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 FOOD BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES

- This course will facilitate the graduates to be professionally competent in Food Biotechnology to solve the problems in food and biomedical engineering.
- This course will offer students with a solid foundation in every aspect of Food production and processing, to enable them to work on engineering applications in food biotechnology as per the requirement of the food industries, and also will enable the students to pursue higher studies and research.
- This course will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology to enable them to understand basic concept in modern biology and help them to advance their carrier in the booming field of Food biotechnology.
- This course will facilitate the students to acquire knowledge in fields such as Food microbiology, application of fermentation technology, and Bioprocess engineering and associated downstream processing enabling their application in food industries.
- This course will aid the students to apply their knowledge in different omics technologies; proteomics, genomics, metabolomics in food production and processing.
- This programme will teach students the importance of Bioethics, entrepreneurship, communication and management skills.
- This course will also offer the graduates to demonstrate their proficiency in theory and practice of bio-techniques through life-long learning and provide confidence to perform as an individual and / or member of a team with professional and ethical behavior.

PROGRAMME OUTCOMES

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

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

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

REGULATIONS 2013
FOR
B.TECH. DEGREE PROGRAMMES

(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)

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

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

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

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

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

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

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

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

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

2.0 ADMISSION

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

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

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

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

3.0 BRANCHES OF STUDY

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

B.TECH. DEGREE PROGRAMMES:

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

4.0 STRUCTURE OF THE PROGRAMME

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

i) Basic Sciences (BS)

ii) Humanities & Social Sciences (HS)

iii) Management Sciences (MS)

iv) Engineering Sciences Fundamentals (ESF)

v) Engineering Core Courses (EC)

vi) Professional Electives (PE)

vii) General Electives (GE)

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

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

one credit per tutorial period per week

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

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

one credit for two weeks of industrial training

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

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

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

5.0 DURATION OF THE PROGRAMME

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

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

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

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

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

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

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

6.2 FACULTY ADVISOR

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

7.0 COURSE COMMITTEE

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

8.0 CLASS COMMITTEE

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

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

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

ii) Course coordinators of all common courses.

iii) Faculty members of all individual courses.

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

v) All first semester class advisors and faculty advisors

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

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

ii) Faculty members of individual courses

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

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

v) Head of the Department

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

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

8.5 The class committee, excluding the student members, shall meet within 10 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide the grades for students in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLMENT

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

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

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

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

10.1 CHANGE OF A COURSE

A student can change an enrolled course within 15 days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

10.2 WITHDRAWAL FROM A COURSE

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

11.0 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

A student can avail a onetime temporary break of study covering the current semester and/or next semester period with the approval of the Head of the Institution at any time before the start of third assessment of current semester, within the maximum period of 14 or 12 semesters as the case may be. If any student is debarred for want of attendance or suspended due to any act of indiscipline it will not be considered as break of study.

A student availed break of study has to rejoin only in the same semester from where he left.

12.0 CREDIT LIMIT FOR ENROLMENT & MOVEMENT TO HIGHER SEMESTER

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

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

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

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

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

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

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

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

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

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

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

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

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

14.0 SUBSTITUTE EXAMINATIONS

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

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

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

15.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the University in approved events etc.) to become eligible to appear for the semester-end examination in that course, failing

which the student shall be awarded "I" grade in that course. If the course is a core course, the candidate should register for and repeat the course when it is offered next.

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

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

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

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

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

16.0 SUMMER TERM COURSES

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

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

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

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

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

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

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

"W" denotes withdrawal from the course.

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

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

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

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

17.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester-end theory examination answer scripts of courses, on payment of prescribed fee, through proper application to Dean (Academic Affairs), who shall constitute a revaluation committee consisting of Chairman of the class committee as convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

17.5 After results are declared, grade sheets shall be issued to each student, which will contain the following details. The list of courses enrolled during the semester including Summer term (redo) courses, if any, and the grade scored, the Grade Point Average (GPA) for the semester and the Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards. GPA is the ratio of the sum of the products of the number of credits of courses registered and the points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester, including summer courses if any.

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

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

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

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

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

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

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

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

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

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

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

19.0 PERSONALITY AND CHARACTER DEVELOPMENT

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

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

20.0 DISCIPLINE

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

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

21.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

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

ii) no dues to the Institution, Library, Hostels

iii) no disciplinary action pending against him/her.

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

22.0 POWER TO MODIFY

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

SCHOOL OF LIFE SCIENCES (SLS)

B.TECH (FOOD 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	Fundamental 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 Laboratory	0	0	4	2

8.	BTB1217	Cell Biology Laboratory	0	0	3	1
9.	BTB1218	Microbiology Laboratory	0	0	2	1
10.	ENB2182	Communication Skills Laboratory	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 Laboratory	0	0	3	1
8.	BTB2108	Molecular Biology Laboratory	0	0	3	1
9.	BTB2109	Bioanalytical Techniques Laboratory	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 Laboratory	0	0	3	1
8.	BTB2217	Immunology Laboratory	0	0	3	1
9.	BTB2218	Animal and Plant Cell Culture Laboratory	0	0	3	1
		Total Credit				**23**

SEMESTER V

Sl. No.	Course Code	Course Title	L	T	P	C
1.	FBB3101	Food Microbiology	3	0	0	3
2.	FBB3102	Food Chemistry	3	0	0	3
3.	FBB3103	Unit Operations in Food Processing	4	0	0	4
4.	FBB3104	Food Fermentation Technology	4	0	0	4
5.	FBB3105	Protein foods Processing	4	0	0	4
6.	FBB3106	Food Additives and Post Process Handling	4	0	0	4
7.	FBB3107	Food Microbiology Laboratory	0	0	3	1
8.	FBB3108	Food Chemistry Laboratory	0	0	3	1
9.	FBB3109	Unit Operations in Food Processing Laboratory	0	0	3	1
		Total Credit				**25**

SEMESTER VI

Sl. No.	Course Code	Course Title	L	T	P	C
1.	FBB3211	Food Toxicology	4	0	0	4
2.	FBB3212	Food Process Technology	4	0	0	4
3.	FBB3213	Food Plant Layout & Design	3	0	0	3
		Group 1 (Elective)	3	0	0	3
		Group 1 (Elective)	3	0	0	3
4.	FBB3214	Food Flavoring Technology	4	0	0	4
5.	FBB3215	Food Process Equipment Design and Drawing Laboratory	0	0	3	1
6.	ENB2282	Confidence Building and Behavioural Skills	0	0	2	1
		Total Credit				**23**

SEMESTER VII

Sl. No.	Course Code	Course Title	L	T	P	C
1.	FBB4101	Dairy Plant Engineering	4	0	0	4
2.	FBB4102	Food Safety and Regulations	4	0	0	4
3.	FBB4103	Food Product Development and Marketing	4	0	0	4
4.	FBB4104	Food Packaging Technology	4	0	0	4
		Group 2 (Elective)	3	0	0	3
		Group 2 (Elective)	3	0	0	3
5.	FBB4105	Dairy food technology Laboratory	0	0	3	1
6.	FBB4106	Food packaging Laboratory	0	0	3	1
		Total Credit				**24**

SEMESTER VIII

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

ELECTIVES (Group 1, Group 2 & Group 3)

GROUP 1 (ELECTIVE)

(Two to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	FBBX01	Fat and Oil processing Technology	3	0	0	0
2.	FBBX02	Fruit and Vegetable Processing	3	0	0	0
3.	FBBX03	Fermented and Traditional Foods	3	0	0	3
4.	FBBX04	Fermented Food Products Technology	3	0	0	3
5.	FBBX05	Neutraceutical Engineering	3	0	0	3

GROUP 2 (ELECTIVE)

(Two to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	FBBX06	Meat poultry and Fish Processing	3	0	0	3
2.	FBBX07	Beverage Processing	3	0	0	3
3.	BTBX04	Intellectual Property Rights	3	0	0	3
4.	BTBX08	Biosafety and Bioethics	3	0	0	3
5.	FBBX09	Crop Processing Technology	3	0	0	3

GROUP 3 (ELECTIVE)

(One to be opted)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	FBBX10	Nanotechnology in Food Processing	3	0	0	3
2.	FBBX11	Food Industry Waste Management	3	0	0	3

GENERAL ELECTIVES

1.	GEBX22	National Service Scheme	0	0	3	1

SEMESTER I

		L	T	P	C
ENB1181	**ENGLISH**	**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 FUNDAMENTAL IN MATHEMATICS

L	T	P	C
3	1	0	4

OBJECTIVES:

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

MODULE I MATRICES **12**

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

MODULE II TRIGONOMETRY **12**

Expansions of $\sin n\theta$ and $\cos n\theta$ in powers of $\sin\theta$ and $\cos\theta$ – Expansions of $\sin^n\theta$ and $\cos^n\theta$ interms of sines and cosines of multiples of θ – 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.

PHB1181	PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I PROPERTIES OF MATTER **7**

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

MODULE II CRYSTAL PHYSICS **6**

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

MODULE III QUANTUM PHYSICS **7**

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

MODULE IV WAVE OPTICS **9**

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

MODULE V LASER & FIBER OPTICS **9**

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

MODULE VI ULTROSONICS AND NDT **7**

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

TOTAL: 45

REFERENCES:

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

8. William T. Silfvast, “Laser Fundamentals”, 2nd edition, Cambridge University Press, 2004.

OUTCOMES:

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

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

CHB1181	CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To make students conversant with the

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

MODULE I WATER TECHNOLOGY 8

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

MODULE II ENGINEERING MATERIALS 8

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

MODULE III ELECTROCHEMISTRY AND CORROSION 9

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

MODULE IV CHEMISTRY OF POLYMERS 6

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

MODULE V SPECTROSCOPY 9

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

MODULE VI GREEN CHEMISTRY 5

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

TOTAL: 45

REFERENCES:

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

OUTCOMES:

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

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

BTB1101 FUNDAMENTALS IN BIOTECHNOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

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

MODULE I INTRODUCTION TO BIOTECHNOLOGY **10**

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

MODULE II MICROBIAL CULTURE AND APPLICATIONS **10**

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

MODULE III PROTEIN ENGINEERING **10**

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

MODULE IV BASICS OF RDNA TECHNOLOGY **10**

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

MODULE V GENOMICS AND PROTEOMICS 10

Introduction, Genome Sequencing Projects, Gene prediction and Counting, Genome similarity, SNPs and comparative genomics, Functional Genomics, History of Bioinformatics, Sequences and Nomenclature, Information Sources, Analysis using Bioinformatics tools.

