, phenylketonuria, alkaptonuria, albinism and animoacidurias. Disorders of nucleic acid metabolism- Disorders in purine/ pyrimidine metabolism.

MODULE III ELECTROLYTES AND ACID-BASE BALANCE AND DIGESTIVE ENZYME

10

Regulation of electrolyte content of body fluids and maintenance of pH, reabsorption of electrolytes Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.

MODULE IV HORMONAL DISTURBANCES

10

Protein hormones (anterior pituitary hormones, posterior pituitary hormones), steroid hormones, adrenocorticosteroids, and reproductive endocrinology.

Disturbances in thyroid function. Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia and hyperphosphataemia.

MODULE V BLOOD CLOTTING

10

Disturbances in blood clotting mechanisms – haemorrhagic disorders – haemophilia, von Willebrand's disease, purpura, Rendu-Osler-Werber disease, thrombotic thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants.

MODULE VI BIOCHEMICAL ASPECTS OF HEMATOLOGY

10

Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias thrombosis and anemias. Laboratory tests to measure coagulation and thrombolysis. Detoxification in the body: enzymes of detoxification, polymorphism in drug metabolizing enzymes. Mechanism of drug action and channels of its excretion, Disorders of vitamins and trace elements.

TOTAL : 60

REFERENCES :

1. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.
2. Lehninger Principles of Biochemistry 5th Edition By David L. Nelson and Michael M. Cox, WH Freeman and Company.
3. Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Edition By LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone.
4. Medical Biochemistry (Paperback) By John W. Baynes and Marek Dominiczak. Publisher: Mosby.
5. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed By Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.
6. Review of Medical Physiology (Lange Basic Science) (Paperback) By William F. Ganong. Publisher: McGraw-Hill Medical

B.Tech. Cancer Biotechnology

7. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
8. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd.
9. Principles of Medical Biochemistry: With STUDENT CONSULT Online Access (Paperback) By Gerhard Meisenberg and William H. Simmons. Publisher:

OUTCOME:

- Student will be able to undersatnd various disorder due to defect in the metabolism of biomolecules.
- They will learn about Electrolytes and acid base balance
- Learn and understand in detail about various hormonal disbalance.

OBJECTIVES:

- To identify the distinct cellular and molecular components of the tumor microenvironment
- To understand the complexity of biological mechanisms that affect tumor progression
- To get an idea about the potential therapeutic targets within the tumor microenvironment to promote tumor regression

MODULE I INTRODUCTION TO THE TUMOR MICROENVIRONMENT 9

Tumor as a heterogeneous organ, components of tumor microenvironment, stromal cells, Components of tumor stroma, basement membrane, fibroblasts, extracellular matrix, immune cells, and vasculature; extracellular matrix, matrix proteins, normal and cancer associated fibroblasts.

MODULE II SIGNALING PATHWAYS IN STROMA AND CANCERS 9

Cancer cell-derived profibrotic growth factors, role of TGF- β in cancer progression, receptor tyrosine kinase (RTK)-mediated growth factor signaling, steroid hormone signaling- role of estrogen in breast cancer progression, non-steroid hormone signaling- insulin, IGF; Epithelial-to-mesenchymal transition (EMT), regulation of EMT, PTEN signaling, Notch signaling, Hedghog signaling, Wnt signaling in regulating tumor microenvironment

MODULE III CELLS OF IMMUNE SYSTEM IN THE MICROENVIRONMENT 9

Immunity in cancer growth and progression, Innate and adaptive immune response to cancer cells, importance of T cells, T regs, T subcells in tumor microenvironment, CD8+ effector T cells; Interferons; tumor associated macrophages, macrophage polarity, macrophage directed therapies; Protective Tumor immunity, Fc receptors in anti-tumor immunity, role of CD4+, CD8+, and NK cells.

MODULE IV ANGIOGENESIS IN TUMOR MICROENVIRONMENT 9

Pro-angiogenic factors, vascular endothelial growth factor, role in promoting malignant angiogenesis, basic fibroblast growth factor (bFGF), matrix

metalloproteinases (MMP), platelet derived growth factor (PDGF), placenta growth factor (PIGF), angiopoietin-1 (Ang-1), angiopoietin-2 (Ang-2) and hepatocyte growth factor; anti-angiogenic growth factors- endostatin, angiostatin, thrombospondin-1 (Tsp-1), tumstatin, platelet factor 4, and interleukins;

MODULE V TUMOR METABOLISM AND MICROENVIRONMENT 9

Metabolic remodeling in tumor microenvironment, role of oxidative stress and redox signaling in microenvironment; aerobic and anaerobic metabolism and extracellular acidosis, pyruvate kinase M2, lactate signaling, role of hypoxia and hypoxia inducible factor- 1a (HIF-1a) regulation of metabolism, von Hippel-Lindan tumor suppressor (pVHL) signaling; reverse Warburg hypothesis, role of caveolin-1; evaluation of tumor microenvironment

TOTAL : 45

REFERENCES:

1. Dietmar W. Siemann. Tumor Microenvironment. John Wiley & Sons Ltd., 2011.
2. Constantinos Koumenisr, Ester Hammond, Amato Giaccia. Tumor Microenvironment and Cellular Stress: Signaling, Metabolism, Imaging, and Therapeutic Targets (Advances in Experimental Medicine and Biology). Springer, 2013.

OUTCOMES:

Upon successful completion of this unit, the student will be able to:

- Understand the importance of tumor microenvironment in carcinogenesis
- Identify the basic causes of cancer
- Learn the recent advances in cancer therapy targeting tumor microenvironment.

CBB3103	CLINICAL PATHOLOGY	L T P C
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OBJECTIVES:

- To understand basic histology and cytology.
- To learn different method involved in the processing of tissue
- To understand the principle of various test at pathology lab

MODULE I INTRODUCTION TO HISTOLOGY 10

Cell, Organelles, nucleus, cell division, tissues, fresh & fixed tissues. Different types of Embedding Viz. Wax, Resin, Cryostat, receiving of specimens The use of Microscope, screening techniques.

