FACULTY OF ENGINEERING

DEGREE OF

BACHELOR OF TECHNOLOGY
IN

FOOD TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

CURRICULUM
(2024-2025)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

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(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the Second Cycle)
Pollachi Main Road, Eachanari Post, Coimbatore – 641 021, Tamil Nadu, India.
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KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established under Section 3 of UGC Act 1956)

Eachanari, Coimbatore-641 021. India

FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY

REGULAR PROGRAMME

REGULATIONS 2024

CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2024 – 2025 and applicable to the candidates admitted to B. E. / B. Tech programmes during 2024 - 2025 and onwards.

1. ADMISSION

1.1 Candidates seeking admission to the first semester of the eight semesters B. E./B.Tech Degree Programme:

Should have passed the Higher Secondary Examination (10+2) prescribed by the State Government / Central Government with Mathematics/ Physics/ Chemistry/ Computer Science/ Electronics/ Information Technology/ Biology/ Informatics Practices/ Biotechnology/ Technical Vocational subject/ Agriculture/ Engineering Graphics/ Business Studies/ Entrepreneurship. (Any of the above three subjects) or any similar Examination of any other institution/ University or authority accepted by the Karpagam Academy of Higher Education as equivalent thereto).

Should have obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together.

(OR)

Passed min. 3 years Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) subject to vacancies in the First Year, in case the vacancies at lateral entry are exhausted. (The University will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgroundsto achieve desired learning outcomes of the programme)

1.2 Lateral Entry Admission

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education with passed minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology are eligible to apply for admission to the third semester of B. E./B. Tech.

OR

Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject.

OR

Passed D.Voc. Stream in the same or allied sector. (The University will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

Eligibility criteria for admission in the third semester is given in the table below.

<table>
<tr><th>S. No.</th><th>Programme</th><th>Eligibility criteria</th></tr>
<tr><td>1.</td><td>B.E Bio Medical Engineering</td><td rowspan="10">Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology.

OR

Passed B.Sc. Degree from a recognizedUniversity as defined by UGC, with at least 45%marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject.

OR

Passed D.Voc. Stream in the same or allied sector.
(The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)</td></tr>
<tr><td>2</td><td>B. E. Civil Engineering</td></tr>
<tr><td>3.</td><td>B. E. Computer Science and Engineering</td></tr>
<tr><td>4.</td><td>B. E. Computer Science and Engineering (Cyber security)</td></tr>
<tr><td>5.</td><td>B. E. Electrical and Electronics Engineering</td></tr>
<tr><td>6.</td><td>B. E. Electronics and Communications Engineering</td></tr>
<tr><td>7.</td><td>B. E. Mechanical Engineering</td></tr>
<tr><td>8.</td><td>B. Tech. Artificial Intelligence and Data Science</td></tr>
<tr><td>9.</td><td>B. Tech. Bio - Technology</td></tr>
<tr><td>10.</td><td>B. Tech. Food Technology</td></tr>
</table>

1.1 Migration from other University

Candidates who are willing to migrate to Karpagam Academy of Higher Education for admission to their next semester of B. E./B. Tech programme may get admitted from 2nd semester onwards upto 7th semester. The student will be exempted from appearing for Examination of the equivalent courses passed in the earlier programme and will have to appear for courses which he/she has not done during the period of his/her earlier programme. Along with the request letter and mark sheets, he/she has to submit a copy of syllabus of the programme duly attested by the Competent authority, he/she has undergone. Equivalence Certificate shall be provided by the respective Head of the Department of Karpagam Academy of Higher Education.

2 . PROGRAMMES OFFERED

A candidate may undergo a programme in any one of the branches of study approved by the University as given below.

List of B. E. and B. Tech. Degree Programmes

1. B.E Bio Medical Engineering
2. B. E. Civil Engineering
3. B. E. Computer Science and Engineering
4. B. E. Computer Science and Engineering (Cyber Security)
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
8. B.Tech. Artificial Intelligence and Data Science
9. B. Tech. Bio-Technology
10. B. Tech. Food Technology

3. MODE OF STUDY

3.1 Full-Time:

In this mode of study, the candidates are required to attend classes regularly on the specified working days of the University.

3.2 Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

4.1 Every programme will have a curriculum with syllabus consisting of theory and practical courses such as:

(i) General core courses comprising Mathematics, Basic Sciences, Engineering Sciences and Humanities.

(ii) Core courses of Engineering/Technology.

(iii) Elective courses for specialization in related fields.

(iv) Workshop practice, computer practice, engineering graphics, laboratory work, internship, seminar presentation, project work, industrial visits, camps, etc.

Every student is encouraged to participate in at least any one of the following programmes

- NSS / Sports/Physical exercise/NCC/YRC.
- Other Co-Curricular and Extra Curricular activities

(V) **Choice Based Credit System**

CBCS is introduced for students admitted in the academic year 2017-18. As per AICTE guidelines, CBCS is an approach in which students opt for courses of their choice. CBCS provides greater flexibility with multiple courses and enable students to undergo additional courses. CBCS is applicable to Full Time Undergraduate & Post Graduate Programmes of study. It provides a choice for students to select from the prescribed courses (Professional core, Professional Electives, Open Electives, Value added courses, Humanity Sciences, Basic sciences & Engineering sciences). A course designated as hard core for a particular programme of study must invariably be completed by the student to receive the degree in the programme. The Hardcore courses cannot be substituted by another courses. Students can exercise their choice among a set of soft-core courses from the list of Soft core courses specified for each Programme of study. The student should meet the criteria for prerequisites to become eligible to register for that course. The student should request for the course for every semester within the first week of semester. Maximum no of students to be registered in each course shall depend on availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

4.2 Each course is normally assigned certain number of credits.

No. of credits per lecture period per week	1
No. of credits per tutorial period per week	1
No. of credits for 3 periods of laboratory course per week	2
No. of credits for 3 periods of project work per week	2
No. of credits for 2 weeks of field project/internship training during semester vacations	1

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding 6 and practical courses not exceeding 4.

4.4 The prescribed credits required for the award of the degree shall be within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
B. E./B. Tech.	160– 165

4.5 The medium of instruction for all Courses, Examinations, Seminar presentations and Project/Thesis reports is English except Tamil/French.

4.6 Value Added Course

Besides core courses and elective courses, value added course is introduced. The blend of different courses is so designed that the interested students would be trained, for the holistic development to enhance employment opportunity.

4.7 Evaluation of the courses comprises of two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE). Evaluation in a mandatory course may be by Internal Assessment only.