MODULE VI PLANT AND ANIMAL CELL CULTURE AND APPLICATION 10

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

TOTAL: 60

REFERENCES:

1. Concepts in Biotechnology, C.F. Bryce,D. Balasubramanian,Universities Press.

2. Biotechnology by Smith, Cambridge Press.

OUTCOMES:

At the end of the course students will be able to

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

SSB1181 INTRODUCTION TO ECONOMICS

L	T	P	C
3	0	0	3

OBJECTIVES:

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

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

MODULE I INTRODUCTION **8**

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

MODULE II NATIONAL INCOME DETERMINATION **7**

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

MODULE III MONEY AND BANKING **7**

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

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

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

MODULE V BUDGET, POLICIES AND INDICATORS 8

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

MODULE VI ECONOMIC GROWTH AND THE ROLE OF ENGINEERS 8

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

TOTAL: 45

REFERENCES:

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

OUTCOMES:

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

PHB1182	PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

REFERENCE

Laboratory Manual

OUTCOMES:

On completion of this course, the student will know

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

CHB1182	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

To make students conversant with the

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

LIST OF EXPERIMENTS:

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

REFERENCE:

Laboratory Manual

OUTCOMES:

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

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

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

OBJECTIVES:

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

MODULE I FUNDAMENTALS OF COMPUTERS **5**

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

MODULE II BASIC PROGRAMMING AND DEBUGGING **5**

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

MODULE III INPUT AND OUTPUT **5**

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

MODULE IV PROBLEM SOLVING **5**

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

MODULE V OPERATORS AND DECISION STATEMENTS **5**

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

MODULE VI ARRAYS AND LOOP CONTROL STATEMENTS 5

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

LIST OF EXPERIMENTS:

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

REFERENCES:

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

OUTCOMES:

Students who complete the course will be able to

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

SEMESTER- II

BTB1211	**BIOCHEMISTRY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

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

MODULE I AMINO ACIDS, CARBOHYDRATES AND LIPIDS 7

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

MODULE II NUCLEIC ACIDS AND VITAMINS 7

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

MODULE III METABOLISM OF AMINO ACIDS 8

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

MODULE IV METABOLISM – NUCLEIC ACIDS, POLYSACCHARIDES AND LIPIDS 8

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

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

MODULE V BIOMEMBRANE, TRANSPORT AND ELECTRICAL CONDUCTIVITY 8

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

MODULE VI BIOCHEMICAL ENERGETICS 7

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

TOTAL : 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

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

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

BTB1212 CELL BIOLOGY L T P C
4 0 0 4

OBJECTIVES:

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

MODULE I INTRODUCTION TO CELL & ITS COMPONENTS 12

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

MODULE II CELL PHYSIOLOGY 12

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

MODULE III CELL ORGANELLE 12

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

MODULE IV CYTOSKELETON 12

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

MODULE V DNA REPLICATION, TRANSCRIPTION AND TRANSLATION 12

DNA replication- Prokaryotic and eukaryotic DNA replication, mechanism of replication. Transcription- Prokaryotic and eukaryotic Transcription; Translation-

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

TOTAL: 60

REFERENCES:

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

OUTCOMES:

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

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

BTB1213 MICROBIOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I MICROBES AND FUNCTIONAL ANATOMY 7

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

MODULE II OBSERVING MICROORGANISMS THROUGH MICROSCOPE 7

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

MODULE III CATABOLIC & ANABOLIC REACTIONS 8

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

MODULE IV MICROBIAL GROWTH 9

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

MODULE V APPLIED & INDUSTRIAL MICROBIOLOGY 7

Industrial fermentation, primary and secondary metabolites, Role of

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

MODULE VI MICROBIAL GENETICS 7

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

TOTAL: 45

REFERENCES:

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

OUTCOMES:

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

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

BTB1214 BIOORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION TO ENZYMES 9

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

MODULE II ENZYME KINETICS 9

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

MODULE III ENZYME IMMOBILIZATION & CASE STUDIES 9

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

MODULE IV PROTEIN FOLDING 9

Kinetics of single substrate reactions; estimation of 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 ci2 – nucleation condensation mechanism – folding of barnase – time resolution – insights from theory – optimization of folding rates – molecular chaperones. Production and purification of crude enzyme extracts from plant,

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

TOTAL : 45

REFERENCES:

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

OUTCOMES:

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

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

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

OBJECTIVES:

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

MODULE I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 7

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

MODULE II CONFORMATION OF NUCLEIC ACIDS 7

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

MODULE III CONFORMATION OF PROTEINS 7

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

MODULE IV CELLULAR PERMEABILITY AND ION – TRANSPORT 8

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

MODULE V ENERGETICS AND DYNAMICS OF BIOLOGICAL SYSTEMS 8

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

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

MODULE VI METHODS IN BIOPHYSICS **8**

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

TOTAL : 45

REFERENCES:

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

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

OUTCOMES:

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

- Develop a conceptual framework for understanding the system by identifying the key physical principles, relationships, and constraintsunderlying the system.
- If required, develop a physical experiment to analyze the system within the frame work 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.

MODULE VI ENGINEERS AND SOCIETY **8**

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

TOTAL: 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will

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

BTB1216	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

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

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

LIST OF EXPERIMENTS:

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

REFERENCES:

Laboratory Manual

OUTCOMES:

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

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

OBJECTIVES:

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

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

LIST OF EXPERIMENTS

1. Microscopic study of cell and cell organelles
2. Cell fractionation
3. Isolation of microtubules
4. Isolation of actin and Myosin filaments
5. Isolation of Mitochondria
6. Nuclear staining

REFERENCE:

Laboratory Manual

BTB1218 MICROBIOLOGY LABORATORY L T P C
0 0 2 1

OBJECTIVES:

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

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

LIST OF EXPERIMENTS:

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

REFERENCE:

Laboratory Manual

OUTCOME:

Students will learn about

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

ENB2182 COMMUNICATION SKILLS LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

- To help the students acquire efficiency in Spoken English with due importance to

  Stress, Accent and Pronunciation
- To enable them to make Presentation effectively
- To prepare them for Interviews and Group Discussions
- To train them in writing official letters, resume'writing and reports.

MODULE I **4**

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

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

MODULE II **6**

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

(ii) Prepared presentations and extempore presentations

Lab: viewing Presentation Tips, Interviews Skills

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

MODULE III **4**

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

Lab: Negotiating Skills, Expressing Opinion

MODULE IV **4**

Theory: Brainstorming – Think, pair and share activity – Discussion etiquette – Assigning different roles in a GD (Note-taker, Manager, Leader and Reporter)

Lab: Viewing Group Discussion

MODULE V **8**

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

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

MODULE VI **4**

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

TOTAL: 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 uhling (1998): John Wiley
4. Introduction to Proteins Structure by Branden and Tooze (1998): Garland Publishing Group.

OUTCOMES:

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

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

BTB2102 BIOINFORMATICS L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I INTERNET AND BIOINFORMATICS 7

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

MODULE II DATABASES 8

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

MODULE III SEQUENCE ALIGNMENT AND DATABASE SEARCHING 8

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

MODULE IV PHYLOGENETIC ANALYSIS 7

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

MODULE V PREDICTIVE METHODS **8**

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

MODULE VI ADVANCED BIOINFORMATICS **7**

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

TOTAL: 45

REFERENCES:

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

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

OUTCOMES:

At the end of the course students will be

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

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

OBJECTIVES:

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

MODULE I OVERVIEW OF PROCESS INDUSTRY **10**

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

MODULE II MATERIAL BALANCES **10**

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

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

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

MODULE IV FLUID MECHANICS **10**

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

MODULE V FLOW THROUGH PACKED COLUMNS **10**

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

MODULE VI REACTORS **10**

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

TOTAL: 60

REFERENCES:

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

OUTCOMES:

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

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

BTB2104 BIOSTATISTICS L T P C
3 1 0 4

OBJECTIVES:

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

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

MODULE I INTRODUCTION 10

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

MODULE II DATA MEASURE AND LOCATION 10

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

MODULE III PROBABILITY AND DISTRIBUTION 10

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

MODULE IV CORRELATION AND REGRESSION 10

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

MODULE V SAMPLING 10

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

MODULE VI EXPERIMENTAL DESIGNS 10

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

TOTAL : 60

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 condence intervals in context
- Interpret the results of hypothesis tests
- Make an informed decision, based on the results of inferential procedures

BTB2105 MOLECULAR BIOLOGY L T P C
3 0 0 3

OBJECTIVE:

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

MODULE I DNA REPLICATION AND REPAIR 9

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

MODULE II TRANSCRIPTION 9

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

MODULE III MODIFICATIONS IN RNA 9

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

MODULE IV TRANSLATION 9

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

MODULE V REGULATION OF GENE EXPRESSION & ANTISENSE TECHNOLOGY 9

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

TOTAL : 45

REFERENCES:

1. Lodish H. F.Cell and Molecular Biology. W.H. Freeman & Co Ltd, 2000.
2. Cooper G. M. Cell: a Molecular Approach.Sinauerassociates,USA2000.
3. Lewin B. Gene VIII. Prentice Hall, USA 2003.
4. Jeremy M Berg, John L Tymoczko, and 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.
- A good understanding of protein synthesis and gene expression.

BTB2107 BIOINFORMATICS LABORATORY L T P C
0 0 3 1

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

DEMO (OPTIONAL)

1. Phylogenetic analysis
2. Shell Programming

REFERENCE:

Laboratory Manual

OUTCOME

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

BTB2108	MOLECULAR BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

LIST OF EXPERIMENTS **30**

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

REFERENCE:

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

OUTCOMES:

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

BTB2109 BIOANALYTICAL TECHNIQUES LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES :

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

LIST OF EXPERIMENTS :

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

REFERENCES:

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

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

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

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, examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

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

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

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

MODULE V PRINCIPLES OF PLANT BREEDING **9**

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

MODULE VI HUMAN GENOME PROJECT **9**

Genetic diseases in humans, Genetics and society

TOTAL : 60

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

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

BTB2212 IMMUNOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION TO IMMUNOLOGY 8

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

MODULE II MOLECULAR IMMUNOLOGY 8

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

MODULE III MHC 8

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

MODULE IV IMMUNOLOGICAL TECHNIQUES 7

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

MODULE V APPLIED IMMUNOLOGY 7

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

MODULE VI HYBRIDOMA TECHNOLOGY **7**

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

TOTAL: 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

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

BTB2213 ANIMAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION TO ANIMAL TISSUE CULTURE 8

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

MODULE II MEDIA 7

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

MODULE III CHARACTERIZATION & QUANTITATION OF CELL LINE 7

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

MODULE IV CRYOPRESERVATION 8

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

MODULE V TRANSGENIC ANIMALS **7**

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

MODULE VI GENE THERAPY **8**

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

TOTAL: 45

REFERENCES:

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

OUTCOMES

At the end of the course students will be able to

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

BTB2214 PLANT BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I HISTORY AND IMPORTANCE 7

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

MODULE II TISSUE CULTURE MEDIA 8

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

MODULE III SOMATIC EMBRYOGENESIS 8

Introduction, some examples of formatic embryogenesis, factors affecting somatic embryogenesis, induction and development, maturation, Haploid Production: Introduction, techniques, factor affecting androgenesis, ontogeny 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,

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

MODULE V MICROPROPAGATION 7

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

MODULE VI GERMPLASM STORAGE 7

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

TOTAL: 45

REFERENCES:

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

OUTCOMES

At the end of the course the students will acquire:

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

BTB2215 INDUSTRIAL BIOTECHNOLOGY L T P C
3 1 0 4

OBJECTIVES:

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

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

MODULE I INTRODUCTION TO BIOTECHNOLOGY 10

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

MODULE II BIOCHEMICAL ENERGETICS 10

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

MODULE III METABOLIC STRATEGIES 10

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

MODULE IV ENZYME TECHNOLOGY & BIOPHARMACEUTICALS 10

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

MODULE V APPLICATIONS **10**

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

MODULE VI PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 10

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

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

OBJECTIVES:

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

MODULE I PHYSICAL ENVIRONMENT **8**

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

MODULE II BIOLOGICAL ENVIRONMENT **7**

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

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

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

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

MODULE IV IMPACTS ON WATER AND AIR AND CONSERVATION 8

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

MODULE V IMPACTS ON ENERGY AND CONSERVATION, ENVIRONMENTAL CRISIS 8

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

MODULE VI ENVIRONMENTAL IMPACT ASSESSMENT AND SUSTAINABILITY 5

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

TOTAL: 45

REFERENCES:

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

OUTCOME:

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

BTB2216 GENETIC ENGINEERING LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

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

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

LIST OF EXPERIMENTS:

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

REFERENCE:

1. Sambrook et al, “Molecular Cloning-A laboratory Manual”

OUTCOMES:

Students will learn about

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

BTB2217	IMMUNOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

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

- Antigen - antibody interaction
- Electrophoresis techniques

LIST OF EXPERIMENTS:

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

REFERENCE:

Laboratory manual

OUTCOMES:

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

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

OBJECTIVES:

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

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

LIST OF EXPERIMENTS:

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

REFERENCE:

Laboratory Manual

OUTCOMES:

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

SEMESTER V

FBB3101	FOOD MICROBIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to:

- Learn about the morphology of different microorganisms.
- study the spoilage caused by microorganism
- Understand the various types of poisoning and infection caused by microorganism.