MODULE II BASIC CYTOLOGY 13

Fixation of tissue, different kind of fixatives, sample fixative, compound fixative, formaldehyde, mercuric chloride, osmium, Picric acid, alcohols, other acids, formaline, buffered formaline, osmic acid, zenleer soln, hely's soln, cytological fixatives, nuclear fixatives, fixation of smear etc., decalcification, method of decalcification, assessment of decalcification, solution for decalcification.

MODULE III PROCESSING OF TISSUE 12

dehydration, impregnation in the wax, manual and automatic tissue processor, gelatin embedding, celloidin embedding, double embedding, cytological fixatives, preparation of different smears, vaginal, sputum, membrane.

MODULE IV DIAGNOSTIC TECHNIQUES USED IN PATHOLOGY 13

Histopathology, Cytopathology, Hematopathology, Immunohistochemistry, Microbiological examination, Biochemical examination, Cytogenetics, Molecular techniques, Autopsy

MODULE V CLINICAL PATHOLOGY 12

Theory of Urine examination a. Physical b. Chemical c. Microscopic, Examination of body fluids, cell counts, Semen analysis, Cerebrospinal Fluid (CSF), Stool examination.

TOTAL : 60

OUTCOMES:

- Student will learn basic histology and cytology.
- learn different and understand method involved in the processing of tissue
- learn and understand the principle of various test at pathology lab

CBB3104	CANCER BIOLOGY AND GENETICS	L T P C
		4 0 0 4

OBJECTIVES:

- To understand history of cancer, oncogenes and suppressor genes.
- To get knowledge on cancer related mutagens and pathways
- To get familiarize in DNA repair and familial appearance of cancer

MODULE I HISTORY OF CANCER 10

Introduction to the biology and history of cancer - history, features of cancer, cancer as a genetic disease.

MODULE II ONCOGENES - SUPPRESSOR GENES 13

The discovery of oncogenes - tumor viruses, chemically induced oncogenes. The discovery of tumor suppressor genes. - pedigree analysis - loss of heterozygosity - case study of retinal cancer (Rb).

MODULE III MUTAGENS AND PATHWAYS 13

Mutagens and cancer - Ames test - cigarette smoke and UV light – other pathways in cancer - cell death - epigenetics - telomeres.

MODULE IV DNA REPAIR AND CANCER 12

DNA repair and cancer - significance for understanding cancer - case study of colon cancer (HNPCC)- Genome stability and checkpoints - Barretts' esophagus - p53 and E2F

MODULE V FAMILIAL CANCER AND MUTATIONS 12

Familial cancer - breast cancer case study multiple mutations and the evolution of metastases. - multiple mutations in cancer - metastasis and angiogenesis.

TOTAL : 60

REFERENCES:

1. Sverre Heim, Felix, Mitelman. Cancer Cytogenetics 3rd Edition Willy- Blackwell 2011.
2. Robin Hesketh. Introduction to Cancer Biology Cambridge, University Press 2013.
3. Fred Bunz. Principles of Cancer Genetics, Springer; 2008 edition

OUTCOMES:

- At the end of the course, the student would have learnt about the oncogenes, suppressor genes mutagens, cancer pathways and familial appearance of cancer.
- Apply this knowledge for future research, findings or give awareness the human societies.

CBB3105	DRUG DISCOVERY AND ITS APPLICATION IN CANCER RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamental concepts in bioinformatics in related to drug discovery
- To understand chemoinformatic and drug discovery process
- To get knowledge on anticancer drugs and pharmacogenomics

MODULE I FUNDAMENTALS OF BIOINFORMATICS 9

Fundamental Concepts in Bioinformatics, Introduction to Databases and Tools in Bioinformatics (NCBI), Protein Structure Prediction.

MODULE II CHEMOINFORMATIC 10

Basic Concept and Chemical File Formats, Storage and Retrieval of Chemical Data and Databases, Rational Drug Designing (Structure Based and Fragment Based), Virtual Screening of Libraries, Molecular Similarity Measures Using 2D Structural Fingerprinting, Pharmacophore and Molecular Descriptors, ADMET, QSAR

MODULE III DRUG DISCOVERY PROCESS 9

Historical Overview (Ancient to ModernMedicine), Drug Target Identification, from Library to Lead Identification, Preclinical Screening, Phases of Clinical Trials, Cancer Clinical Trials, Ethical Issues and Regulatory Affairs.

MODULE IV BASIS OF ANTICANCER DRUGS 8

Anticancer Drugs - Classes of Anticancer Drugs, Drug Metabolism and Toxicity, Targeted Therapy in Cancer;

MODULE V PHARMACOGENOMICS 9

Pharmacogenomics – Introduction to Personalized Medicine, High Throughput Gene ExpressionTechnology, SNP, Gene Drug Interaction

TOTAL : 45

REFERENCES:

1. Text Book of Drug Design and Discovery Povl Krogsgaard-Larsen, Taylor & Francis.
2. Advanced Drug design and Development E.Rekka Taylor & Francis, 2007
3. Cancer Bioinformatics from Therapy Design to Treatment Sylvia Nagl John Wiley & Sons, 2006

OUTCOMES:

- Students will be able to define components cancer drug discovery process and accordingly he/she can discover the new cancer drugs
- Student can retrieve the stored chemical file formats for the new drug discovery
- Student can be knowledgeable in the processes of preclinical trials, ethical issues and regulatory affairs related to cancer drug discovery.

CBB3106	TRADITIONAL CANCER THERAPIES	L T P C
		4 0 0 4

OBJECTIVES:

the aim of the study is to know about:

- The basics of cancer its types and the etiology of cancer
- The several diagnostic method for several types of cancer
- The traditional and advanced therapy for the cancer treatment

MODULE I CANCER BASIC CONCEPT 12

introduction of cancer biology and cancer genetics, intra and extra cellular control of cell division, programmed cell death (apoptosis), intrinsic and extrinsic pathways of cell death, necrosis, malignancies, metastasis, apoptosis in relation with cancer.