5. DURATION OF THE PROGRAMME

5.1 The prescribed duration of the programme shall be

Programme	Min. No. of semesters	Max. No. of semesters
B. E./B. Tech. (HSC Candidates)	8	14
B. E./B. Tech. (Lateral Entry Candidates)	6	12

5.2 Each semester shall normally consist of 90 working days or 540 hours.

5.3 Additional classes for improvement, conduct of model test, etc., over and above the specified periods shall be arranged, if required. But for the purpose of calculation of attendance requirement for eligibility to appear for the end semester Examinations (as per Clause 11) by the students, 540 hours conducted within the specified academic schedule alone shall be taken into account and the overall percentage of attendance shall be calculated accordingly.

6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER

6.1 Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

6.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean concerned. However, the candidate has to execute a one-time bond (Stamp paper) with an undertaking from the parent and the student that this situation never arises in the future.

6.3 Candidates who are not recommended for condonation and those who have less than 65% attendance will not be permitted to proceed to the next semester and have to redo the course. However, they are permitted to write the arrear Examinations, if any.

7. CLASS ADVISOR

To help the students in planning their courses of study and for general advice on theacademic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students and counsel them periodically.If necessary, the Class Advisor may display the cumulative attendance particulars in the Department notice board and also discuss with or inform the Parents/Guardian about the progress of the students. Each student shall be provided with course plan for each course at the beginningof each semester.

8. CLASS COMMITTEE

8.1. Every class shall have a class committee consisting of teachers of the class concerned, Maximum of six student representatives [boys and girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 4 and 5 which should be displayed on Department Notice-Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar, etc.) the breakup of marks for each experiment / exercise /module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Solving problems experienced by students in the class room and in the laboratories.
- Informing the student representatives, the academic schedule, including the dates of assessments and the syllabus coverage for each assessment.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any and requesting the teachers concerned to provide some additional academic support.

8.2 The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Dean.

8.3 The class committee shall be constituted within the first week of each semester.

8.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

8.5 The Dean may participate in any Class Committee of the Faculty.

8.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean through the HOD within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the

Management, the same shall be brought to the notice of the Registrar by the HOD through Dean.

8.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of the nominatedas Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

10.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD'(Log book) which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

10.2 Continuous Internal Assessment (CIA): The performance of students in each course will be continuously assessed by the respective teachers as per the guidelines given below:

a. **THEORY COURSES**

S. No.	CATEGORY	MAXIMUM MARKS
1.	Assignment	5
2.	Seminar *	5
3.	Attendance	5
4.	Test – I	12.5
5.	Test – II	12.5
Continuous Internal Assessment: TOTAL		40

*Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering 2.5 units of the syllabus. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either-or type, covering 2.5 units of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

b. PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Internal Practical Assessment	15
5.	Viva – Voce [Comprehensive]	10
Continuous Internal Assessment: TOTAL		40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

INTEGRATED THEORY AND PRACTICAL COURSES:

The Continuous Internal Assessment for Integrated Theory and Practical Course is awarded for 40 Marks with mark split up similar to regular theory course. But Assignment and Seminar components are replaced by Observation and Record marks.

S.No.	CATEGORY	MAXIMUM MARKS
1.	Observation	5
2.	Record	5
3.	Attendance	5
4.	Test –I	12.5
5.	Test –II	12.5
Continuous Internal Assessment: TOTAL		40

The external evaluation of integrated practical component from End semester Examination by internal mode is awarded for 50 Marks and later scaled down to 15 Marks and similarly the external evaluation for integrated theory from End semester Examination is awarded for 100 Marks and later scaled down to 45 Marks. Hence the external assessment for integrated theory and practical components contribute to 60 Marks.

10.3 ATTENDANCE

Attendance carries a maximum of 5 marks and the distribution is as under:

S. No.	Attendance %	Marks
1	91 and above	5.0
2	81-90	4.0
3	76-80	3.0

10.4 PROJECT WORK/ INTERNSHIPS:

Final year project work will be normally in-house. However, as a special case, if a student is able toget a project from a government organization or private or public sector company, the student may be permitted to do his/her project work in that institution/research organization/industry.

11. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for Examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as arrear Examinations failing which the candidate will not be permitted to attend the next semester. A candidate already appeared for a course in a semester and passed the Examination is not entitled to reappear in the same course of the semester for improvement of grade.

12. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each course, for 100 marks, later scaleddown to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part – A	Question no. 1 to 10 Two Mark Questions, covering all the 5 units. **(10 x 2= 20 Marks)**
Part- B	Question 11 to 15 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5 x 16=80 Marks).**

13. PASSING REQUIREMENTS

13.1 Minimum marks to pass: The minimum marks to pass for CIA is 20 (i.e. out of 40 marks). The minimum marks to pass for ESE is 30 (i.e. out of 60 marks). The overall minimum marks to pass for theory/laboratory course is 50 (Sum of his/her score in CIA and ESE) out of 100 marks.

13.11 The minimum marks to pass for Value Added Course /Skill Development is 50 marks out of 100marks. There will be two tests, the first covering 50% of syllabus for 50 marks and the other for 50 marks.

13.2 If the candidate fails to secure a pass in ESE of a particular course, it is mandatory that candidate shall register and reappear for the Examination in that course during the subsequent semester when Examination is conducted in that course. Further the candidate should continue to register and reappear for the Examination till a pass is secured in such supplementary Examination within the stipulated maximum duration of the programme (Clause 5.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance were nhe/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

13.3 If the candidate fails to secure a pass in CIA of a particular course, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such subsequent Examination within the stipulated maximum duration of the programme (Clause 5.1).

13.3.1 If a candidate fails to secure a pass in Value Added Course /Skill Development course, he/she has to appear for the tests when course is conducted subsequently.

13.4 CREDIT TRANSFER THROUGH MOOC

The MOOC coordinator shall assist the students for the online courses offered by the SWAYAM platform periodically and also monitor their course.

Open Elective Courses shall be considered for the credit transfer. Only courses available in SWAYAM platform (which are totally beyond the scope of the programme under consideration) shall be considered as open elective courses and get completed at any time within the duration of the Programme before the last semester. This is a mandatory requirement for completion of the programme. At least 2 Open Electives (3 credits each) to be completed for the credit transfer.

14. AWARD OF LETTER GRADES

14.1 All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate letter grades, each carrying certain number of points will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

14.2 GRADE SHEET

After results are declared, Grade sheet will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the grade scored,

ii. The Grade Point Average (**GPA**) for the semester and

iii. 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 (**C**) of courses enrolled and the Grade Points (**GP**) 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.

$$\text{GPA} = \frac{\text{Sum of [C*GP]}}{sum\ of\ c}$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from First semester. **RA** grade and value added course will be excluded for calculating **GPA** and **CGPA**.