MODULE I

Classification of microorganism, morphology of yeast, mould, bacteria, virus, algae and protozoa.

MODULE II

General principles underlying spoilage of food, fitness and unfitness of food for consumption, contamination and spoilage of non perishable and perishable foods.

MODULE III

Food in relation to disease - food born diseases, food infection, intoxication, microbial toxins - types, bacterial poisoning and infection - causative agents and sources, symptoms and prevention of Staphylococcal food poisoning, botulism, salmonella, bacillus infection, E.coli, food poisoning of fungal origin - ergotism, aflatoxin.

MODULE IV

Control of microorganism - Principles of preservation, Preservation by high and low temperature, chemical preservatives, salt, sugar as preservative, new trends in preservation.

MODULE V

Sterilization by Physical agents - Heat, moist heat, fractional sterilization, pasteurization, other types of sterilization, chemical sterilization. Microbiology of water, typical organisms in water, types of bacterial examination for water, water treatment.

REFERENCES:

1. Food microbiology - Adams, M.R. and Moss M.O.
2. Foundations in Microbiology - Kathleen Talaro and Arthur Talaro
3. Industrial Microbiology - Patel, H.P.
4. Industrial Microbiology - Casida
5. Industrial Microbiology - Prescott and Dunn
6. Microbiology - Concepts and Applications - Paul A. Ketchum
7. Microbiology - Concepts and Applications - McKane and Kandel
8. Bergeys Manual of Determinative Bacteriology - IX edition
9. Elements of Biotechnology - Gupta
10. Elements of Biotechnology - Singh
11. Food Technology - Latest Issues

OUTCOMES:

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

- Demonstrate a broad understanding of the diversity and range of microorganisms, the interactions between humans and microorganisms, the role of microorganisms in industrial and environmental processes, and their role in the development of the techniques that underpin modern molecular biology
- Demonstrate proficiency in a set of core microbiological and molecular biologicaltechnical methods, including both an understanding of the principles of the methods and their utilisation in laboratory settings
- Demonstrate familiarity with the risk assessment process, and use this information to operate safely in the laboratory environment
- Collect, organise, analyse, evaluate and interpret experimental data using appropriate quantitative, technological and critical thinking skills

FBB3102 FOOD CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

This course seeks to achieve the following goals:

- To introduce the basic fundamentals of food chemistry,
- To provide detailed information on food components of water, carbohydrates, proteins, lipids, vitamins and minerals

MODULE I WATER 9

Water: The basic molecular of life. Physical properties of water- Properties of Hydration, solvation. Bound water, free water, gels, emulsions and foams, water activity. Distribution of water in various foods and moisture determination.

MODULE II CARBOHYDRATES 11

Carbohydrates: Nomenclature and classification, structure and chemical properties of monosaccharide carbohydrates CH-2 disaccharides and polysaccharides (cellulose, starch, fructans, galactans, hemi-cellulose, pectic substances, carageenan); changes in carbohydrates during processing, Carbohydrates determination methods.

MODULE III PROTEINS 9

Proteins: Classification, structure and properties of amino acids, structure of protein, physical and chemical properties of proteins. Changes in protein during processing, protein determination methods. Proteins from plant and animal sources.

MODULE IV LIPIDS 8

Lipids: Lipids- Classification- Simple, Compound and Derived Lipids- structure and properties- phospholipids- glycoplipids-sphingolipids- cholesterol. Fatty acids- saturated and unsaturated fatty acids -Structure. Lipids-simple & derived. Changes during food processing.

MODULE V VITAMINS AND MINERALS **8**

Vitamins and minerals: Classification, structure and role of vitamins in food and effects of cooking. Aroma substances and flavor enhancers sugar substitutes and food color.

TOTAL : 45

REFERENCES:

1. Cox M.M., Melson D.L. (2008) Lebninger Principles of Biochemistry. 5th edition, W.H. Freeman and Company, New York
2. Food science Chemistry & Experimental Foods by Dr. M.Swaminathan
3. Food chemistry by Lillian Hoagland Meyer

OUTCOMES:

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

- Can perform foods components analysis and moisture determination
- Can perform carbohydrates and protein determination analysis
- Define changes of lipid during food processing Interpret results acquired from various chemical components analysis

FBB3103 UNIT OPERATIONS IN FOOD PROCESSING

L	T	P	C
4	0	0	4

OBJECTIVES:

The course aims to

- Provide a programme of education which can enable its graduates to enter a career in the food processing and technologies employed for this.

MODULE I INTRODUCTION **11**

Basic Principles of food processing, Dimensions and Units, Dimensional Consistency, Conservation of mass and energy.

MODULE II EVAPORATION **12**

Basic principle, need for evaporation, single effect, multiple effect, heat economy,vapour recompression, boiling point elevation, types of evaporator.

MODULE III DISTILLATION **12**

Liquid vapour equilibrium, distillation of binary mixtures, simple distillation, flash distillation, steam distillation. Crystallization-rate of crystallization, crystallization equilibrium

MODULE IV CONTACT EQUILIBRIUM SEPARATION PROCESS **13**

Concentration, Gas – Liquid equilibria, Solid – Liquid equilibria, Extraction-Solid Liquid extraction, Liquid-Liquid extraction, stage equilibrium extraction. Super critical fluid extraction, Application-extraction of fatty acid, Essential oils.

MODULE V MECHANICAL SEPARATION AND MATERIAL HANDLING **12**

Sedimentation, Floatation, Centrifugal separation, filtration, Mixing, Material handling-Belt conveyor, Screw Conveyor, bucket elevator and pneumatic conveyor.

TOTAL : 60

REFERENCES:

1. Paul Singh and Dennis R Heldman., “Introduction to Food Engineering”.Third Earle R.L., “MODULE operations in Food Processing”, Pergamon Press.
2. R. edition. “Academic press”, London 2004.

1. McCabe, W.L. and Smith.J.C, “Unit Operations of Chemical Engineering”, McGraw-Hill 1976.

2. Geankoplis C.J, “Transport Processes and Unit Operations”, 3rd edition, Printice Hall of India 2003.

OUTCOMES:

At the end of the course students should be able:

- to apply the principles of mass, heat transfer and thermodynamics to analyze and synthesize unit operations in food processing technology.
- to use short cut and graphical methods in design of multicomponent distillation, absorption, stripping and other processes
- to analyze critically advantages and disadvantages of various design options and parameters.

FBB3104 FOOD FERMENTATION TECHNOLOGY L T P C
4 0 0 4

OBJECTIVES

Students completing this course student should be able

- To understand various concepts, principles and procedures involved in the area of fermented food production
- To familiarize with different fermentor types and their design criteria

MODULE I FERMENTATION PROCESS 11

Introduction to fermentation - definition - benefit of fermentation - nutritive value of fermented foods - microbial changes in fermented foods - micro organism - proteolytic, liploytic and fermentative bacteria.

MODULE II FERMENTATION TYPES 13

Selection of industrial importance microorganisms -production of single cell protein. Media for industrial fermentation - Medium Composition - Energy, CO2, nitrogen and other growth factors, buffering and foam agents. Types of fermentation - Ethonolic fermentation - mixed alcoholic and acidic fermentation - Lactic acid fermentation.

MODULE III STERILIZATION 12

Sterilization - Principles, sterilization of fermentation media, fermenter - in-batch and continuous process - development of inoculum for industrial fermentation - criteria for transfer of inoculums - aseptic noculation.

MODULE IV FERMENTOR 12

Basic functions of fermentor - Design of fermentor - types of fermentor – different parts - agitator, impellers, aerator, baffles, process control, function and maintenance of various parts of fermentor. Recovery and purifications of food products - filtration - batch and continuous types - fermentor accessories.

MODULE V TECHNOLOGYOF FERMENTED FOOD PRODUCTS 12

Traditional fermented foods - Curd, yoghurt, dhokla, miso, shrikand, cheese, butter milk, dosa. Modern fermented products - Wine, beer, brandy, vinegar,

baker's yeast, sauerkrauts, sausages, fermentation of milk, meat, fruits and vegetables.

TOTAL : 60

REFERENCES :

1. Stanbury, P.F., Allan Whitaker and S.J. Hall, “Principles of Fermentation Technology”. Aditya books private Ltd., New Delhi 2002.
2. James M. Jay, Martin.J. Loessner, David. A. Golden, “Modern Food Microbiology”. Springer Science Media Publisher, New York. USA 2005.
3. Pederson, C.S., “Microbiology of food fermentations”, AVI Publishing company. Westport, Connecticut 1971.
4. Joshi V.K, and Ashok Pandey, “Biotechnology: Food Fermentation” 2005.

OUTCOMES:

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

- Explain processes involved in production of Nigerian and selected foreign fermented foods
- Classify and explain the different types of fermented foods
- Understand purpose and functions of fermented foods
- Produce flow chart for the production processes of fermented foods
- Be able to use fermentation processes in waste management
- Be able to describe processing operations involved in enzyme, single cell protein, antibiotics production

FBB3105 PROTEIN FOOD PROCESSING L T P C
4 0 0 4

OBJECTIVES:

This course provides the students with an understanding of the science and applications of proteins as food sources, their functionality in food systems, and changes in their functionality due to processing operations. The prime scientific and technological theme is an understanding of how proteins and their structural and functional characteristics underpin a range of technologies responsible for the production of a vast array of food products.

MODULE I PROTEINS 8

Properties of proteins in food system- Chemical and physical properties of food proteins, Factors affecting properties of proteins in food systems, Structure and function of proteins: classification and relationships.

MODULE II SOURCES OF PROTEINS 12

Caseins, Heterogeneity of the caseins, Molecular properties of the caseins, The caseins as food constituents and ingredients, The casein micelle: introduction, Properties and stabilisation mechanisms of casein micelles, Structure models of the casein micelle, Stability of casein micelles, Muscle Proteins, Structure of muscle proteins and endogenous proteases, Muscle protein functionality, Prepared muscle proteins as functional ingredients,

Proteins from oil-producing plants, Introduction, Oilseed protein characteristics, Factors limiting protein utilization, Extraction and isolation of proteins, Functional properties of proteins, Improving functionality of oilseed protein.