MODULE II CANCER: EPIDEMIOLOGY AND ETIOLOGY 12

awareness and challenges faced by cancer patients, different types of cancer, lung, liver, prostate, breast, colorectal, cervical, mutagens, carcinogens and mutations.

MODULE III STEM CELLS 12

Introduction to concepts in stem cell biology, definition, introduction tissue stem cells, stem cell and cancer, epidermal stem cell and neural stem cells, embryonic stem cell, moving stem cell to clinic, stem cell as future treatment of disease.

MODULE IV DIAGNOSTIC METHODS 12

Common practice of diagnostic methods, cytogenetics and molecular test, routine diagnostic test, purpose of frozen section, biopsy, endoscopy, diagnostic imaging, blood test, Proteomics and genomic approach, microarray.

MODULE V TRADITIONAL THERAPIES 12

Treatment traditional chemotherapies, limitation in therapies, treatment immunotherapy, conventional chemotherapy, drawbacks, role of immune system in suppressing cancer.

TOTAL : 60

REFERENCES:

1. DNA repair in cancer therapy: molecular targets and clinical applications. Edited by Mark R. Kelley Academic press Elsevier, 2012.
2. The biology of cancer by Robert Weinberg G. Garland sciences, Taylor and Francis group, New york ISBN 0-8153-4076-1.
3. Text book of cancer epidemiology by Han Adams ISBN: 9780195311174
4. Every one guide to cancer therapy by Andrewko. ISBN: 978-0740768576.

OUTCOMES:

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

- Know about cancer and their several types
- Have the information regarding various cause for the cancer
- Understand what are the therapies and treatment Module for the cancer patient

OBJECTIVE :

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.

LIST OF EXPERIMENTS :

1. Introduction to Clinical Laboratories, Laboratory Work Flow cycle ,Phlebotomy equipments, Identification of Blood Collection Tubes & Preparation of Blood Plasma and Serum.
2. Retic. Count, Preparation of Blood Film, Blood staining.
3. Liver Function Tests, Measurement of Serum ALT & AST
4. Liver Function Tests Measurement of Serum Bilirubin (Total, direct & indirect)
5. Renal Function Tests ,Measurement of Serum BUN
6. lipid Profil Measurement of Serum Total cholesterol, Measurement of Serum LDL-C, Measurement of Serum HDL-C,-Measurement of Serum TG

REFERENCE:

Lab manuals

Lecture Notes on Clinical Chemistry. Whitby, L.G., Percy-Robb, I.W., and Smith, A.F., 6th ed. Blackwell, 1998.

Advances in Clinical Chemistry. Latner, A.L. and Schwartz, M.K. (Eds.). Academic 1998. Annual volumes. Biochemical Basis of Pediatric Disease. Soldin, S.J., Rifai, N., Hicks, J.M.B., 3rd ed, American Association for Clinical Chemistry, 1998. Cases in Chemical Pathology: A Diagnostic Approach. Walmsley,

OUTCOMES :

At the end of this course students will be able to understand and develop expertise in various biochemical techniques used in clinical diagnosis.

OBJECTIVE:

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.

LIST OF EXPERIMENTS :

1. Examination of Urine :- Routine & Microscopic, Occult blood test, 24 hours urinary protein & creatinine, Bence Jones protein and Specific gravity.
2. Examination of Sputum :- Routine & Microscopic, Examination of Ascetic fluid, pleural fluid gastric juice.
3. Haematology and Blood Banking :- Blood groups, Rh, Coomb's test (direct & indirect)/ HbS Ag/HIV/Malaria/Thalassemia/Leptospira, blood collection & labelling, safe transfusion and cross matching, organisation of Blood Donation Camp. Blood components; preparation & storage, aphaeresis, donor motivation and screening, quality control. Lectins, maintenance of blood bank safety.

REFERENCE:

- Lecture Notes on Clinical Chemistry. Whitby, L.G., Percy-Robb, I.W., and Smith, A.F., 6th edition, Blackwell, 1998.
- Advances in Clinical Chemistry. Latner, A.L. and Schwartz, M.K. (Eds.). Academi 1998. Annual volumes. Biochemical Basis of Pediatric Disease. Soldin, S.J., Rifai, N., Hicks, J.M.B., 3rd edition, American Association for Clinical Chemistry, 1998. Cases in Chemical Pathology: A Diagnostic Approach. Walmsley.

OUTCOMES:

- At the end of this course students will be able to understand and develop expertise in various techniques used in clinical and pathological laboratories.

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.

LIST OF EXPERIMENTS

1. Preparation of culture media and sterilization
2. Myeloma cell culture
3. Trypan Blue assay- Live cell counting
4. Study of effect of anti cancer drugs in cell culture- MTT assay.
5. Study of effect of small molecular inhibitor of cancer-targeted therapy.
6. Study of effect of monoclonal antibody as cancer drugs in cell culture.

OUTCOMES:

Students will learn about

- Prepare cell culture media and maintain cell culture.
- Analysis the effect of various therapeutic drugs against cancer.

SEMESTER VI

CBB3211	STRESS RESPONSES AND METABOLISM IN CANCER	L T P C
		4 0 0 4

OBJECTIVES:

- A better understanding of the abnormalities of normal cellular metabolism and stress signaling during cancer
- To learn how metabolism and stress signaling interplay with each other to create/maintain a malignant state
- An idea about the metabolomics methodologies.

MODULE I METABOLISM IN NORMAL AND TRANSFORMED CELLS 10

Glucose metabolism and the Warburg effect, Glutamine metabolism and anaplerosis, Fatty acid synthesis/Myc control, Fatty acid metabolism, Metabolism and epigenetics, Viral effects on metabolism, Oncometabolites/ mutations in metabolic enzymes, nuclear functions of metabolic enzymes.