14.3 REVALUATION

Revaluation and Re-totaling are allowed on representation. A candidate can apply for revaluation of his/her semester Examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can applyfor revaluation

of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary Examinations, Practical Examinations, Technical Seminars, In-plant Training and Project Work.

14.4 TRANSPARENCY AND GRIEVANCE COMMITTEE

A student may get the Photostat copy of the answer script on payment of prescribed fee, if he/she wishes. The students can represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the University), HoD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External Examiner will be final. The student has to pay prescribed fee for the same.

15. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time. The award of the degree must be approved by the Board of Management of KarpagamAcademy of Higher Education.

16. CLASSIFICATION OF THE DEGREE AWARDED

16.1 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 5.1) securing a CGPA of not less than **7.5** shall be declared to have passed the Examination in First Class with Distinction.

16.2 A regular candidate or a lateral entrant is eligible to register for BE(Honors), B.Tech.(Honors). If, he / she has passed all the courses in the first appearance and holds / maintains a CGPA of 7.5 upto VIII Semester, he / she has to take an additional 20 credits by studying online courses through Swayam/NPTEL. Such a candidate is eligible for the award of BE(Honors), B.Tech.(Honors). However, if he / she fails in securing 20 additional credits but maintains CGPA of 8 and above is not eligible for Honors degree but eligible for First class with Distinction.

16.3 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses within the specified minimum number of semesters (vide Clause 5.1) plus one year (two semesters), securing CGPA of not less than **6.5** shall be declared to have passed the Examination in First Class.

16.3 All other candidates (not covered in Clauses 17.1 and 17.2) who qualify for the award of the degree (vide Clause 15) shall be declared to have passed the Examination in Second Class.

17. SUPPLEMENTARY ESE: After the publication of VIII semester results, if a student has **ONE** arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for supplementary Examination.

18. DISCIPLINE

Every student is required to observe discipline and decorous behavior both inside and outside the University and not to indulge in any activity which will tend to bring down the prestige of the University. The erring student will be referred to the Disciplinary Committee constituted by the University, to enquire in to acts of indiscipline and recommend to the University about the disciplinary action to be taken.

If a student indulges in malpractice in any of the ESE/CIA he/she shall be liable for punitive action as prescribed by the University from time to time.

19. ADVANCED LEARNERS, ON-DEMAND EXAMINATION

Students,

1. Who secure 7.5 CGPA and maintain an attendance of 75% in every semester
2. Clear all the courses in their first appearance itself are referred to as advanced learners. When a student fails to maintain any of the above conditions at any given time, he cannot be an advanced learner further.

When a student fails to maintain any of the above conditions at any given time, he cannot be an advanced learner further. These students can request for an on-demand examination for the courses in their forthcoming semester(s). These students on prior permission can appear for such examinations well in advance and complete the entire courses well before the prescribed period of study and can progress for a full time Research Project/Internship/Minor Project during the remaining prescribed period of study. The Internal and External examinations will be conducted for these courses as like the other courses. One or more faculty mentors will be allocated based on the number of students/courses enrolled for the on-demand examination.

Also, these advanced learners can also register for online courses from NPTEL/SWAYAM/SWAYAM Plus portals on prior and proper approval from the department. The credits earned from those courses will be transferred to the mark statement of the students.

20. REVISION OF REGULATION AND CURRICULUM

The University may from time-to-time revise, amend or change the Regulations, Scheme of Examinations and syllabi, if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam Academy of Higher Education.

21. CREDIT TRANSFER THROUGH ONLINE / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by MOOC platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses

will be determined by a committee named Subject Equivalency Committee comprising the Dean, Head of Department (HoD), and one faculty member nominated by the Vice Chancellor. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. Additionally, the equivalent grade points for marks/grades/grade points awarded by various MOOC platforms and international institutions of higher learning will be determined by a committee named Grade Equivalency Committee duly constituted by the Vice-Chancellor. The decisions of this committee will also be submitted for ratification/approval by the Academic Council. This shall be approved to be implemented from the even semester of the academic year 2024-25.

22.KARPAGAM INNOVATION AND INCUBATION COUNCIL (KIIC)
(A Section 8 Company)

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 Tamil Nadu Startup Policy, KIIC has recommended to the KAHE students who are affiliated with the KIIC that it be incorporated in the university Program Regulations 2023-24 and implement from this academic year.

21.1 Norms to Student Start-Ups

a) Any (UG/PG /(Ph.D.) Research scholars, student, right from the first year of their programme is allowed to set a startup (or) work part time/ full time in a startup or work as intern in a startup

b) Any (UG/PG / (Ph.D.) Research scholars) student right from the first year of their programme is allowed to earn credit for working on Innovative prototypes/business Models/ Pre incubation(case to case basis). Start Up activities will be evaluated based on the guidelines being given by the expert committee of the KIIC

c) Student Entrepreneurs may use the address of incubation center (KIIC) to register their venture while studying in KAHE.

d) Students engaged in startups affiliated with the KIIC or those who work for them may be exempted from KAHE's attendance requirements for academic courses under current regulations, up to a maximum of 30% attendance per semester, including claims for ODs and medical emergencies Potential Students who have been incubated at KIIC may be permitted to take their University semester exams even if their attendance is below the minimum acceptable percentage, with the proper authorization from the head of the institution.

(On case-to-case basis depends upon the applicability strength, societal benefits and quality of the Innovation and Subsequent engagement of the students with the/ her business)

e) Any Students Innovators/entrepreneurs are allowed to opt their startup in place mini project /major project, /seminar and summer training etc. (In plant training, Internship, value added Course.). The area in which the student wishes to launch a Startup may be interdisciplinary or multidisciplinary.

f) Student's startups are to be evaluated by Expert committee, formed by KIIC and KAHE.

21.2 Guide lines to award Credits/ Marks to a Student startup

Student's startup stages are divided into five phases and these startup phases can be considered equally in place of the course title as mentioned below with the same credits allotted to the course title in a university curriculum.