MODULE III ANALYSIS AND MODIFYING PROTEINS 12

Introduction, Protein structure: sample characteristics and commercial proteins, Testing functionality, Model foods: foaming, Model foods: emulsification and gelation. Factors affecting enzyme activity in foods, Types of enzymes and post-harvest food quality, Parameters affecting enzyme activity, Methods of analysing allergenic proteins, Methods of detecting food allergens, Developing new rapid tests: dip-sticks and biosensors

MODULE IV APPLICATIONS **12**

Using Proteins as additives in foods, Rheological properties of proteins, surfactant properties of proteins, protein flavor relationship, Protein structure and Techhno-functionality.Materials and Methods used in protein film formation, properties of protein film, Treatments used for modifying the functional properties of protein films and caoatings.

MODULE V PROTEOMICS **8**

Proteomics: Introduction, Protein separation techniques, Using Mass spectrometry to identify and characterize proteins, Impact of food processing on soy protein. Texturized vegetable protein, Effect of additives on texturized vegetable protein.

MODULE VI **8**

Immobilized enzymes and Impact of proteins in food color, Modifications of carbohydrates, Production of flavors and speciality products, modification of lipid, modification of proteins.

TOTAL : 60

REFERENCES:

1. Proteins in Food Processing by R.Yada, CRC Press
2. Food protein analysis by R.K.Owusu-Apenten CRC Press

OUTCOMES:

- Upon successful completion of the course, students should be able to:
- Identify protein supply and the world's shortage of proteins
- Classify animal and plant proteins in terms of their structural complexity
- Analyze the functional properties of proteins in terms of their structural configuration
- Identify functionality of different types of proteins
- Evaluate the relevant end-product characteristics of a range of protein products
- Identify how cultural and religious preferences impact on the appeal of protein foods

- Define methods of recovering useful ingredients from protein food processing plants
- Match different protein food sources with different extraction, purification and preservation processes.
- Evaluate the change in nature and functionality of protein foods as a result of the processes employed
- Assess the structural and functional characteristics including 'interchangeability' of proteins and end-product characteristics
- Recognize the sensitivity of protein components, and the implications of variables (eg heat, pH, mineral concentration and/or physical factors on their nature
- Recognize that different protein foods require different treatments and processing to maintain optimum functionality and nutritional value

FBB3106 FOOD ADDITIVES AND POST PROCESS HANDLING

L	T	P	C
4	0	0	4

OBJECTIVES:

- A better understanding of the additive compounds used in food processing
- To learn the post processing handling procedures
- An idea about the recent methodologies involved in food processing.

MODULE I INTRODUCTION TO FOOD ADDITIVES **12**

Definitions, uses and functions of Acid, Base, Buffer systems, Salts and chelating/sequestering agents, Masticatory substances. Low calorie and non nutritive sweeteners, Polyols.

MODULE II FOOD ADDITIVE AGENTS-I **12**

Antioxidants, Emulsifying and stabilizing agents, Anti-caking agents, thickeners, Firming agents. Flour bleaching agents and Bread improvers.

MODULE III FOOD ADDITIVE AGENTS-II **11**

Anti microbial agents / Class I and Class II preservatives as per PFA Act.

MODULE IV FOOD ADDITIVE AGENTS-III **11**

Colorants, Flavoring agents and related substances, clarifying agents. Gases and Propellants, Tracers and other additives.

MODULE V FOOD STANDARDS AND SPECIFICATIONS **14**

Compulsory and voluntary trade and Company standards. Consumer Protection Act (1986) and relevant Food Legislation (Act, orders, standards): PFA(1954), FPI(1955), SWMA, MPO(1977), VCO(1978), AgMark, BIS, US, Canadian, EU, ISO and Codex Food Standards, Export Quality Control and Inspection act (1963), Environment Protection Act (1986), WTO & GATT.

TOTAL : 60

REFERENCES:

1. O.R. Fennema Food Chemistry. Mercel Dekker, Inc. 1996.
2. David E Newton, Food Chemistry. Facts on File Inc. 2007

OUTCOMES:

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

- Understand the importance of food additives
- Identify the basic post processing techniques
- Learn the recent advances in food processing techniques

FBB3107	FOOD MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

1. Identification of microorganism - Yeast, mould, algae.
2. Simple staining, grams staining and hanging drop preparation.
3. Identification of microorganisms in curd.
4. Identification of mould in bread.
5. Bacteriological testing of milk.
6. Observation of culture characteristics and preparation of culture media.
7. Preservation using low temperature, high temperature and chemical preservatives.

REFERENCE

Laboratory Manual

OUTCOMES:

By the end of the course, the students should be in position to know current aspects of food microbiology with special emphasis on spoilage organisms and food borne pathogens and its applications in health.

FBB3108	FOOD CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To learn the preliminary methods in food chemistry.
- To estimate various components of food by biochemical assays

LIST OF EXPERIMENTS:

1. Chemical Analysis of Lipids Determination of Iodine value, Determination of saponification value
2. Determination of peroxide value, Determination of Free Fatty Acid
3. Analysis of food – total protein by Kjeldahl's methods
4. Analysis of food -total carbohydrate content
5. Analysis of food – total fat content
6. Analysis of Water- total solids, acidity, alkalinity, determination of Chloride and Hardness of water
7. Estimation of vitamin 'C' in foods
8. Ash content
9. Estimation of iron in foods
10. Estimation of calcium in foods

REFERENCES:

1. Cox M.M., Melson D.L. (2008) Lebninger Principles of Biochemistry. 5th edition, W.H. Freeman and Company, New York
2. Sathe A.Y. (1999) A First Course in Food Analysis. New Age International (P) Ltd. publishers, New Delhi.
3. Berwal J.S., Grewal R.B., Kapoor C.M., Garg M.K. (2004) Practical Methods in Food Analysis. Agrotech publishing academy, Udaipur

OUTCOMES:

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

FBB3109	UNIT OPERATIONS IN FOOD PROCESSING LABORATORY	L	T	P	C
		0	0	3	1

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.

LIST OF EXPERIMENTS:

1. Experiments on evaporation
2. Experiments on size reduction of burr mill
3. Experiments on size reduction by mini dhal mill
4. Experiments on oil extraction by soxhlet apparatus
5. Experiments on super critical fluid extraction
6. Experiments in rotary flash evaporator
7. Experiments of mixing solid with solid
8. Experiments on inclined belt separator
9. Experiments on batch distillation process
10. Performance evaluation of screw conveyor
11. Performance evaluation of bucket elevator
12. Study of drying characteristics of the given material by fludisied bed drying

REFERENCE:

Laboratory Manual

OUTCOMES:

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

1. Define unit operations employed in food processing with respect to their function and effects on food materials and the equipment employed.
2. Construct process flow diagrams and their combination and sequence within a process.

3. Interpret the mechanisms of preservation applied to the foods through the unit operations

4. Operate equipment used in production and preservation with an understanding of the effect of the operation applied on food properties.

FBB3211 FOOD TOXICOLOGY L T P C
4 0 0 4

OBJECTIVES:

- To introduce the four basic areas of instrumental methods, examine the differences between the instrumental methods as well how the methods are different yet complimentary to each other.
- To learn the advantages and limitations of the instrumental methods
- To be able to choose the most appropriate instrument to solve ananalytical problem.

MODULE I INTRODUCTION TO FOOD TOXICOLOGY 9

Scope, history and development of toxicology. Principles of food toxicology. Classifications and divisions in Toxicology. Classes of toxicants. Indicators of toxicity and their evaluation. Understanding about Safe Food and Nutrition. Further developments of Toxicology.

MODULE II NATURAL TOXICANTS PRESENT IN FOODS 10

Natural toxicants present in foods (plants, animal, marine and microbial toxins). Phytoalexins, alcaloids, inhibitors of enzymes and toxic proteins, cyanogenic glycosides, phenols. Antagonists of vitamins. Xenobiotics. Natural carcinogens in animal and plant materials. Types of these dangerous chemical substances and their effects on living organisms.

MODULE III NATURAL TOXICANTS BROUGHT INTO THE FOOD THROUGH SPOILAGE 12

Food-borne disease agents among the major microbial groups: fungi, bacteria, algae viruses, protozoa and worms. Methods of identification and characterization of microbes. Bacteria staining techniques - simple, differential-staining techniques of microorganisms, spores and food poisoning microorganisms; microbial growth and survival; food toxicants; Bacteriotoxins Mycotoxins their production, properties and regulation; microbial genetics. Control of microbial agents of food spoilage and methods of sterilization.

MODULE IV ENVIRONMENTAL FACTORS INFLUENCING GROWTH OF TOXIGENIC MICROORGANISMS 11

Cultivation and research of toxigenic microorganisms. Microbiological media, enriched medium, enrichment medium, transport medium, selective medium & pure culture techniques. Methods of preservation and maintenance of cultures. Environmental factors influencing the growth and survival of microorganisms. Physical factors - temperature, light, osmotic pressure and hydrostatic pressure. Chemical factors - pH, 02 and CO2. Biological factors - inter-reactions of microbial population and comm MODULEy dynamics - growth in closed environments and in open environments,

MODULE V TOXICANTS FORMED IN PROCESSED FOODS 9

Food Engineering—Basic Terms and Principles. Toxicants formed in processed foods. Hazardous chemical compounds arising from processing and storing of foods. Heating and Chemical Changes. Changes to Frying Food and Frying Oil. Conservation. Radiation and Microwave Energy. Nitrosamines and other biologically active nitro compounds. Polycyclic aromatic hydrocarbons.

MODULE VI ENVIRONMENTAL TOXICANTS 9

Health Effects of Nitrate, Nitrite and N-Nitroso Compounds. Pesticides. Heavy metals and other toxic elements (lead, arsenic, mercury, cadmium and others). Radionuclides. Organic environmental contaminants of industry (polycyclic aromatic hydrocarbons, diphenyls, dioxins and pentachlorophenol)

TOTAL : 60

REFERENCES:

1. Schlegelh, 1988: general microbiology. - cambridge, new york, new rochelle, melbourne, sydney.: cambridge university press.
2. Toxins in Food – Waldemar M. Dabrowski and Zdzislaw E. Sikorski CRC press.
3. Principles of Food Toxicology, Second Edition. By Tonu Pusa, Academic Press.

OUTCOMES:

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

- Define components and operation of modern chemical instrumentation
- Interpret results acquired from various chemical instrumentation
- Assess the benefits and limitations of different instrumentation methods and instrumental components
- Identify appropriate instrumental methods for a chemical analysis

FBB3212 FOOD PROCESS TECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

The course aims to

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

MODULE I HISTORICAL BACKGROUND 10

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

MODULE II BREWING, MALTING, MASHING, HOPS, PRIMARY & SECONDARY FERMENTATION 8

Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl. Beer, wine and distilled spirits.

MODULE III NUTRITIONAL BOOSTS AND FLAVOR ENHANCERS 9

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

MODULE IV 11

Food Preservation, Food Preservation Using Irradiation, Characteristics of

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

MODULE V **10**

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

MODULE VI **12**

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

TOTAL : 60

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

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

FBB3213 FOOD PLANT LAYOUT AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

This course aims to provide students with fundamental knowledge of the design and analysis of various equipments in process industries and their applications in various areas.