MODULE II STRESS AND DNA DAMAGE RESPONSE 13

DNA Lesions Generated by Endogenous and Exogenous DNA Damage, single strand break, double strand breaks; Mismatch repair, base excision repair, nucleotide excision repair, non-homologous end joining, homologous recombination, DNA-PK, ATM and ATR signal transduction pathways of DNA damage response, chromosomal instability and microsatellite instability in cancer, MMR gene mutations in colorectal cancer, BRCA gene mutation and familial breast cancer

MODULE III STRESS SIGNALING AND STRESS RESPONSES IN NORMAL AND TRANSFORMED CELLS 12

Endoplasmic stress response in cancer-Unfolded protein response (UPR), ER stress sensors IRE1a, PERK and ATF6, ER chaperone GRP78/BiP defects in cancer, GRP78 as therapeutic target, proteasome inhibitors; Heat shock responses in cancer- introduction to heat shock proteins, Hsp27, Hsp70, Hsp90 in cancer, heat shock transcription factors (HSFs), implications in diagnosis and prognosis, Viral effects on stress signaling, use of activators and inhibitors of signaling pathways

**MODULE IV INTERACTION OF STRESS SIGNALING AND METABOLISM
IN CANCER** **12**

Hypoxia, hypoxia inducible factor (HIF), AMP activated protein kinase (AMPK) signaling pathways, stress and mTOR signaling, oxidative stress and reactive oxygen species (ROS), mitochondrial deregulation, PI3K-Akt-mTOR pathways, hormonal regulation-insulin and glucagon signaling, insulin receptor signaling, Sirtuins, clinical implications of antimetabolites

MODULE V APPLICATION OF METABOLOMICS IN CANCER **13**

Introduction to metabolomics, discovery of metabolic biomarker; sample analysis, metabolic imaging strategies-computerized tomography (CT), magnetic resonance (MR) imaging, positron emission tomography (PET), single photon emission computed tomography (SPECT); flux analysis- NMR spectroscopy, LC(Liquid chromatography) or GC (Gas chromatography)-Mass Spectrometry (LC-MS/GC-MS); bioinformatics for metabolomics data.

TOTAL : 60

REFERENCES:

1. NMR Metabolomics in Cancer Research. M Cuperlovic-Culf. Woodhead Publishing Limited, 2012
2. An Omics Perspective on Cancer Research. William C. S. Cho, Springer, 2010.
3. Signaling Pathways in Cancer Pathogenesis and Therapy. David A. Frank, Springer, 2011.

OUTCOMES:

Upon successful completion of this unit, the student will be able to:

- Understand the basics of altered metabolic profile and stress signaling in carcinogenesis
- Learn how to identify the potential therapeutic targets/biomarkers
- Learn the recent advances in metabolomics and its implications in cancer treatment

OBJECTIVES:

- To understand the basis of Genomic science and genomic medicine and their relevance to cancer.
- To provide students for the current information on genome-based approaches to biology and medicine.
- To inform students about the medical applications of genomic science.

MODULE I GENOME-BASED APPROACHES TO BIOLOGY AND MEDICINE **9**

Key concept in genomic science- genetic code, genome; principle of human genomes- mapping of functional genome, population perspective on genome variation and complex disease, Gene – environment interaction: Eco-genetics and Toxicogenomics, system biology and system medicine.

MODULE II TRANSLATION APPROACHES **10**

Application of human genome information to clinical practice, genomic, personalized medicine and public health, designing genomic-based clinical studies, translation bioinformatics for Genomic Medicine, electronic health records in Genomic Medicine, clinical implication of genomic medicine in primary care, Pharmacogenomics and Pharmacogenetics.

MODULE III ONCOLOGY, INFLAMMATORY AND METABOLIC DISEASE GENOMIC MEDICINE **10**

Genomics in Lymphomas, Leukemias, lung cancer, breast cancer, ovarian cancer, colorectal cancer, prostate cancer, head and neck cancer, brain tumors and gliomas, Melanoma, metastatic cancer. Genomic in autoimmune disorders, inflammatory bowel disease, the metabolic syndrome.

MODULE IV MEDICAL APPLICATIONS OF GENOMIC SCIENCE **10**

Introduction-Advances in genome technologies, Genetics of rare and common diseases, Identification of susceptibility genes for common diseases, Bioinformatics and genomic medicine. The role of epigenetics in disease, The importance of biobanks and population cohorts for advancing genomic science.

MODULE V IMPLEMENTATION AND SERVICE DELIVERY

11

Introduction, Integration of genetics into mainstream practice, Infrastructure investment, Provision of genetic services in the NHS, Commissioning of genetic services, Commissioning across the NHS, Uptake of pharmacogenetic tests in the NHS, Provision of laboratory services, Computational use of Medical and Genomic , Data: Medical Informatics and Bioinformatics-Introduction, The emergence and growth of bioinformatics, Linking informatics with electronic medical records, Developing expertise in bioinformatics Immediate informatics needs of NHS Regional Genetics Centres and laboratories.

MODULE VI PUBLIC ENGAGEMENT AND ETHICAL, SOCIAL AND LEGAL ISSUES

10

Introduction, Public engagement, Ethical aspects particular to genomic science and medicine, Use of genetic information for insurance and employment, purposes—genetic discrimination, Direct to Consumer Tests

TOTAL : 60

REFERENCES:

1. The Biology of Cancer by Robert Weinberg. Garland Science, Taylor & Francis Group, New York, N.Y. ISBN 0-8153-4076-1
2. Textbook of Cancer epidemiology by Hans Adami. ISBN: 9780195311174
3. Everyone's Guide to Cancer Therapy by Andrew Ko. ISBN: 978-0740768576

OUTCOMES:

- Student will be able to understand the basis of Genomic science and genomic medicine and their relevance to cancer.
- Student will be informed about the public engagement and ethical, social and legal issues and their their relevance to cancer

OBJECTIVES:

- To understand the basic mechanisms of apoptosis and their relevance to cancer.
- To provide students for the current technologies for the detection of cancer
- To inform students about the genetic and molecular basis of cancer.