Sl. No.	Description/Startup phases	In place of the Subject / Course title	Grades/Credits /Marks
1	Idea stage/Problem Identification	Seminar	Same Marks/Credits can be awarded that are listed in the course title's curriculum for the respective startup phases.
2	Proof of Concept (POC) /Solution development	In-plant training /Internship	
3	Product Development (Lab scale) /Prototype Model/ Company Registered	Mini Project/ Value added Course	
4	Validation/Testing	Main Project phase I	
5	Business Model/Ready for Commercialization/Implementation	Main Project phase II	

DEPARTMENT OF FOOD TECHNOLOGY

B. TECH. FOOD TECHNOLOGY

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To prepare the graduates with strong knowledge and practical skills in their professional career.
2. To prepare the graduates to find out the workable solutions to troubleshoot the challenges involved in the food processing and its related sectors.
3. To prepare the graduates with ethical attitude, leadership, interdisciplinary skills, adapt to current trends through lifelong learning and to serve the society.

PROGRAM OUTCOME (PO)

The graduates of Food Technology (B. Tech.) will be able to:

a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
d. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receiveclear instructions.

k. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO)

At the end of the B.Tech. Food Technology program, the graduates will be able to

1. Demonstrate the knowledge in fundamental sciences and engineering that are essential to understand food processing and preservation technology.
2. Demonstrate a working knowledge to apply for advanced food sciences and technologies.

PEO-PO mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
PEO1	✓	✓	✓	✓	✓					✓		
PEO2		✓	✓	✓		✓	✓	✓				
PEO3				✓					✓		✓	✓

PEO-PSO mapping

	PSO1	PSO2
PEO1	✓	✓
PEO2	✓	✓
PEO3		✓

B. TECH. – FOOD TECHNOLOGY

COLLEGE OF STUDY AND SCHEME OF EXAMINATION

(2024 BATCH ONWARDS)

Semester – I												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/ week**			**Credits**	**Maximum Marks**			**Page №**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTCC101	Technical English I	HS	8,9,10,12	1,2	3	0	0	3	40	60	100	1
24BTCC102	Matrices and Calculus	BS	1,2,3,12	1	3	1	0	4	40	60	100	3
24BTFT103	Physics for Life Sciences	BS	1,2,3,6,9, 12	1,2	3	0	0	3	40	60	100	5
24BTFT141	Engineering Chemistry (EC)	ES	1,2,3,4,6, 7,8,9,12	1,2	3	0	2	4	40	60	100	7
24BTFT142	Python Programming (EC)	ES	-	-	3	0	2	4	40	60	100	9
24BTMC151	Women Safety and Security*	MC	-	-	1	0	0	0	100	-	100	11
24BTMC152	தமிழர் மரபும் பண்பாடும்*	MC	-	-	1	0	0	0	100	-	100	12
	TOTAL				**17**	**1**	**4**	**18**	**400**	**300**	**700**	

Semester - II												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTCC201	Technical English II	HS	8,9, 10, 12	1,2	3	0	0	3	40	60	100	14
24BTCC202C	Transforms and its Applications	BS	1,2,3,12	1	3	1	0	4	40	60	100	16
24BTCC203	Environmental Studies	BS	1,2,6,7,8, 12	1,2	3	0	0	3	40	60	100	18
24BTFT204	Physics for Food Technology	BS	1,2,3, 4,5,6, 7,8,12	1,2	3	0	0	3	40	60	100	20
24BTFT205	Fundamentals of Food Science and Technology	ES	-	-	3	0	0	3	40	60	100	22
24BTFT241	Basic Electrical and Electronics Engineering (EC)	ES	-	-	4	0	2	4	40	60	100	24
24BTCC211	Communication Skills Lab	HS	-	-	0	0	2	1	100	-	100	26
24BTFT212	Physical Sciences Lab	BS	-	-	0	0	2	1	100	-	100	27
24BTMC251	Yoga	MC	-	-	0	0	4	2	100	-	100	28
	TOTAL				**19**	**1**	**10**	**24**	**540**	**360**	**900**	

Semester – III												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTFT301B	Numerical Methods	HS	1,2,3, 4,12	1	3	1	0	4	40	60	100	29
24BTFT302	Post-Harvest Technology	ES	1,2, 11, 12	1,2	3	0	0	3	40	60	100	31
24BTFT303	Food Process Calculations	ES	1,2,9	1,2	3	0	0	3	40	60	100	33
24BTFT304	Fluid Mechanics	ES	1,2,9	1,2	3	0	0	3	40	60	100	35
24BTFT341	Food Microbiology	ES	1,2,9 ,11	1,2	3	0	2	4	40	60	100	37
24BTFT342	Food Chemistry	ES	1,2,9 ,11	1,2	3	0	2	4	40	60	100	39
24BTMC351	Aptitude and Reasoning	MC	-	-	1	0	0	0	100	0	100	41
24BTMC352A /24BTMC352B	Foreign Language German/Foreign Language French	MC	-	-	1	0	0	0	100	0	100	43
24BTFT391	Field Project/ Internship	P	-	-	0	0	0	1	100	0	100	45
SEMESTER TOTAL					**20**	**1**	**4**	**22**	**540**	**360**	**900**	

Semester – IV												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credit**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTFT401A	Probability and Statistics	HS	1,2,3, 4,12	1	3	1	0	4	40	60	100	46
24BTFT402	Thermodynamics	ES	1,2,9	1,2	3	1	0	4	40	60	100	48
24BTFT403	Plantation Products and Spice Processing Technology	ES	1,2, 11	1,2	3	0	0	3	40	60	100	50
24BTFT404	Heat and Mass Transfer	ES	1,2,9	1,2	3	0	0	3	40	60	100	52
24BTFT441	Unit Operations in Food Processing	ES	1,2,9	1,2	3	0	2	4	40	60	100	54
24BTFT442	Food Biochemistry and Nutrition	ES	1,2,9 ,11	1,2	3	0	2	4	40	60	100	56
24BTFT411	Community Engagement and Social Responsibility	HS	-	-	0	0	4	2	100	0	100	58
24BTMC451	Foundation of Entrepreneurship	MC	-	-	1	0	0	0	100	0	100	59
24BTMC452	Essence of Traditional Indian Knowledge and Heritage	MC	-		1	0	0	0	100	0	100	60
SEMESTER TOTAL					**20**	**2**	**8**	**24**	**540**	**360**	**900**	

Semester – V												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credit**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTFT501	Refrigeration and Cold Chain Management	ES	1,2,3	1,2	3	0	0	3	40	60	100	61
24BTFT502	Dairy Technology	ES	1,2	1,2	3	0	0	3	40	60	100	63
24BTFT5E-	Professional Elective - I	ES	-	-	3	0	0	3	40	60	100	-
24BTFT5E-	Professional Elective - II	ES	-	-	3	0	0	3	40	60	100	-
24BTFT541	Food Analysis	ES	1,2	1,2	3	0	2	4	40	60	100	65
24BTFT542	Fruits and Vegetables Processing Technology	ES	1,2, 11	1,2	3	0	2	4	40	60	100	67
24BTMC551	Cryptography and cyber security	MC	-	-	1	0	0	0	100	0	100	69
24BTFT511	Skill development I	P	-	-	0	0	2	1	100	0	100	71
24BTFT591	Field Project/ Internship	HS	-	-	0	0	0	1	100	0	100	73
SEMESTER TOTAL					**19**	**0**	**6**	**22**	**540**	**360**	**900**	