MODULEI INTRODUCTION 9

Introduction to plant design - special features of food process industry-types of processing machineries-Manufacturing processes-concept -types-special features for fruit, vegetable, bakery & milk products - Characteristics of an efficient layout

MODULE II SELECTION OF PLANT LOCATION 9

Plant location, location theory and models, Plant location factors-plant site selection-estimation of series- peak and critical load-Economic plant size-plant layout objectives-classical and practical layout.

MODULE III DEVELOPMENTOF THE LAYOUT 9

Development and presentation of the layout, selection of site and Location of plant, General points of considerations for designing food plant, floor plant types of layouts Food building planning, -preparation of machinery layout for fruit, vegetables and meat-size reduction machinery layout

MODULE IV EVAPORATIONAND DRYING PLANT LAYOUT 9

Evaporation plant layout-single, multiple, vacuum and film evaporators-types and concepts, drying plant layout, drying process, drier types, selection of driers.

MODULE V PROCESSING PLANT LAYOUT 9

Baking oven and frying plant-types, concepts and layout. Filling closing and labeling plant layout.Organization and trends in plant layout - sample layout, installation procedure for food processing plant.

TOTAL : 45

REFERENCES :

1. James, M.More, “Plant Layout and Design”. MacMillian Publishing Co., New York 1976.
2. Slade, F.H, “Food processing plant”. Leonardhill Books, London1967.
3. American Society of Heating, “Refrigerating and Air-Conditioning Engineers”, Ashrae Handbook, Fundamentals. ASHRAE, Atlanta, Georgia 1981.
4. Hall, H.S and Y.Rosen, “Milk plant layout” (F.A.O. Publication) 1976.

OUTCOMES:

The outcomes from the course are to create future managers who are sufficiently confident, within a food production environment, that they can lead and initiate processing related to foods in a safe and creative manner.

- Knowledge and understanding: to learn of: design and hygiene operation of food factories and plant; understand legal requirements and codes of practice for the safe operation of food factories; quality of services required (e.g. steam, water, automation); the unit operations used in food processing.
- Intellectual skills: the ability to: identify the key features determining successful new processes; combine hygienic requirements of food production with efficient pant layout and
- Professional practical skills: the ability to: identify the critical control points where product or process can be compromised, draw, using standard symbols, factory layouts.

FBB3214 FOOD FLAVORING TECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

- A better understanding of the added flavors to food
- To learn technological advancements in food flavoring technology
- To provide recent advancements in food flavoring techniques

MODULE I INTRODUCTION 13

Food flavor and its importance to consumers and food processors. Flavor and nutrition. Sources, extraction, delivery systems, and analyses (chemical, instrumental, and sensory) of flavours and flavorings in foods. Sensory perception of flavor: Senses of taste and smell, tasting versus sniffing, astringency, pungency, interaction of senses in flavor perception; taste, odour and acceptance of flavor stimuli.

MODULE II CHEMISTRY OF FOOD FLAVORS 12

Chemistry of substances responsible for taste and flavor-taste sensations, flavour enhancers, flavour potentiators or modifiers. Methodology of sensory evaluation and determination of threshold levels.

MODULE III FOOD FLAVORS-I 12

Flavoring constituents of various foods like meat, fish, milk, vegetables, fruits, fats & oils, spices & herbs, cereals and pulses. Flavor changes during processing, preservation, packaging, and storage of foods. Roles as sulfur compounds, fatty acids, amino acids, terpenoids, lactic acid-ethanol in food flavours. Process and reaction flavours/volatiles in foods.

MODULE IV FOOD FLAVORS-II 11

Spices and herbs as food flavorings: Processing of basil, mint, saffron, cloves, tamarind, ginger, cardamom, chilies, pepper etc. for essential oils, extracts and oleoresins.

MODULE V FOOD FLAVORS-III 12

Determination of hygroscopic nature and shelf life/acceptance of foods. Natural, Nature identical and Synthetic flavors: Definitions, chemical composition/

constituents, extraction and preparation of flavors, Stability and utility of flavor preparations. Methods used in flavor evaluation. BIS Specifications/PFA restrictions for use of certain constituents in flavoring materials.

TOTAL : 60

REFERENCES:

1. Henryk Jelen. Food Flavors: Chemical, Sensory and Technological Properties. CRC Press, 2012.
2. Andrew J. Taylor, Robert Linforth. Food Flavour Technology. Blackwell publishing, 2010.

OUTCOMES:

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

- Understand various methodologies for food flavoring
- Learn the diverse chemistry of food flavors
- Learn the recent technological advances and their implications in food flavor technology

FBB3215	FOOD PROCESS EQUIPMENT DESIGN AND DRAWING LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

To familiarize:

1. The design and drawing of fittings and ancillary parts of the food processing equipments.
2. The design and drawing of various types food processing equipments.

LIST OF EXPERIMENTS:

1. Design and drawing of Enclosures.
2. Design and drawing of Vessel supports
3. Design and drawing of Flanges.
4. Design and drawing of Agitators.
5. Design and drawing of Centrifuge.
6. Design and drawing of Filter press.
7. Design and drawing of Crystallizer.
8. Design and drawing of Heat Exchangers
9. Design and drawing of Evaporator
10. Design and drawing of Dryer

REFERENCES:

1. Sinnott, R.K., Coulson & Richardson's,"Chemical Engineering", Volume 6, 3rd Edition, Butterworth Heinemann, New Delhi 1999.
2. Perry, R.H., and Green, D.W., “Chemical Engineers’ Handbook”, 7th Edition, McGraw-Hill. New York 1997.
3. Joshi, M.V., and Mahajani, V.V, "Process Equipment Design", 3rd Edition, Macmillan India Limited, New Delhi 1996.
4. McCabe, W.L., Smith, J.C., and Harriot, P, “Unit Operations in Chemical Engineering”, 6th Edition, McGraw-Hill, New York 2001.

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

OBJECTIVES:

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

TOPICS OUTLINE:

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

LAB ACTIVITIES:

- Introduction: Soft skills definition, examples
- Verbal communication: Case study, communication and discussion
  - 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
  - Organization and Planning
  - Time keeping
  - Conduct in workplace
  - Conscientiousness
  - Work output
  - Professionalism
  - Motivation
- Ownership of tasks
- Adaptability/flexibility

ASSESSMENT:

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

OUTCOMES :

The students should be able to:

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

FBB4101 DAIRY PLANT ENGINEERING L T P C
4 0 0 4

OBJECTIVES

1. To make the student familiarize with
2. The unit operations involved in the processing of milk and its products
3. The different equipments and technologies applied in a dairy plant from the point of reception of milk till it is packed and stored.

MODULE I PASTEURIZATION 12

Milk-physical, chemical and functional properties-composition -reception and storage-testing—milk grading and defects-cooling of milk –Pasteurization – principles, objectives and methods.LTLT/holding pasteurization-types, advantages and disadvantages. HTST pasteurization- functions of HTST pasteurizer, advantages and disadvantages –milk flow diagram-.vacreation.

MODULE II STERILIZATION AND HOMOGENIZATION 12

Sterilization-Inbottle sterilization, UHT processing-advantages-difficulties, Indirect heating systems using plate heat exchangers, Direct heating-Fouling of heat exchangers. Packaging for asceptic processing-Homogenization theory, mechanism-merits and demerits –factors influencing homogenization

MODULE III CENTRIFUGATION, BACTOFUGATION AND MEMBRANE SEPARATION 12

Principles of Centrifugation-clarification-separatoion-standardisation-clarifiers and cream separators - components -factors affecting fat percentage in cream-fat loss in skim milk. Membrane processing-principles of -Reverse osmosis – Ultra filtration and Electro dialysis. Bactofuge treatment- Factors affecting bactofugation-Application

MODULE IV CLEANING AND PACKAGING 12

Principles of Cleaning- -can washing- - Cleaning Cycle, Washing Methods-Types of Can washers cleaning-in-place- Cleaning procedures, -Centralized and Decentralized CIP systems –-corrosion control.

MODULE V MANUFACTURE OF DAIRY PRODUCTS 12

Milk powder - spray drying- construction, powder recovery system, - Butter, cheese, Ice cream, Paneer, Khoa, Rabari, Basundi, Rasmalai, condensed milk – manufacturing methods-defects- standards- packaging.

TOTAL : 60

REFERENCES :

1. Tufail Ahmed, “Dairy Plant Engineering and Management”, CBS Publishers and Distributors, New Delhi 2001.
2. De Sukumar, “Outlines of Dairy Technology”, Oxford University Press, New Delhi 1999.
3. R.K. Robinson, “Modern Dairy Technology I: Advances in Milk Processing”. Elsevier Applied Science Publishers, Ltd., London, UK 1986.
4. R.K. Robinson, “Modern Dairy Technology II Advances in Milk Products”. (Ed.). Elsevier Applied Science Publishers, Ltd., London, UK 1986.
5. Ananthakrishnan. C.P. and M.N.Sinha, “Technology and Engineering of Dairy Plant Operations”, Laxmi Publications, New Delhi 1997.
6. Farrall.A.W., “Engineering for Dairy and Food Products”, John Wiley and Sons, New York 1995.
7. Robinson .R.K., “Modern Dairy Technology Vol.1 “Advances in Milk Processing”, Elsevier Applied Science Publishers, London 1996.
8. Dairy Science and Technology: Principles and Applications. La Fondation de Technologie Laitiere du Quebec, Inc (Ed.), Les Presses de 'Universite Laval, Quebec, Canada 1985.
9. Kessler. H.G, “Food Engineering and Dairy Technology”. Verlag Kessler, Germany 1981.

OUTCOMES:

At the end of this course the students should have developed the following capabilities:

- A broad and coherent body of knowledge of milk source and composition
- An in-depth understanding of biochemical and microbiological changes taking place during dairy products manufacture and the significance of healthy and functional foods
- Hands-on skills in manufacturing selected dairy products in a pilot plant setting
- An appreciation of the safety and quality factors that determine the acceptability of the dairy products by consumers

FBB4102 FOOD SAFETY AND REGULATIONS L T P C
4 0 0 4

OBJECTIVES

The students will be able to

- Identify the wide variety of parameters affecting food safety, to Implement HACCP in any food industry, to know the requirements of FSSAI.

MODULE I INTRODUCTION 12

Principles of food safety –Establishment: design and facilities – emergency preparedness – Maintenance cleaning and sanitation – personal hygienic – packaging and labeling – transportation – traceability – recall procedure.

MODULE II CODEX ALIMENTARIUS 13

Codex Alimentarius – PRP – GMP – GAP - GRAS- SSOP, HACCP - principles – Hazard analysis – determine CCP – establish critical limit – establish monitoring procedure – establish corrective action – record keeping – verification – AOQL (Average Outgoing Quality Limit) – HACCP plan chart.

MODULE III ADULTRATION 13

Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides – inorganic residues and contaminants.

MODULE IV FOOD LAWS 12

FSSAI, Essential Commodities Act, BIS, organizational chart – prohibition and regulation of sales – Laboratory and sampling analysis – scope and objective of industry – food safety policy – environmental policy – glass policy – jewelry policy – visitor policy.