MODULE I PRINCIPLES OF GENE THERAPY 11

Cancer Gene therapy; The genetic basis of cancer; Tumor suppressor Gene Replacement for cancer; Cancer therapeutic application of Ribozymes; Fusogeneic Membrane glycoproteins for cancer gene therapy, molecular chemotherapeutic approach

MODULE II VECTORS-MEDIATED CANCER GENE THERAPY 12

Adenovector mediated cancer gene therapy; Efficacy, toxicity and Immunogenicity of Adenoviral vectors; lentiviral and retroviral vector system; Vaccinia and Pox-Virus; Herpes Simplex Virus as therapy for Cancer; Alphavirus vectors for gene therapy application; Vesicular Stomatitis Virus and RNA virus; Parvovirus vectors; Non-viral vector system.

MODULE III GENE THERAPY APPROACHES 13

Oncogenes, Tumor suppressor gene, and apoptosis inducing gene utilised in cancer gene therapy; gene silencing therapy against cancer; tumor targeting-retargeted adenovirus, oncolytic herpes simplex for gene therapy in preclinical and clinical trail; cytokine gene therapy; combination of gene therapy with radiation.

MODULE IV CLINICAL APPLICATION GENE THERAPY 12

Problem, side effects and disappointment; trial and tribulation in developing clinical trials; drugs resistance and metabolic gene therapy; steps in a Translational cancer gene therapy trial., cancer related gene therapy clinical trials; regulatory aspects in developing gene therapy; safety testing for gene therapy products.

MODULE V PUBLIC ENGAGEMENT AND ETHICAL, SOCIAL AND LEGAL ISSUES **12**

Introduction, Public engagement, Ethical aspects particular to genomic science and medicine, Use of genetic information for insurance and employment, purposes—genetic discrimination, Direct to Consumer Tests.

TOTAL : 60

REFERENCES:

1. The Biology of Cancer by Robert Weinberg. Garland Science, Taylor & Francis Group, New York, N.Y. ISBN 0-8153-4076-1
2. Textbook of Cancer epidemiology by Hans Adami. ISBN: 9780195311174
3. Everyone's Guide to Cancer Therapy by Andrew Ko. ISBN: 978-0740768576

OUTCOMES:

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

- Understand the basics and the concepts of cancers in full details
- Get the knowledge about the roles of cell signalling pathways in cancer
- Know about the experimental model and techniques to understand cancer

OBJECTIVES:

- To understand the basic mechanisms of apoptosis and their relevance to cancer.
- To provide students for the current technologies for the detection of cancer
- To inform students about the genetic and molecular basis of cancer.

MODULE I CANCER: MOLECULAR AND CELLULAR LEVEL 9

Cancer introduction, types of cancer, apoptosis, necrosis, Definition, benign tumors vs. Malignant tumors, invasion, metastasis, cell proliferation, metabolism in cancer cells, benign and malignant tumors, angiogenesis, molecular basis of cell differentiation.

MODULE II BASIC IMMUNOLOGY 9

Basic introduction to immune system, B cells and T cells, antigens and antibody, immunoglobulins and their expression, primary and secondary lymphoid organs, cytokines, B lymphocytes, T lymphocytes, natural killer cells

MODULE III SIGNAL TRANSDUCTION 9

Ligand and receptor interactions, environment stimuli, G-protein and coupled receptors, major pathways-MAPK/ERK pathway, cAMP dependent pathway, AKT(PI3) pathways, NFkB pathways, RAS signalling.

MODULE IV APOPTOSIS AND CANCER METABOLISM 9

apoptosis and molecular mechanism (intrinsic and extrinsic), p53, autophagy, tumorigenesis, necrosis, angiogenesis, carcinogenesis, tumor vasculature, biomarkers, targeting cancer metabolism, tumor invasion and metastasis, oncogene and tumor suppressor gene.

MODULE V CANCER GENOMICS AND PROTEOMICS 9

basic concept of genomics, central dogma of molecular biology, prokaryotic and eukaryotic genomics, proteome analysis- by 2D electrophoresis and by

mass spectrophotometers, protein-protein interactions, proteomics and their clinical significance in cancer.

TOTAL : 45

REFERENCES:

- The Biology of Cancer by Robert Weinberg. Garland Science, Taylor & Francis Group, New York, N.Y. ISBN 0-8153-4076-1
- Textbook of Cancer epidemiology by Hans Adami. ISBN: 9780195311174
- Everyone's Guide to Cancer Therapy by Andrew Ko. ISBN: 978-0740768576

OUTCOMES:

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

- Understand the basics and the concepts of cancers in full details
- Get the knowledge about the roles of cell signalling pathways in cancer
- Know about the experimental model and techniques to understand cancer.

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.

LIST OF EXPERIMENTS

1. A Study of Membrane Protein determination by Immunohistochemistry
2. Method on Formalin Fixed Paraffin Embedded Tissues
3. Assessment of Apoptosis (Immunofluorescence)
4. Identification of Oncogenes using pcr
5. Ficoll density centrifugation and lymphocyte culture.
6. Eosin hematoxylin Staining.

REFERENCE:

Laboratory Manual

OUTCOMES:

Students will learn about

- Prepare cell culture media and maintain cell culture.
- Identify various parameter associated with cancer.