Semester – VI												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTMC651	Universal Human Value	MC	-	-	2	0	0	2	40	60	100	74
24BTFT641	Food Additives	ES	1,2	1,2	3	0	2	4	40	60	100	76
24BTFT642	Bakery and Confectionary Technology	ES	1,2,3	1,2	3	0	2	4	40	60	100	78
24BTFT601	Food Safety Regulations	ES	1,2	1,2	3	0	0	3	40	60	100	80
24BTFT611	Skill development II	P	-	-	0	0	2	1	100	0	100	82
24BTFT6E	Professional Elective – III	ES	-	-	3	0	0	3	40	60	100	-
24BTFT6E	Professional Elective – IV	ES	-	-	3	0	0	3	40	60	100	-
24BTFT6OE	Open Elective –I	ES	-	-	3	0	0	3	40	60	100	-
24BTFT691	Mini Project	P	-	-	0	0	2	2	100	0	100	84
SEMESTER TOTAL					**20**	**0**	**8**	**25**	**480**	**420**	**900**	

Semester – VII												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
24BTFT701	Professional Ethics and IPR	HS	1,7,8,12	-	3	0	0	3	40	60	100	85
24BTFT702	Process Economics and Plant Layout Design	ES	1,2,3,6,7,8,9,10,11,12	1,2	3	0	0	3	40	60	100	87
24BTFT741	Food Packaging Technology	ES	1,2,6,7,10,11,12	1,2	3	0	2	4	40	60	100	89
24BTFT7E	Professional Elective -V	ES	-	-	3	0	0	3	40	60	100	-
24BTFT7E	Professional Elective -VI	ES	-	-	3	0	0	3	40	60	100	-
24BTFT7OE	Open Elective – II	ES	-	-	3	0	0	3	40	60	100	-
24BTFT791	Project Work Phase I	P	-	-	0	0	8	4	100	0	100	91
SEMESTER TOTAL					**18**	**0**	**10**	**23**	**340**	**360**	**700**	

Semester – VIII												
Course Code	**Course Title**	**Category**	**Objectives**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									160	**240**	**400**	
24BTFT891	Project Work Phase – II	P	-	-	0	0	16	8	160	240	400	92
SEMESTER TOTAL					**0**	**0**	**16**	**8**	160	240	400	
TOTAL CREDITS					**166**							

Professional Elective - I

Course Code	Course Title	Category	Objectives		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
24BTFT5E01	Lipid Processing Technology	ES	1,2, 11	1,2	3	0	0	3	40	60	100	93
24BTFT5E02	Food processing and preservation	ES	1,2,9	1,2	3	0	0	3	40	60	100	95
24BTFT5E03	Cereals and Pulses Technology	ES	1,2,9	1,2	3	0	0	3	40	60	100	97
24BTFT5E04	Milling Technology	ES	1,2, 11	1,2	3	0	0	3	40	60	100	99
24BTFT5E05	Technology of Oil seeds Processing	ES	1,2,9	1,2	3	0	0	3	40	60	100	101

Professional Elective – II

Course Code	Course Title	Category	Objectives		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
24BTFT5E06	Design and Formulation of Foods	ES	1,2,9	1,2	3	0	0	3	40	60	100	103
24BTFT5E07	Functional Foods and Nutraceuticals	ES	1,2,9	1,2	3	0	0	3	40	60	100	105
24BTFT5E08	Snack Food Technology	ES	1,2,9	1,2	3	0	0	3	40	60	100	107
24BTFT5E09	Analytical Methods for Food Products	ES	1,2,9	1,2	3	0	0	3	40	60	100	109
24BTFT5E10	Beverage Processing Technology	ES	1,2,3, 7,12	1,2	3	0	0	3	40	60	100	111

Professional Elective – III

Course Code	Course Title	Category	Objectives		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
24BTFT6E01	New Product Development and Sensory Science	ES	1,2,3,12	1,2	3	0	0	3	40	60	100	113
24BTFT6E02	Marketing Management and International Trade	ES	1,2,8	1,2	3	0	0	3	40	60	100	115
24BTFT6E03	Food Process Automation	ES	1,2,3	1,2	3	0	0	3	40	60	100	117
24BTFT6E04	Energy Conservation in Food Design	ES	1,2,3,7	1,2	3	0	0	3	40	60	100	119
24BTFT6E05	Process Control for Food Engineers	ES	1,2,3	1,2	3	0	0	3	40	60	100	121

Professional Elective – IV

Course Code	Course Title	Category	Objectives		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
24BTFT6E06	Waste Management in Food Industries	ES	1,2,3	1,2	3	0	0	3	40	60	100	123
24BTFT6E07	Food Colorants and Flavorants	ES	1,2,3	1,2	3	0	0	3	40	60	100	125
24BTFT6E08	Biologically Active Phytochemicals in Foods	ES	1,2,3	1,2	3	0	0	3	40	60	100	127
24BTFT6E09	Livestock and Marine Technology	ES	1,2	1,2	3	0	0	3	40	60	100	129
24BTFT6E10	Novel Food Processing Technologies	ES	1,2,3,4,5,10,11,12	1,2	3	0	0	3	40	60	100	131

Professional Elective – V

Course Code	Course Title	Category	Objectives		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
24BTFT7E01	Extrusion Technology	ES	1,3,5, 8,9, 10,12	1,2	3	0	0	3	40	60	100	133
24BTFT7E02	Food Allergy and Toxicology	ES	2,9	1,2	3	0	0	3	40	60	100	135
24BTFT7E03	Total Quality Management	ES	1,2,4, 6,8,9, 10,11 ,12	1,2	3	0	0	3	40	60	100	137
24BTFT7E04	Cryogenic Engineering	ES	1,2,3, 4,9, 11	1,2	3	0	0	3	40	60	100	139
24BTFT7E05	Process Instrumentation and Control in Food Processing	ES	1,2,3, 9,10, 11	1,2	3	0	0	3	40	60	100	141