MODULE V FOOD SAFETY IMPLEMENTATION 10

Implementation of food safety for a desired food processing industry

TOTAL : 60

REFERENCES:

1. Food safety and standards regulations, 2010.
2. General requirements (Food Hygiene) of the Codex Alimentarius, Volume II.

Food and Agriculture organization of the MODULEed Nations.

3. The ministry of health and family welfare, The Gazette of India : Extraordinary, Part- III, section.

OUTCOMES:

On successful completion of the programme, students should be able to

1. apply the fundamentals of food chemistry and the analytical techniques associated with food to assure food safty in the community;
2. identify the major microorganisms and other harmful substances in foods as well as the conditions, including inspection and sanitation practices, under which the assurance of food safety can be achieved;
3. use the basic principles involving food preservation, processing and engineering as well as the associated practices and requirements to solve problems in diverse sectors of food technology;
4. integrate and apply the knowledge and skills acquired to identify and solve food safety and technology related problems, in particular those related to the control and assurance of the quality of food products, sensory evaluation of food, analysis of food hazards, sanitation operation, etc.;

FBB4103	FOOD PRODUCT DEVELOPMENT AND MARKETING	L	T	P	C
		4	0	0	4

OBJECTIVES

The students should develop:

- knowledge, understanding and skills related to food hygiene, safety and the provision of quality food
- knowledge and understanding of food properties, processing and preparation and an appreciation of their interrelationship to produce quality food
- knowledge and understanding of nutrition and food consumption and an appreciation of the consequences of food choices on health
- skills in researching, evaluating and communicating issues in relation to food
- skills in designing, producing and evaluating solutions for specific food purposes
- knowledge, understanding and appreciation of the significant role of food in society

MODULE I FOOD PRODUCT DEVELOPMENT 10

Basic principles and concept of food product development, cultural approach to development of dietary pattern of various groups-language, linguistic, regional, religious (ethnic), Factors involved in food habit alteration, availability, importance and role of different research and development departments in food production industry.

MODULE II STEPS IN PRODUCT DEVELOPMENT 10

Steps in product development-material resources based on market demand, standardization methods involved in product development. Portion size and portion control; Calculation of nutritive value and cost of production, shelf life and storage stability evaluation procedure of developed food products.

MODULE III FORMULATION 10

Formulation of new food products for infants, preschool children, adolescents, pregnant and nursing mothers, old age, sports persons, armed sources personnel and therapeutic uses. Selection and training of judges, Development of Score Card and analysis of data, Role of advertisement and Technologies in promotion of new products.

MODULE IV MARKETING **10**

Concept of market and marketing - approaches of study marketing and marketing functions, market structure, marketing efficiency and market integration, Role of Government in promoting agricultural marketing. Market promotion and positioning of food products.

MODULE V QUALITY PROCESSING **9**

Conditions for sale, license and identification and quality processing, conditions for distribution, storage and sanitation, studying the global market status, Role of export promoting agencies, Economic feasibility of new products.

MODULE VI SUPPLIER MANAGEMENT **11**

Supplier management: Supplier pre-assessment and review, supplier documentation, internal audits, external audits, study of regulatory compliance, food quality management sanitation programs in the supply chain, food safety assessment, employee training, environmental monitoring, foreign material control, label control programs and consumer packaging, product and ingredient tracing, product testing, control of non-conforming product, consumer complaints, recalls and market withdrawals, crisis management.

TOTAL : 60

REFERENCES:

1. New Food Product Development: From Concept to Marketplace, Third Edition, Garden W Fuller, CRC Press
2. Accelerating New Food Product Design and Development Jacqueline H. Beckley M. Michele Foley, Elizabeth J. Topp J. C. Huang,Witoon Prinyawiwatkul, Blacwel publishing, IFT Press.

OUTCOMES:

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

- demonstrates hygienic handling of food to ensure a safe and appealing product
- identifies, assesses and manages the risks of injury and WHS issues associated with the handling of food
- describes the physical and chemical properties of a variety of foods

- accounts for changes to the properties of food which occur during food processing, preparation and storage
- applies appropriate methods of food processing, preparation and storage
- evaluates the impact of activities related to food on the individual, society and the environment

FBB4104 FOOD PACKAGING TECHNOLOGY L T P C
4 0 0 4

OBJECTIVES:

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

- Understand the fundamental concepts of food packaging
- Identify the basic approaches for packaging industry
- Learn the recent advances in food packaging techniques

MODULE I INTRODUCTION TO FOOD PACKAGING 12

Basic concept of packaging, functions of a food package, package development factors, food package development, current status and trends in food packaging in India and abroad.

MODULE II PACKAGING MATERIALS 12

Packaging materials and forms: Glass containers and closures tin-plate containers, tin free steel containers, aluminum and other metal containers. Protective lacquers and coatings for metal containers. Wooden crates, cellulosic papers, pouches, bags and card board / corrugated paper boxes.

MODULE III FOOD CONTAINERS 12

Rigid and flexible plastics (polyamides, polyester, PVC, PVDC, PVA, polycarbonates, olefins, cellophane, inomers, copolymers, phenoxy, acrylic, and polyurethanes) containers and films (oriented, coextruded, laminates, metallized) and their mechanical sealing and barrier properties.

MODULE IV EVALUATION OF PACKAGING 12

Material and package performance, packaging equipment, package standards and regulation. Shrink packaging. Bar coding, aseptic and retortable pauches. Flexible and laminated pouches, aluminium as packaging material. Biodegradable packaging, Active packaging.

MODULE V PACKAGE REQUIREMENTS 12

Food product characteristics and package requirements. Selection of materials, forms machinery and methods for fresh product (fruits and

vegetable), eggs, meat, fish and marine products, snacks and confections. Package printing, packaging laws and regulations.

TOTAL : 60

REFERENCES:

1. Richard Coles, Derek McDowell, Mark J. Kirwan. Food Packaging Technology. Blackwell Publishing, 2003.

2. Frank A. Paine, H.Y. Paine. A Handbook of Food Packaging. Chapman and Hall, India , 1992.

OUTCOMES:

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

- Understand the importance of food packaging in general
- Identify the basic techniques for packaging industry
- Learn the recent advances in food packaging sector

FBB4105 DAIRY FOOD TECHNOLOGY LABORATORY

L	T	P	C
0	0	3	1

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.

LIST OF EXPERIMENTS:

1. To check the purity of milk using lactometer
2. Viscometric characterization of flowable buffalo-milk products
3. Visit to a bio-processing unit.
4. Measurement of different functional properties of casein and whey protein
5. Vacuum packaging of dairy products.
6. Preparation of flavored milk using artificial sweetener and its estimation
7. Properties of various gelling agents for foods.
8. Development of pro-biotic cheese and fermented foods.
9. Development of improved infant food formulations.
10. Preservation of dairy foods by employing bio-preservatives.
11. Development of low-cost quality food formulations with protein supplementation.

OUTCOMES:

At the end of the course students will know

- about the properties of the milk and checking its quality and how quality it can be preserved.
- To know how to check the adulteration in milk.

FBB4106	FOOD PACKAGING LABORATORY	L	T	P	C
		0	0	3	1

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.

LIST OF EXPERIMENTS:

1. Development of bio-degradable / eco-friendly packaging materials.
2. Development of processing and packaging methods for extending shelf life of traditional Indian foods
3. enzymatic extraction and clarification of fruit juices
4. study on different packaging system
5. testing of packaging materials for quality assurance, like bursting strength, tearing strength.
6. packaging of turmeric powder and ground chilli powder
7. vacuum packing of dairy products

OUTCOMES:

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

1. Gain deeper appreciation of the principles and concepts learnt in related food chemistry and food processing subjects.
2. Acquire the practical skills in food preservation, processing and packing.
3. Recognize the effects of processing conditions on the physical and chemical properties of food products and inhibit the undesirables.
4. Develop better skills in planning and conducting experiments, collecting experimental data, analyzing and interpreting results, and writing technical reports.

ELECTIVES
Group 1
(Two to be opted from elective subjects offered below)

FBBX01 FAT AND OIL PROCESSING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To identify the different sources of fat, To study the different unit operation involved in refining oil
- To know the products made from fat and oil

MODULE I SOURCES OF FAT 10

Fat consumption-nutritive value- chemical composition of fat and oil- types of fatty acid - sources of fat- Physical, thermal and chemical properties of fat and oil. Pretreatment and storage of oil seeds.

MODULEII INDUSTRIAL PRODUCTION OF OIL 10

Production of oil-extraction of oil - cold pressing and hot pressing, solvent extraction, rendering-removal and recovery of solvent form miscella-removal and recovery of solvent from extracted residue-refining of oil-neutralization degumming - bleaching - alkali refining-deoderization.

MODULE III EDIBLEOIL PRODUCTION 7

Winterization of oil, hydrogenization of oil, generation and storage of hydrogenproduction and regeneration of catalysts-filtration of hardened oil-production of palm oil –rice bran oil, soybean oil.

MODULE IV PROCESSINGOF ANIMAL FATS 8

Animal fats-sources-nutritive value- industrial application-Lards-tallow-physical nature- production and storage, production of margarine, partial sterilizationemulsification- chilling-kneading and cooling-Incorporation of salt and colouring agent.

MODULE V PRODUCTMADE FROM FAT AND OIL 10

Changes during storage of oil seeds-rancidity-causes-atmospheric oxidation and enzyme action-free fatty acids-Non edible oil-Castor oil-Linseed oil-vegetable waxes-production-industrial application of fats and oil-soap-candle –paints and varnishes.

TOTAL : 45

REFERENCES

1. Kirschentiuer, H.G, “Fats and Oils”, Reinhold Publishing Corporation, New York 1944.
2. Weiss, T.J, “Food oils and their Uses”. The AVI Publishing Company, Inc., Westport, Connecticut 1970.
3. Hilditch, T.P, “Industrial chemistry of fats and waxes”. Bailliere, Tindal and cox, London 1943.
4. Willans, P.N. and Devine, “The Chemistry and technology of Edible oils and fats” 1984.

OUTCOMES:

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

- Explain the relationship between the chemical structure and the physical properties of fats and oils.
- Describe the various steps in fat extraction and refining process.
- Describe the various processes used in the production of some fat products.
- Recognize the functionality roles of fats in fat-based foods.

FBBX02 FRUIT AND VEGETABLE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

At the end of this course the students get a detailed background about

- Various methods used for preserving fruits and vegetables.
- Different operations involved in processing fruits and vegetables
- Technology behind intermediate moisture and minimally processed fruit and vegetable.

MODULE I INTRODUCTION **9**

Importance of fruit and vegetable in world agriculture. Importance of fruit and vegetable in human diet. Processing planning. Processing systems. Choice of processing technologies. Global marketing view. Chemical composition and nutritional aspects. Auxiliary raw materials –water, sweeteners, salt, food acids, pectin preparation and intensive sweetners.

MODULE II PRESERVATION METHODS FOR FRUITS AND VEGETABLES 9

Pre processing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification, preservation with sugar - Heat preservation – Food irradiation- Combined preservation techniques.