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
 - o Prepared speech
 - o Impromptu speech
 - o Debate: Case studies - Attitude and Behavior: role play and exploration
 - o Ability to ask for help – communication and team work
- Manners and etiquette
 - o Organization and Planning
 - o Time keeping
 - o Conduct in workplace
 - o Conscientiousness
 - o Work output
 - o Professionalism
 - o 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

CBB4101	NEW TECHNOLOGIES IN CANCER ASSESSING RISK, DIAGNOSTICS AND TREATMENT	L T P C
		3 0 0 3

OBJECTIVES:

- A better understanding of the therapeutic approaches for cancer
- To learn technological advancements in cancer diagnosis and prevention
- To provide alternative treatment methodologies for cancer treatment

MODULE I CONVENTIONAL CANCER THERAPY – I 9

Chemotherapy-types and ways to administer chemotherapy, anticancer drugs - alkylating agents (nitrogen mustard, cyclophosphamide, Cisplatin), antimetabolites (Folic acid analogue, methotrexate, pyrimidine analogues, purine analogues), cytotoxic antibiotics (dactinomycin, bleomycin), plant derivatives (vinca alkaloids, taxanes); Radiotherapy- external beam therapy, internal radiation, side effects.

MODULE II CONVENTIONAL CANCER THERAPY – II 9

Hormone therapy- inhibitors of hormone synthesis, estrogen, progesterone and GnRH analogues, targeting growth factor receptors, cetuximab, imatinib; side effects of hormone therapy; Gene therapy- germinal and somatic gene therapy, gene transfer – viral and non-viral methods of gene transfer, adenoviral, retroviral, electroporation, gene gun, magnetofection, liposomal.

MODULE III CANCER IMMUNOTHERAPY 9

Introduction to immunotherapy, types of immunotherapy-monoclonal antibodies, types of mAb and side effects, vaccines, tumor cell vaccines, antigen vaccines, dendritic cell vaccines, DNA vaccines, vector based vaccines, non-specific immunotherapies and adjuvants, recent advances in cancer immunotherapy.

MODULE IV NANOTECHNOLOGIES IN CANCER 9

Introduction to nanotechnology, nanotechnology for cancer imaging and early detection, targeted molecular imaging of cancer, gold nanoparticles for detection and eradication of blood cancer cells, protein catalyzed capture agents

(PCC) in detection and therapy, silver nanoparticle in cancer prevention, nanoparticles for targeted delivery of cancer drugs.

MODULE V ADVANCED TECHNOLOGIES AND TREATMENTS 9

Tomotherapy, robotic surgery, brachytherapy, alternative treatments for cancer-use of herbals and nonconventional therapies, development and synthesis of new drugs and their effects; photodynamic therapy; anti-angiogenic therapy, radio-immunotherapy, cancer stem cell therapy, stem cell transplant-autologous, allogeneic, syngeneic transplant, cryotherapy, laser therapy.

TOTAL : 45

REFERENCES:

1. Cancer: Principles & Practice of Oncology (8th Ed). Vincent T. DeVita, Theodore S. Lawrence, Steven A. Rosenberg, Lippincott Williams and Wilkins, 2008.
2. Enhancing Cancer Care, Complementary Therapy and Support. Jennifer Barraclough, Oxford University Press, 2007.
3. Gene Therapy of Cancer. Edmund C Lattime, Stanton L Gerson, Academic Press, 2013.
4. Stem Cell Therapy. Erik V Geer, Nova Science Publishers Inc., 2006

OUTCOMES:

Upon successful completion of this unit, the student will be able to:

- Understand various treatment methodologies for cancer
- Learn how to identify the potential therapeutic targets/biomarkers
- Learn the recent technological advances and their implications in cancer treatment

CBB4102	CANCER TREATMENT-TARGETED THERAPY	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To understand the basic concept of targeted therapy.
- To provide students for different types of targeted therapy.

MODULE I INTRODUCTION TO CANCER TREATMENT TARGETED THERAPY 12

Hallmarks of cancer, invasion and metastasis, resistance to targeted therapy as a result of mutation in the target, the dynamic of cell signalling network; implication for targeted therapies.

MODULE II EXTERNAL TARGETED CANCER THERAPY 12

Monoclonal antibodies, Membrane-bound receptor kinase (EGFR, HER2), Hepatocyte Growth Factor receptor (HGF/c-Met) pathways, Insulin like growth receptor pathways

MODULE III INTERNAL TARGETED CANCER THERAPY 12

Intracellular signalling kinases (eg src, PI3K, AKT, mTOR, MAPK; hedgehog pathways, protein kinase inhibitors, heat shock proteins and ubiquitin-proteasome inhibitors.

MODULE IV TUMOR VASCULATURE 12

Targeting angiogenesis-anti-angiogenesis Drug therapy, hypoxia-inducible factor, mTOR and Angiogenesis, nursing consideration and drug informations-targetted therapies.

MODULE V TARGETING TUMOR MICROENVIRONMENT 12

Bone Metastasis, pharmacologic management, targeting apoptosis, mitotic kinase inhibitors, small molecules inhibitors.

TOTAL : 60

REFERENCES:

1. The Biology of Cancer by Robert Weinberg. Garland Science, Taylor & Francis Group, New York, N.Y. ISBN 0-8153-4076-1

B.Tech. Cancer Biotechnology

2. Current Clinical oncology: Targeted Cancer Therapy. EDITED BY R. Kurzrock and M. Markman, Human Press Totowa, NJ.
3. Everyone's Guide to Cancer Therapy by Andrew Ko. ISBN: 978-0740768576

OUTCOMES:

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

- Understand the basics and the concepts of targeted therapies
- Get the knowledge and difference between different types of targeted therapies.

OBJECTIVES:

- To understand the basic mechanisms of immunology and their relevance to cancer.
- To provide students for the current immunotherapy for cancer
- To inform students about molecular basis of cancer immunology.

MODULE I ETHIOLOGY OF TUMOR

11

Tumor immunology - Introduction, ethiology of tumor- inherited, viral, chemical, radiological, apontaneous.; solid tumors, deregulation of proto-oncogenes, lymphoproliferative diagnosis of leukemia, lymphoma and myeloma.