Professional Elective – VI

Course Code	Course Title	Category	Objectives		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
24BTFT7E06	Food Biotechnology	ES	1,4,6, 11	1,2	3	0	0	3	40	60	100	143
24BTFT7E07	Supply Chain Management	ES	1,2,3, 4,8,9, 10,11	1,2	3	0	0	3	40	60	100	145
24BTFT7E08	Drying Technology for Foods	ES	1,2,3, 4,8,9, 10,11	1,2	3	0	0	3	40	60	100	147
24BTFT7E09	Food Fermentation Technology	ES	1,2,3, 4,8,9, 10,11	1,2	3	0	0	3	40	60	100	149
24BTFT7E10	Rheology and Texture Analysis of Foods	ES	1,2,3, 4,8,9, 10,11	1,2	3	0	0	3	40	60	100	151
24BTFT7E11	Sea Food Processing Technology	ES	1,2,3, 4,5,6, 7,8,9, 10,11	1,2	3	0	0	3	40	60	100	152

24BTCC101 **SEMESTER-I**

TECHNICAL ENGLISH – I **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

OBJECTIVES:

- To reacquaint oneself with fundamental reading and writing skills, proper grammar usage, listening, and speaking
- To improve skills in listening and speaking, in expressing oneself formally in writing, and in deducing meaning from what one reads
- To enhance one's receptive (reading and listening) and productive (writing and speaking) language skills

OUTCOMES:

Learners will be able to

CO1: recall the usage of grammar in reading, speaking, and writing skills
CO2: know precise transitions while reading, writing, and speaking to enhance coherence and clarity while communicating
CO3: utilise the linguistic parameters in day-to-day reading, listening, and speaking interactions
CO4: detect the errors, restructure paragraphs, compose, compile, and synthesize documents for presentations
CO5: enhance proficiency in reading, writing, and critical listening, as well as the ability to interpret and articulate complex ideas persuasively in written and oral forms

UNIT I **9**

Grammar **:** Parts of Speech – Gerunds and infinitives – Sentence Pattern
Reading **:** Reading comprehension: (vocabulary, referents, and inferences/conclusions)
Writing **:** Business letter – e-mail Writing
Listening **:** Listening to different short recordings – Listen to a longer recording
Speaking **:** Introduction to Phonetics, Diphthongs

UNIT II **9**

Grammar **:** Tenses: Simple Tenses – Concord – Types of Sentences
Reading **:** Identifying main and secondary information
Writing **:** Check lists – Building Itineraries
Listening **:** Listening Comprehension – Job Description
Speaking **:** Pronunciation – Describing people, places, jobs and things – Asking and answering questions

UNIT III **9**

Grammar **:** Tenses: Progressive Tenses – Direct and Indirect speech – Concord
Reading **:** Identifying, organizing, comparing and Interpreting information
Writing **:** Writing Articles – Paragraph Writing
Listening **:** Telephonic conversation
Speaking **:** Stress, Intonation – Self Introduction

UNIT IV **9**

Grammar **:** Tenses: Perfect Tenses – Active and Passive voice
Reading **:** Reading Comprehension (Reconstruction, Rewording)
Writing **:** Memo – Notice – Agenda
Listening **:** Critical Listening
Speaking **:** Oral presentation

UNIT V **9**

Grammar **:** Tenses: Perfect Continuous Tenses – Reported Speech
Reading **:** Reading Comprehension (Cause and Effect identification)
Writing **:** Creative writing – Copy Writing
Listening **:** Listening and Interpretation of ideas
Speaking **:** Group Discussion

TOTAL: 45+15

TEXT BOOKS:

1. Richards J C, Hull J, et al., "Interchange 2 Student's Book", 5th Edition, Cambridge University Press, 2022.
2. Kumar Sanjay and Pushp Latha, "English Language and Communication Skills for Engineers", 1st Edition, Oxford University Press, 2018.

REFERENCE BOOKS:

1. Swan Michael and Walter Catherine, "Oxford English Grammar Course", 1st Edition, Oxford University Press, 2019.
2. Sudharshana N P and Savitha C, "English for Engineers", 1st Edition, Cambridge University Press, 2018.
3. Brook-Hart G, "Business Benchmark: Upper intermediate: Business Vantage: Student's Book", 2nd Edition, Cambridge University Press, 2021.

WEB URLs:

1. www.onestopenglish.com
2. www.britishcouncil.org
3. www.cambridgeenglish.org/learning-english/

1. Sanjay Kumar, Pushpalata, (2011), Communication skills, 1st Edition Oxford Press.
2. Ashraf Rizvi M, Effective Technical Communication, McGraw Hill Education, First Edition, 2013.

CO – PO MAPPING:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO2	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO3	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO4	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO5	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	3	**-**	**2**	**1**	**1**

24BTCC102 **SEMESTER-I**

MATRICES AND CALCULUS **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students:

- To provide sufficient knowledge in calculus and matrix algebra in the respective fields
- To find an extremum value for a function of several variables subject to a given constraint.
- To provide knowledge in evaluating double and triple integrals
- To apply mathematical tools to solve second and higher order ODE and PDE with constant coefficients.

COURSE OUTCOMES:

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

- Make use of orthogonal transformation to reduce the quadratic form to canonical form.
- Utilize differential calculus of multivariable to optimization problems.
- Apply multiple integrals for finding area and volume.
- Solve the n^{th} order Ordinary Differential Equations (ODE) and Homogeneous equation of Euler's type.
- Solve the n^{th} order Partial Differential Equations.

UNIT – I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix– Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT – II DIFFERENTIAL CALCULUS OF MULTIVARIABLE FUNCTIONS **12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions –Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT – III MULTIPLE INTEGRALS **12**

Definite and Indefinite Integrals – Double integrals – Change of order of integration – Double integrals in polar coordinates – Area using double integrals – Evaluation of Triple Integrals- Volume of Solids.

UNIT – IV ORDINARY DIFFERENTIAL EQUATIONS **12**

Linear differential equation of second and higher order with constant coefficients –Cauchy-Euler linear differential equation – Method of Variation of parameters.

UNIT – V PARTIAL DIFFERENTIAL EQUATIONS **12**

Homogeneous linear partial differential equations of second and higher order with constant coefficients – Classification of partial differential equations.

TOTAL: 45+15

TEXT BOOKS:

1. Hass, Heil and Weir, "Thomas Calculus", 14th Edition, Pearson Education, 2018.
2. Dennis G. Zill, "Advanced Engineering Mathematics", 7th Edition, Jones & Bartlett Learning, 2022.