MODULE III FRUIT SPECIFIC PRESERVATION TECHNOLOGIES **9**

Semi-processed fruit products technology. Fruit sugar preserves technology. Banana and plantain processing. Mango and guava processing. Pineapple processing. Jackfruit processing. Papaya processing. Fruit beverage technology- processing operations, product preparation –RTS, Squash, Cordial nectar.

MODULE IV VEGETABLE SPECIFIC PROCESSING TECHNOLOGIES **9**

Tomato processing. Potato processing. Pickles and sauerkraut technology. Mushroom processing. Onion processing. Vegetable juices and concentrated products. sensory evaluation methods for fruit and vegetable products.

MODULE V FRESH CUT FRUITS AND VEGETABLES **9**

Fresh cut products and colour preservation- enzymatic browning, control of enzymatic browning, Evaluation of enzymatic browning. Other colour changes. Prevention of texture loss – fruit and vegetable tissue firming, water loss prevention.

TOTAL: 45

REFERENCES:

1. Mircea Enachescu Dauthy, “Fruit and Vegetable Processing” FAO Agricultural Services Bulletin No.119 , 1995.
2. Canning and Preservation of fruits and vegetables. By ERRI board.
3. Srivastava, R and Sanjeev Kumar “Fruit and Vegetable Preservation”, Principles and Practices International Book Distributing Co., 1998.
4. Suman Bhatti, Uma Varma “Fruit and Vegetable Processing”, CBS Publishers.
5. PH.Pandey, “Post Harvest Technology of Fruits and Vegetables”, Saroj Prakashan, Allahabad.
6. P.J. Fellows, “Food Processing Technology Principles and Practice”, Woodhead Publishing Limited, England.

OUTCOMES:

On completion of this subject, students should have an understanding of:

- The structure and composition of fruits and vegetables and their role in nutrition
- The concept of quality in relation to fruit and vegetable based products
- Pathological and physiological deterioration and their control
- Preservation and processing technologies applied to fruits and vegetables
- Production of fresh and manufactured food products and ingredients from fruits and vegetables

FBBX03 FERMENTED AND TRADITIONAL FOODS

L	T	P	C
3	0	0	3

OBJECTIVES:

- The course aims to provide the students with the knowledge of Fermentation process, microorganisms involved and important fermented and traditional foods.

MODULE I FERMENTATION PROCESS AND ORGANISMS 9

Fermentation process. Fermentation products of importance. Isolation and maintenance of pure culture. Preparation of substrates/media, inoculums.

MODULE II FERMENTER AND PRODUCTS 9

Features of different types of Fermenter. Process variables and its control, recovery of fermentation products and conversion into marketable /storage forms.

MODULE III MICROBIAL FOODS, ENZYMES AND MUSHROOMS 9

Production of bakers yeast, food yeast, SCP, beer, wine, cider, vinegar, organic acids (eg. Citric and lactic acids) and enzymes (eg. Amylases, protease, lipases, pectinases, celluloses, hemicellulose etc.). IMFL/ distilled spirits (eg. Rum, gin, whisky). Mushroom cultivation and preservation.

MODULE IV FERMENTED ORIENTAL, DAIRY, MEAT AND FISH PRODUCTS 9

Oriental Fermented Products, soy sauce, pickles, Fermented Dairy Products: Cheeses, Curd and Yoghurt, Butter milk and the fermented milks. Microbial fats. Fermented meat and fish products.

MODULE V INDIAN TRADITIONAL FOODS 9

Indian traditional sweet, savory and snack food products: Sweetmeats, Namkins, Papads, wari, Idli, Dosa, Dhokla etc.

TOTAL : 45

REFERENCES:

1. Industrial Microbiology - Prescott & Dunn

2. Industrial Microbiology - L.E. Casida

3. Principle of Fermentation Technology - Whittaker and Stanbury

4. Handbook of Indigenous Fermented Foods - K.H. Steinkrus

5. Food Microbiology - Adams and Moss

6. Mushroom Cultivation - J. N. Kapoor, ICAR

OUTCOMES:

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

- Understand about the basics of fermentation process, organisms involved and preparation of fermentation products
- Gather the knowledge about different types of fermented foods and traditional Indian foods

FBBX04 FERMENTED FOOD PRODUCTS TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

Students completing this course students should be able:-

- To understand various concepts, principles and procedures involved in the area of fermented food production
- To familiarize with different fermentor types and their design criteria

MODULE I FERMENTATIONPROCESS **9**

Introduction to fermentation - definition - benefit of fermentation - nutritive value of fermented foods - microbial changes in fermented foods - micro organism - proteolytic, liploytic and fermentative bacteria.

MODULE II FERMENTATION TYPES **9**

Selection of industrial importance microorganisms -production of single cell protein. Media for industrial fermentation - Medium Composition - Energy, CO2, nitrogen and other growth factors, buffering and foam agents. Types of fermentation - Ethonolic fermentation - mixed alcoholic and acidic fermentation - Lactic acid fermentation.

MODULE III STERILIZATION **9**

Sterilization - Principles, sterilization of fermentation media, fermenter - in-batch and continuous process - development of inoculum for industrial fermentation - criteria for transfer of inoculums - aseptic inoculation.

MODULE IV FERMENTOR **9**

Basic functions of fermentor - Design of fermentor - types of fermentor – different parts - agitator, impellers, aerator, baffles, process control, function and maintenance of various parts of fermentor.Recovery and purifications of food products - filtration - batch and continuous types - fermentor accessories.

MODULE V TECHNOLOGYOF FERMENTED FOOD PRODUCTS **9**

Traditional fermented foods - Curd, yoghurt, dhokla, miso, shrikand, cheese, butter milk, dosa. Modern fermented products - Wine, beer, brandy, vinegar,

baker's yeast, sauerkrauts, sausages, fermentation of milk, meat, fruits and vegetables.

TOTAL : 45

REFERENCES :

1. Stanbury, P.F., Allan Whitaker and S.J. Hall, “Principles of Fermentation Technology”. Aditya books private Ltd., New Delhi 2002.
2. James M. Jay, Martin.J. Loessner, David. A. Golden, “Modern Food Microbiology”. Springer Science Media Publisher, New York. USA 2005.
3. Pederson, C.S., “Microbiology of food fermentations”, AVI Publishing company. Westport, Connecticut 1971.
4. Joshi V.K, and Ashok Pandey, “Biotechnology: Food Fermentation” 2005.

OUTCOMES:

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

- Understand about the basics of fermentation process, organisms involved and preparation of fermentation products
- Gather the knowledge about different types of fermented foods and traditional Indian foods

FBBX05 NUTRACEUTICALS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- The course aims to provide the students with a knowledge on the Nutraceuticals and its role in diseases. Furthermore, the techniques associated with gene cloning and the expression of recombinant proteins. To provide knowledge about the design of proteins with specific properties.

MODULE I HISTORICAL PERSPECTIVE 5

Cassification, scope & future prospects. Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition. Balanced Diet, Basic Five Food Groups, Food Pyramid, Classification of Nutrients

MODULE II NUTRITIONAL ASSESSMENT OF CARBOHYDRATES, LIPIDS AND PROTEINS 8

Classification, Functions, Recommended Dietary Intake. Dietary Fibre – Components, physiological Effects, potential health benefits, recommended Dietary Intake. Nutritional Assessment of Proteins –Classification based on amino acid content, food sources, functions, RDA, Nitrogen Balance, Protein Efficiency Ratio(PER), Net Protein Utilisation(NPU). Lipids – Classification of Fats and Fatty Acids, Functions, Nutritional Requirements, Associated Deceases and Preventive Measures. Basics of Energy Balance - Basal Metabolic Rate (BMR) and Factors Affecting BMR, Thermogensis and Physical activity

MODULE II NUTRACEUTICAL AND ITS REMEDIES 8

Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e. g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina etc.Probiotics and Prebiotics as nutraceuticals.

MODULE IV NUTRACEUTICALS OF PLANT AND ANIMAL ORIGIN 8

Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids. Extraction and purification, applications with specific examples with reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants. Concept of cosmoceuticals and aquaceuticals. Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment.

MODULE V MICROBIAL AND ALGAL NUTRACEUTICALS 8

Concept of prebiotics and probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora - extraction from plant sources. Synbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment.

MODULE VI METABOLIC DISORDERS 8

Types of metabolic disorders, Nutritional Factors, prevention and treatment. Role of nutraceuticals in the prevention and treatment with special reference to diabetes mellitus, hypertension, hypercholesterolemia. Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress. Role of nutraceuticals and functional foods in pediatrics, geriatrics, sports, pregnancy and lactation.

TOTAL : 45

REFERENCES:

1. Nutraceuticals: A Guide for Healthcare Professionals
2. Nutraceuticals: Developing, Claiming, and Marketing Medical Foods.
3. Understanding Normal and Clinical Nutrition
4. Handbook of Nutraceuticals and Functional Foods by

OUTCOMES:

- This Course will provide knowledge in Neutraceuticals and how it can be used for curing diseases and its excess can cause metabolic disorders.

Group II (Elective)
(Two to be opted from elective subjects offered below)

		L	T	P	C
FBBX06	**MEAT POULTRY AND FISH PROCESSING**	**3**	**0**	**0**	**3**

OBJECTIVES:

To familiarize with the

- Advanced treatment of the concepts involved in the production and processing.
- The marketing strategies of various products derived from meat and poultry.

MODULE I PRETREATMENTSOF MEAT **9**

Meat-nutritional quality of meat and poultry, structure of muscles-factor affecting quality of fresh meat-grading based on-maturity, degree of fat marbling-muscle firmness, colour. Slaughtering-pre slaughter care –stunning, methods of stunning –bleeding-skinning of animals.

MODULE II AGINGOF MEAT **7**

Post slaughter care-post mortem and Biochemical changes in meat-rigour mortis – tenderization-artificial tenderization-muscle stretching-mechanical disruptionartificial enzymes.

MODULE III MEATPRESERVATION AND PRODUCTS **11**

Meat preservation-Methods of preservation-low temperature, chilling and freezing- Thermal processing-dehydration-curing and smoking-preservation using antibiotics-preservation by irradiation.Meat products – Ham and Beckon, sausage, quality control and standardization of meat.

MODULE IV POULTRYAND EGGPROCESSING **9**

Composition and nutritive value of eggs-grading and preservation of egg defects – spoilage of egg-storage-manufacturing of egg powder, frozen egg. Waste from egg industry-utilization. Dressing –grading-slaughtering-scalding-Mechanical defeathering-eviscerating-preservation-Quality control and standardization of poultry meat.

MODULE V FISHPROCESSING **9**

Sea foods – nutritional composition- fishing resources – transportation of fish

– grading – sea food products and processing – preservation methods – freezing – IQF- canning – salting –surumi process – quality control in fish processing.

TOTAL : 45

REFERENCES:

1. Mead,“Processing of poultry” 1989.
2. Richardson and Mead,“Poultry meat science” 1999.
3. Pearson and Tauber,“Muscle and meat biochemistry” 1989.
4. Barbut, “Poultry products processing an industry guide” 2002.
5. Pearson and Dutson, “Quality attributes and their measurement in meat poultry and fish” 1994.