MODULE II TUMOR ASSOCIATED ANTIGE

11

Tumor Antigen, harmones, enzymes, Viral antigen, Mutant Antigens, tumor specific antigens, oncofetal antigen, oncogene protein, transplantation antigens, circulating and cellular tumor markers.

MODULE III IMMUNE SURVEILLANCE SYSTEM

13

Immune Surveillance System during neoplastic transformation, new antigen development, expression of normally Silent Genes, cell mediated immune response, NK cells, macrophage, cytotoxic T cells, cell mediated T cells, B cells, changes on the surface molecules, carbohydrates structure related to Metastatic Potential

MODULE IV TUMOR ESCAPE

14

MHC molecules, antigen loss variants, immunosuppression factors, immunologic tolerance, innate and adaptive immune response to tumor cells, regulatory T Cells, CD8+ effector T Cells, HLA changes on tumor cells.Effector functions of innate immune cells (e.g., neutrophils, monocytes, macrophages, dendritic cells, NK cells, basophils, eosinophils, mast cells, gdT, cells, b1 cells), Pattern recognition receptors and ligands, recruitment and activation of non-lymphocyte leukocytes , adhesion molecules, chemotaxis, endothelial responses, cytokines, chemokines, lipid mediators, other autocoids, and their receptors.

MODULE V CANCER IMMUNOTHERAPY

11

Modify Co-stimulatory signal, Enhance APC activity, Cytokine therapy, MABs, Tumour cell vaccines, exploitation of Acquired Immune Response, Monoclonal Antibodies, Cancer Vaccines – Therapeutic Vaccines, Whole Cell Vaccine, Peptide Based Vaccine, Dendritic Cell Vaccine.

TOTAL : 60

REFERENCES:

1. The Biology of Cancer by Robert Weinberg. Garland Science, Taylor & Francis Group, New York, N.Y. ISBN 0-8153-4076-1
2. Cancer Immunology and Immunotherapy Current Topics in Microbiology and Immunology, Vol. 344, Dranoff, Glenn (Ed.)
3. Everyone’s Guide to Cancer Therapy by Andrew Ko. ISBN: 978-0740768576

OUTCOMES:

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

- Understand the basics and the concepts of cancer immunology in full details
- Get the knowledge about the roles of cell signalling pathways in cancer immunology.
- Know about the recent advancement toward immunotherapy against cancer.

CBB4104	CANCER EPIDEMIOLOGY AND ETIOLOGY	L T P C
		4 0 0 4

OBJECTIVES:

This course seeks to achieve the following goals:

- To introduce basic of cancer epidemiology at the molecular aspects of epidemiology.
- To understand cancer related risk factors and classification
- To get knowledge on cancer screening and treatment modalities

MODULE I CANCER EPIDEMIOLOGY 12

Global Cancer Incidence and Mortality; Data Source and Measurements, Overall Cancer Risk, Incidence and Mortality Patterns for Common Cancers, Issues in Interpreting Temporal Trends, Analytical Methods for Epidemiological Studies - Ecological Studies, Cross- Sectional Studies, Cohort Studies, Case-Control Studies, Interpretation of Epidemiology Findings, Molecular Epidemiology

MODULE II CANCER RISK FACTORS 12

Cancer Risk Factors; Physical, Chemical - Exogenous and Endogenous Carcinogens, Metabolism of Chemical Carcinogens, DNA Adduct Formation, Biological - DNA Viruses and RNA Viruses, Genetic Syndromes, Life Style Factors.

MODULE III CANCER CLASSIFICATION 12

Cancer Classification; TNM Classification - Purpose, Types of Staging, TNM System, Stage Grouping, Other Factors That Can Affect the Stage, Other Staging System, Molecular Classification of Cancer

MODULE IV CANCER SCREENING 12

Cancer Screening; Screening - Definition, Principles, Evaluating Screening Tests, Developing and evaluating a Cancer Screening Programme, Different Kind of Screening Tests, Screening for Specific Types of Cancer, Genetic Counseling.

MODULE V TREATMENT MODALITIES 12

Treatment Modalities; Essential Terms, Surgery, Radiation, Chemotherapy,

B.Tech. Cancer Biotechnology

Biological Therapy, Hormone Therapy, Transplantation, Targeted Therapies, Gene Therapy, Other Treatment Methods Cryosurgery, Laser Therapy, Photodynamic Therapy, Hyperthermia), Cancer Clinical Trials

TOTAL : 60

REFERENCES:

1. Cancer: Principles and Practice of Oncology, 9th Edition Vincent T. DeVita, Jr., Theodore S. Lawrence, Steven A. Rosenberg Lippincott Williams and Wilkins 2011
2. Introduction to Cancer Biology Robin Hesketh Cambridge University Press 2013
3. The Biology of Cancer Robert A. Weinberg Garland Science 2012.

OUTCOMES:

- Students will be able to define cancer epidemiology and accordingly he/she can use this knowledge for drug discovery processes.
- Students can use cancer related risk factors, cancer classification and treatment modalities knowledge to their work environment, societies and their surroundings.

ELECTIVES (GROUP 1)

BTBX01	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I PHARAMCOGENOMICS 9

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

MODULE II BIOPROCESS TECHNOLOGY 9

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

MODULE III IMMUNOBIOTECHNOLOGY AND MICROBIOLOGY 9

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

MODULE IV ADVANCED PHARMACEUTICAL BIOTECHNOLOGY 9

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

MODULE V MICROBIAL PATHOLOGY AND CHEMOTHERAPY 9

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

TOTAL : 45

REFERENCES :

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

OUTCOMES:

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

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 7

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

8

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 screening systems 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 10

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 8

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

Synthetic peptide libraries - Peptide libraries through phage display - Applications in epitope and agretope mapping, synthetic vaccine design - Artificial combinatorial - Peptides, benzodiazepines 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.