REFERENCE BOOKS:

1. Rogawski, Adams and Franzosa, "Calculus", 4th Edition, W. H. Freeman, 2019.
2. Boyce, DiPrima and Meade, "Elementary Differential Equations and Boundary Value Problems", 12th Edition, John Wiley & Sons, 2021.
3. Alexander Graham, "Matrix Theory and Applications for Scientists and Engineers", 1st Edition, Dover Publications Inc.,2018.
4. Grewal, B. S.,Higher engineering mathematics. 2018, Khanna Publishers, New Delhi.

WEBSITES:

1. www.classcentral.com/course/matrix-methods-13644
2. www.classcentral.com/course/brilliant-calculus-ii-59290
3. www.classcentral.com/course/differential-equations-engineers-13258

CO PO MAPPING:

CO - PO Mapping: (Low - 1; Medium - 2; High - 3)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C102.1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-

24BTFT103 **SEMESTER-I**

PHYSICS FOR LIFE SCIENCES **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

(i)THEORY

COURSE OBJECTIVES:

The goal of this course is:

- To introduce the concepts of quantum mechanics and crystal for diverse applications.
- To understand the basics of laser and optical fiber with appropriate applications.
- To inculcate the basics of properties of matter and its applications.

COURSE OUTCOMES:

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

- Outline the basics of crystals, structures and its defects.
- Examine the performance of light and laser.
- Identify the numerical aperture and acceptance angle of an optical fibre.
- Relate the quantum concepts in electron microscope.
- Apply the elastic properties of the materials to understand the modulus of the material.

UNIT I – CRYSTAL PHYSICS **9**

Classification of solids: Crystalline and amorphous solids – crystal structure - unit cell, primitive cell – seven crystal systems, Bravais lattices, Miller indices – inter-planar distances (Qualitative) - Coordination number and atomic packing factor for Simple Cubic, Body Centered Cubic, Face Centered Cubic– Defects in crystal: Point & Line defect.

UNIT II – LASERS **9**

LASER: Introduction - characteristics – Absorption- Spontaneous emission- stimulated emission- Einstein's co-efficients derivation- principle of laser action- population inversion- pumping methods -Types of lasers - Nd: YAG, Semiconductor Laser (Homo Junction Laser)- Applications of LASER in industry and medicine.

UNIT III - FIBRE OPTICS **9**

Fiber optics – principle and propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (Material, refractive index and mode) – types of loses in optical fibers -fiber optical communication system (block diagram).

UNIT IV – QUANTUM PHYSICS **9**

Black body radiation - Energy Distribution laws (Qualitative): Stefan Boltzmann's law, Wein's Displacement law- Rayleigh Jeans Law. Photo electric effect (Qualitative) – Compton effect (Qualitative) – De Broglie hypothesis - uncertainty principle – physical significance of wave function - Schrödinger's Time dependent wave equation - Schrödinger's Time independent wave equation – Particle in one dimensional box- Scanning Electron Microscope and Transmission Electron Microscope.

UNIT V – PROPERTIES OF MATTER **9**

Elasticity – stress – strain – Hookes law- classification of elastic modulus -Poisson's ratio - Stress-Strain diagram and its uses - factors affecting elastic modulus and tensile strength - Moment, Couple and Torque– Twisting couple on a wire – bending moment – cantilever- young's modulus uniform bending – I- shaped girders and its applications.

TOTAL: 45

TEXT BOOKS:

1. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, 2015.
2. Gaur R.K. and Gupta S.L, Engineering Physics, Dhanpat Rai Publications, 2012.
3. Pandey. B.K. & Chaturvedi. S, Engineering Physics, Cengage Learning India, 2012.
4. Charles Kittel, Kittel's Introduction to Solid State Physics, Wiley India Edition, 2019.
5. P.M. Mathews, K.Venkatesan, A text book of Quantum Mechanics, 2/e, Mc Graw Hill Education, 2017.
6. Laser Fundamentals, William T Silfvast, Cambridge Univ Press. 2012.
7. Fiber Optics and Optoelectronics, R P Khare, Oxford, 2012.
8. D.S. Mathur, Elements of properties of matter, S.Chand, 2010.

REFERENCES:

1. Halliday.D. Resnick R. & Walker. J, Principles of Physics, Wiley, 2015.
2. Daniel V.Schroeder, An Introduction to Thermal Physics, Pearson, 2014.

WEBLINKS:

1. www. nptel.ac.in/courses/122/103/122103011/
2. www.nptel.ac.in/courses/113/104/113104081/
3. www.hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html.

CO PO MAPPING:

CO - PO Mapping: (Low - 1; Medium - 2; High - 3)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C103.1	3	2	-	-	-	-	-	-	2	2	-	1	1	-
C103.2	3	2	-	-	-	-	-	-	2	2	-	1	1	-
C103.3	3	2	-	-	-	-	-	-	2	2	-	1	-	-
C103.4	3	3	2	-	-	1	-	-	2	2	-	1	1	1
C103.5	2	1	-	-	-	-	-	-	-	1	-	1	1	1
AVG	2.8	2.0	2.0	-	-	1.0	-	-	2.0	1.8	-	1.0	1.0	1.0

B.TECH. - Food Technology **2024-2025**

24BTFT141 **SEMESTER-I**

ENGINEERING CHEMISTRY
(Theory & Laboratory) **5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

(i) THEORY

COURSE OBJECTIVES:

The goal of this course is:

- To summarize water treatment process and engineering materials.
- To acquire knowledge on fuels, lubricants and principles of corrosion.
- To explain the concepts of analytical techniques and its applications.

COURSE OUTCOMES:

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

- Identify the quality of water and its treatment methodologies.
- Interpret the basics of engineering materials and its applications.
- Outline the methods to enhance the quantity & quality of fuels and Lubricants.
- Illustrate the types of corrosion and its prevention techniques.
- Demonstrate the principle and working of analytical techniques.

UNIT I – WATER TECHNOLOGY **9**

Sources-Characteristics - Specification for drinking water, BIS &WHO-Alkalinity- Types of alkalinities and determination - Hardness - Types and estimation by EDTA method - Domestic water treatment - Disinfection methods (Chlorination, Ozonation. UV treatment) - Boiler feed water - Requirements - Disadvantages of using hard water in boilers - Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) - External conditioning - Demineralization process - Desalination - Reverse osmosis.

UNIT II – ENGINEERING MATERIALS **9**

Plastics – Thermoplastics & Thermosets. Preparation, properties and engineering applications of Poly vinyl chloride and Bakelite. Alloys – Introduction – Definition – Properties of alloys – Significance of alloying, functions and effect of alloying elements – Nichrome and stainless steel (18/8) – Heat treatment of steel. Refractories – Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories. Composites– Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites.