OUTCOMES:

After successful completion of this course each student should be able to:

- Demonstrate an understanding of market organisation, economic importance ($ value) and product range of the industries studied and where appropriate, environmental or ecological market issues.
- Develop Process Flow Diagrams for products studied, and thereby describe the process and in particular be able to give a technical justification for the steps in the process.
- Discuss and associate raw material characteristics, formulations, handling and processing procedures with quality, yield and cost of product produced and in most cases safety.
- Analyse the processes studied and identify the control points for quality and in most cases safety. For these control points you should be able to recommend appropriate parameters (and limits).

FBBX07 BEVERAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

At the end of this course students should be able to

- Understand various concepts, principles and procedures involved in processing of beverages.
- Demonstrate various MODULE operations involved in the food beverage manufacturing.
- List the quality control steps in beverage preparation.

MODULE I BASICINGREDIENTS IN BEVERAGES 9

Beverage-definition-why we drink beverages-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nanoemulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

MODULE II BEERAND WINE MANUFACTURE 9

Ingredients -Malt-hops-adjuncts-water,yeast. Beer manufacturing process malting, preparation of sweet wort, brewing, fermentation, pasteurization and packaging. Beer defects and Spoilage.Wine-fermentation-types –red and white. Wine defects and spoilage.

MODULE III CARBONATEDBEVERAGES 9

Procedures- carbonation equipments-ingredients-preparation of syrups-Filling system-packaging-containers and closures.

MODULE IV NON CARBONATED BEVERAGE 9

Coffee bean preparation-processing-brewing-decaffeination- instant coffee-Teatypes- black, green and oolong- fruit juices, nectars, quash, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages.

MODULE V QUALITYCONTROL 9

Effective application of quality controls- sanitation and hygiene in beverage industry-Quality of water used in beverages - threshold limits of various

ingredients according to PFA, EFSA and FDA – Absolute requirements of Soluble solids and titrable acidity in beverages.

TOTAL : 45

REFERENCES:

1. Ashurst, P.R, "Chemistry and technology of Soft drink and fruit juices", 2nd edition, Blackwell Publishing Ltd. 2005.
2. Steen, D.P and Ashurst, P.R, "Carbonated soft drinks – Formulation and manufacture", Blackwell Publishing Ltd. 2000.
3. Shankunthala Manay, N. and Shadakdharaswamy, M, "Foods – Facts and Principles", New Age International Pvt. Ltd, 3rd revised edition 2000.
4. Charles, W.Bamforth, "Food, fermentation and microorganisms", Blackwell Science Publishing Ltd. 2005.

OUTCOMES:

Upon successful completion of the course the student should be able to:

- define processes employed in the manufacture of fruit and vegetable based products and beverages through construction of Process Flow Diagrams.
- Understand and apply the principles underpinning the safe and effective production of beverages (beer, soft drinks, sports drinks, packaged water and fruit juices)

BTBX04 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
4	0	0	4

OBJECTIVES:

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

MODULE I WTO **9**

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

MODULE II GENERAL INTRODUCTION TO PATENT **9**

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

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

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

MODULE IV PATENT LITIGATION **9**

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

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

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

TOTAL: 45

REFERENCES:

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

2. Intellecutla property rights – Ganguli – Tat McGrawhill

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

OUTCOMES:

At the end of the course students will be able to

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

BTBX08 BIOSAFETY AND BIOETHICS

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I BIOTECHNOLOGY AND SOCIETY 7

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

MODULE II BIOETHICS 8

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

MODULE III BIOSAFETY CONCEPTS AND ISSUES 7

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

MODULE IV BIOSAFETY IN THE LABORATORY INSTITUTION 8

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

MODULE V BIOTECHNOLOGY AND FOOD SAFETY 7

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

MODULE VI ECOLOGICAL SAFETY ASSESSMENT 8

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

TOTAL: 45

REFERENCES:

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

OUTCOMES:

At the end of the course students will be able to

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

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

FBBX09 CROP PROCESSING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To study about the various methods of paddy Processing ,To demonstrate a basic knowledge on process of milling of wheat ,corn and Minor Millets
- To Update knowledge of Processing and preservation of fruits and vegetables.

MODULE I PADDY PROCESSING AND EQUIPMENTS 9

Rice variety, consumption, nutritive value, parboiling of paddy, traditional methods, unit operations involved in parboiling – CFTRI Method, Pressure Parboiling, Dry heat parboiling – advantage of modern methods – storage of rice and paddy – Cleaner and grader-Cylinder separator, Spiral separator, Colour sorter, Inclined belt separator.

MODULE II PROCESSING OF WHEAT, CORN AND MINOR MILLET 9

Wheat milling – types – tempering, break and reduction rolls, purifiers and sifters, flour blending, corn milling– wet milling, dry milling, high fructose corn syrup, corn starch, oats processing- Extruded products, break fastcereals. Processing of sorghum, ragi, barley – malting of barley – processed products.

MODULE III PULSE PROCESSING 9

Types of legumes and pulses – chemical composition, pretreatments of pulses – commercial methods of dehulling – dry and wet grinding of pulses – machinery used for dhal milling – roasting and parching of pulses –processed products of pulse.

MODULE IV PROCESSING OF PLANTATION CROPS 9

Processing of tea – black tea, Green tea, Oolong tea, flavored tea. Coffee – processing – instance coffee. Processing of cashew nut, coconut, oil palm, areca nut, cocoa – Equipments used - products.

MODULE V PROCESSING OF SPICES AND TUBER CROPS 9

Processing of pepper, chilli, turmeric, cardamom. Tuber crops- tapioca, potato processing – processed products. Drying – importance – pretreatments before

drying – drying curve – shrinkage, case hardening, Cold storage – cooling load calculation – evaporation cooling – types – waxing, canning, bottling.

TOTAL: 45

REFERENCES:

1. Kent, "Technology of cereals"
2. Ryall and Lipton, Handling, Transportation, storage of fruits and Vegetables", Vol.1, AVI Publishing co.,
3. Tressler and Josl YU, "Fruits and Vegetables Juice processing Technology", AVI publishing co.
4. Brooker, "Theory of cereal grains"
5. Altschule A.M., "Processed protein food stuffs"
6. Sivetz and Foote, "Coffee processing Technology", AVI publishing Co.,
7. Talburt and Smith, "Potato processing", AVI publishing co.

OUTCOMES:

By the end of this course, students should be able to:

- Explain the postharvest processing of selected perennial crops
- Regulate environmental factors that influence the postharvest quality of selected perennial crops
- Design structures and systems for reducing postharvest losses of perennial crops
- Develop methods for value addition in perennial crops

Group III (Elective)
(One to be opted from elective subjects offered below)

FBBX10 NANOTECHNOLOGY IN FOOD PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide basic information about nano materials for manufacturing nano particles.
- To learn about instrumentation for analyzing nanoparticles.
- To adopt nanotechnology techniques in food industries

MODULE I INTRODUCTION **9**

Definition of nanotechnology, potential applications related to food, functional materials in food nanotechnology, nano-nutraceuticals and nano functional foods, nanotechnology and risk assessment-regulatory approaches to nanotechnology in food industries

MODULE II NANOMATERIALSAND MANUFACTURE **9**

Nanomaterials technology- nano powder production-nano particles manufacture nanotechnology devices- analytical methods for nanotechnology.

MODULE III NANOPARTICLES **9**

Nanofilters, nanotubes, nanoclay, nanofilms, nanomembranes, nanoemulsions, nanocomposite, nano laminates, nanoscale food additives – nanolycopene.

MODULE IV NANOSCALEDELIVERY SYSTEMS FOR FOOD FUNCTIONALIZATION **9**

Liposomes- nano cochleates- hydrogels based nanoparticles- dendrimers- lipid nanoparticles- polymeric nano particles- anno crystalline particles – delivery systems – mode of action.

MODULE V NANOTECHFOR FOOD INDUSTRIES **9**

Nanotechnology in food industry- Food quality monitoring - nanosensors nanotechnology in food microbiology-bacterial identification- antimicrobial packaging-improved food storage- green packaging-tracking-tracing and brand products-nanotechnology research in food industry.

TOTAL : 45

REFERENCES:

1. Pandua W., “Nanotech research methods for foods and bioproducts”, Wiley publications 2012.
2. Fulekar M.H.,“Nanotechnology-Implications and applications”, International Publishing House (P) ltd 2010.
3. Lestie prey, “Nanotech in food products”, Wiley publications 2010. 2. James A Schwarz, “Dekker encyclopedia of nanoscience and nanotechnology”. Marcel From instrumentation to nanotechnology. J. Gardner.1992. Taylor and Francis 2004.

OUTCOMES:

Upon successful completion of this course, the student should have good knowledge of:

- Processing technologies of a wide range of miscellaneous food commodities;
- Extrusion cooking technology and use of extruders;
- Food irradiation principles and nanotechnology.

FBBX11 FOOD INDUSTRY WASTE MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

Students completing this course should

- Be able to list the wastes obtained from different food processing industries,
- Understanding the properties of different food industry wastes.
- Able to recognize and communicate common processes which allow the different food processing waste to be converted into valuable products.

MODULE I WASTE UTILIZATION FROM CEREAL FOOD INDUSTRIES 11

Different sources of wastes from food industries and their availability in Indian Nature of different waste - Waste utilisation from rice mill - Thermal andbiotechnological uses of rice husk - pyrolysis and gasification of rice husk -cement preparation and different thermal applications - utilisation of rice bran - stabilization - defatted bran utilisation.

MODULE II UTILIZATION OF FRUIT AND VEGETABLE WASTES 9

Processes for Waste utilization from fruit and vegetable industries- Distillation for production of alcohol - oil extraction from waste - waste management in sugar mills - citric acid production from fruit waste.

MODULE III FISH, MEAT AND POULTRY WASTE UTILISATION 7

Fish industry by products and waste utilisation - meat and poultry waste recycling.

MODULE IV TUBERCROPS WASTE UTILISATION 9

Waste from tuber crops - effluent safe disposal- effluent treatment plant- waste recycling plant - feasibility report for food industries using food waste and by products.

MODULE V BY- PRODUCT UTILIZATION OF WHEAT AND PULSE MILL 9

By products of wheat milling – germs and bran – by products of pulse milling – husk, germs and broken. Coconut processing – by- product utilization – fuel briquette.

TOTAL : 45

REFERENCES :

1. Bor S. Luli (ed), "Rice Production and Utilisation"
2. Beagle, "Rice Husk Conversion to Energy"
3. Chereminoff P. N. & A.C Morresi, "Energy from Solid Wastes" 1976,
4. Chakravarthy & De, "Agricultural Waste and By Product Utilisation".

OUTCOMES:

After the course the student will be able to:

- Have an awareness of the broad range of environmental issues that might impact your Organization;
- Have a broad understanding of the key aspects of waste management, especially the waste management options of reduction, reuse, recycling and disposal;
- Can appreciate the financial and legislative importance of managing wastes in your business;
- Can identify potential areas within your business that you may be able to reduce your waste production;
- Can develop a waste disposal strategy for your organization; and
- Are aware of the additional sources of guidance and support that are available to you

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

OBJECTIVES:

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

MODULE I INTRODUCTION AND BASIC CONCEPTS OF NSS 4

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

MODULE II NSS PROGRAMMES AND ACTIVITIES 10

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

MODULE III UNDERSTANDING YOUTH 5

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

MODULE IV COMMUNITY MOBILISATION **9**

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

MODULE V VOLUNTEERISM AND SHRAMDAN **7**

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

Total Hours: 35