CBBX01	EPIGENETICS	L T P C
		3 0 0 3

OBJECTIVE:

- To understand the concept of epigenetics and cancer
- To understand the basis of DNA and Histone modification
- To learn the role of epigenetics in Diagnosis and Therapy

MODULE I INTRODUCTION 9

Introduction to concepts of epigenetics; DNA methylation and cancer, histone alterations and cancer, impact of epigenetic processes in cancer, epigenetics in diagnosis, prognosis and therapy of cancer, future in cancer research.

MODULE II DNA METHYLATION AND CANCER 9

DNA hypomethylation and cancer, DNA Hypermethylation and oncogenesis, imprinting alterations in tumorigenesis, protein factors in DNA methylation, DNA methylation and cancer progression

MODULE III HISTONE MODIFICATIONS IN CANCER 9

Histone acetylations and cancer, histone methylations in cancer initiation, Sirtuins in aging and carcinogenesis, proteins involved in histone modifications, dietary and environmental factors for regulating histone modifications in cancer

MODULE IV EPIGENETIC ASPECTS OF CANCER 9

Non coding RNAs in cancer, Chromosome position effects, chromatin remodeling and cancer, poly-ADP ribosylation in cancer, polycomb group proteins in tumorigenesis, epigenetic connection between cancer and aging.

MODULE V EPIGENETICS IN DIAGNOSIS AND THERAPY 9

DNA methylation in tumor diagnosis, DNA methylation profiles as Cancer prognostic marker, histone modifications in cancer diagnosis, histone modifications in cancer prognosis, therapeutic implications of DNA methylations, clinical trials and approved drugs for epigenetic cancer therapy.

REFERENCES:

1. Epigenetics Edited By Bruce Stillman, Cold Spring Harbor Laboratory; David Stewart, Cold Spring Harbor Laboratory © 2004
2. Epigenetics, Second edition edited by C. David Allis, Marie-Laure Caparros; Thomas Jenuwein, Max-Planck; Danny Reinberg, Howard Hughes 2014.

OUTCOMES:

- Student will learn and understand the concept of epigenetics and cancer
- Able to understand the basis of DNA and Histone modification
- Able to co-relate the role of epigenetics in Diagnosis and Therapy

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 8

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

MODULE II METHODS OF GENE TRANSFER 8

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 7

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 7

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. Scharzt.
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.

GROUP 2 ELECTIVE

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

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 CLINICAL 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 8

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 8

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 7

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 7

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, Inborn 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 innovative biomedical 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, 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, bioethical 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 8

Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton), Biosafety assessment of biotech pharmaceutical products such as drugs/vaccines etc, International dimensions in biosafety: Cartagena 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.

B.Tech. Cancer Biotechnology

- 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
- Organise and synthesise ideas and questions on dual-use biosecurity, biosafety and bioethics relevant to the conduct of research and other work with pathogens.

CBBX02	STEM CELLS AND REGENERATIVE MEDICINE	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 how 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 Publication.

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.

GROUP 3 ELECTIVE

CBBX03

CYTOGENETICS

L T P C
3 0 0 3

OBJECTIVE:

- To understand the structure and function of chromatin
- To understand the molecular mechanism of mutation
- To learn the molecular organization of chromosome.

MODULE I ANALYSIS OF CHROMOSOME

9

Relation between structure and function of chromatin. Chromosomal shape, karyotyp, idiogram. Banding methods. Q, G, C, R, N-banding. HRT technique. Physical, chemical mutagens and chromosomal damage. Structural chromosomal changes. Origin and significance of chromosomal aberrations.

MODULE II MUTATIONS

9

a) Molecular Mechanisms of Mutation: Forward Genetics and Reverse Genetics Mutation – At DNA level and At protein level, Frame shift mutations: Extragenic suppression and Intragenic suppression Physiological suppression. b) Loss of function mutation, Gain of function mutation, Amorph, Hypomorph and Hypermorph.

MODULE III CHROMOSOME ORGANISATION

9

Molecular organization of Eukaryotic chromosome, Heterochromatin, Histone and Non-Histone proteins. Basic techniques of cytogenetic preparation making. Pretreatment, fixation, maceration, staining, closing of preparations. Paraffin technique, squash methods, spreading methods.

MODULE IV CELL DIVISION

9

Molecular Mechanisms of cell division, Molecular Regulation of cleavage, Molecular organization of centrosome and spindle, Dynamic instability of microtubules during metaphase and anaphase. Role of Motor proteins and segregation of chromosome.

MODULE V CHROMOSOME AND DISEASES

9

Cytogenetic abnormalities in hematological malignancies and solid tumors. Molecular cytogenetics. Methods and applications of fluorescence in situ hybridization in biological dosimetry and detection of disease-specific chromosomal alterations, Technique of comparative genomic hybridization (CGH). Spectral karyotyping. Array-CGH. 14. An International System for Human Cytogenetic Nomenclature (ISCN).

TOTAL : 45

OUTCOMES :

- Student will have the knowledge of the structure and function of chromatin
- Learn and understand the molecular mechanism of mutation
- Understand the molecular organization of chromosome.

REFERENCES:

1. Alberts, B, Johnson, J Lewis, M. Raff, K Roberts and P. Watter. 2002. Molecular Biology of the cell IV ed. Garland Science, New York.
2. Beatty, B., S. Mai and J. Squire. 2002. FISH . Oxford Univ. Press, Oxford
3. Hollander A (Editor) 1971-76 Chemical mutagens: Principles and Methods of their detection. Vols. 1-, Plenum Press New York.
4. Macgregor, H. C. 1993. An introduction to Animal Cytogenetics. Chapman & Hall, London.
5. Snustad D P, M J Simmons and J P Jenkins, 1997. Principles of Genetics. John Wiley and Sons, INC.
6. Verma R. S. (Editor) 1988. Heterochromatin: Molecular and Structural aspects. Cambridge University Press. Cambridge.

BTBX04	INTELLECTUAL PROPERTY RIGHTS IN BIOTECHNOLOGY	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 reference 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

Substantive 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. Intellectual 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.

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