UNIT III – FUELS AND LUBRICANTS **9**

Fuels – Introduction- Analysis of coal (proximate and ultimate), Carbonization- Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – Octane number– Cetane number- Power alcohol and biodiesel. Lubricants – Introduction – Characteristics of a good lubricant – Classification, Physical and Chemical Properties – Mechanism of lubricants – Applications.

UNIT IV - CORROSION AND ITS CONTROL **9**

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion- Factors influencing the rate of corrosion-Corrosion control - Sacrificial anode and impressed current cathodic methods - Corrosion inhibitors - Protective coatings - Organic Coatings-Paints - Constituents and functions Inorganic coatings- Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating - Hot dipping.

UNIT V – ANALYTICAL TECHNIQUES AND APPLICATIONS **9**

Introduction-Instrumentation and applications of Colorimetry, Flame Photometry, Potentiometry, Conductometry (Strong acid with strong base, Mixture of acids with strong base, precipitation titrations)-Electronic spectroscopy- Vibrational Spectroscopy-Atomic Absorption spectroscopy.

Total Hours: 45+30

TEXT BOOKS:

1. P C Jain & Monica Jain, (2022). Engineering Chemistry, 18th edition, Dhanpat Rai Publishing Company
2. Shivani Jaggi Guleria, “Engineering Chemistry”, Concept for engineers, 1st Edition, Atlantic, 2021.
3. S S Dara, S S Umare, “A Text book of Engineering Chemistry”, 12th Edition, S Chand, 2015.
4. B. H. Mahan, (2010). University chemistry, Pearson Education.

5. R V Gadag, A Nithyananda Shetty, "Engineering Chemistry", 3rd Edition, Wiley India Pvt, 2019.

REFERENCE BOOKS:

1. M. J. Sienko and R. A. Plane, (1976) Chemistry: Principles and Applications. 5th edition, McGraw-Hill Higher Education.
2. C. N. Banwell, (2001) Fundamentals of Molecular Spectroscopy, McGraw-Hill.
3. P. W. Atkins, (2022) Physical Chemistry, Oxford University Press.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web- book)
5. K. P. C. Volhardt and N. E. Schore, (2014). 5th Edition, Organic Chemistry: Structure and Function, W.H. Freeman Publications.

WEB REFERENCES:

1. https://www.bspublications.net/downloads/0523ff2e4a5331_chemistry_ch_01_JNTUK.pdf
2. https://www.uobabylon.edu.iq/eprints/publication_10_31957_6172.pdf
3. https://www.researchgate.net/publication/265602506_chapter_engineering_materials_and_engineering plastics

(ii) LABORATORY

LIST OF EXPERIMENTS – CHEMISTRY

1. Determination of Ca / Mg using complexometric titration
2. Determination of chloride content of water
3. Determination of the rate of corrosion by weight loss method
4. Conductometry - Determination of conductance of solutions (strong acid Vs strong base)
5. pH Metry - Determination of Acid/Base
6. Potentiometry - Estimation of iron content in a water sample.
7. Estimation of Copper and Zinc in Brass

CO PO MAPPING:

CO - PO Mapping: (Low - 1; Medium - 2; High - 3)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C104.1	3	2	1	1	-	1	1	1	1	-	-	1	1	1
C104.2	2	2	1	1	-	1	1	1	1	-	-	1	-	-
C104.3	2	2	1	1	-	1	1	1	1	-	-	1	-	-
C104.4	2	1	-	-	-	1	1	1	-	-	-	1	1	1
C104.5	2	1	-	-	-	1	1	1	-	-	-	1	1	1
C104	2.2	1.6	1.0	1.0	-	1.0	1.0	1.0	1.0	-	-	1.0	**1.0**	**1.0**

24BTFT142 **SEMESTER-I**

PYTHON PROGRAMMING **5H-4C**

(Theory and Laboratory)

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

(i) Theory:

COURSE OBJECTIVES:

The goal of this course is for the students:

- To learn about basic python syntax and semantics like control structures and functions
- To develop logical thinking abilities and to propose novel solutions for real world problems through object–oriented programming concepts
- To deepen the empirical knowledge on applying programming on business domains

COURSE OUTCOMES:

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

- Interpret the representation of the data structures and sequential programming in solving complex problems.
- Outline the need for control statements in data structure to understand their role in managing program flow and enhancing computational efficiency.
- Develop functions, modules, and packages for code reusability.
- Identify the possible error-handling constructs for unanticipated states.
- Build exemplary applications on the real-world problems.

UNIT I PYTHON BASICS **8**

Fundamentals of computing – Building blocks of algorithms – Introduction to programming – Elements of python – Variables – Data types – Operators – Operator precedence – Expressions – Conditional statement – Loops – Break, Continue and Pass – Illustrative problems: square root, GCD, Exponentiation, Sum an array of numbers, Linear search, Binary search.

UNIT II PYTHON DATA STRUCTURES **8**

Mutable vs immutable data types – String – Indexing and slicing – String functions – List – List slices – List methods – Iterate over a list – Mutability – Aliasing – Cloning lists – List parameters – List comprehension– Tuples– Tuple assignment – Tuple as return value – Dictionaries – Operations and methods

UNIT III FUNCTIONS, MODULES AND PACKAGES **9**

Built–in functions – User defined functions – Creating function – Calling functions – Types of function arguments – Recursion and lambda or anonymous functions – Packages: Defining – Creating and accessing a package – Importing packages and user defined modules; Illustrative programs: Factorial, Maximum element, Palindrome, Armstrong number

UNIT IV FILE HANDLING, CLASS AND OBJECT **9**

Introduction to files – File path – Opening and closing files – Reading and writing files – File position – Decorators – Introduction to elements of OOP – Class – Object – Inheritance – Data abstraction – Encapsulation – Polymorphism – UML class diagram – Access specifiers – Creating classes – Creating object – Accessing members – init() method – Instance, static and class methods – Importance of self – Implementing encapsulation. Illustrative programs: File operations on TEXT and CSV, Scientific calculator using class and objects

UNIT V INHERITANCE, ABSTRACTION AND EXCEPTION HANDLING **9**

Inheritance: Implementing inheritance – Types of inheritance. Polymorphism: Implementing polymorphism – Method overloading – Method overriding – Operator overloading – Abstraction – Abstract classes – Association and aggregation – Exception handling: Errors vs exceptions – Handling exceptions – Raising exception – Creating user defined exception. Illustrative programs: Banking applications using inheritance.

TOTAL: 45+30

(ii) Laboratory

LIST OF EXPERIMENTS:

1. Create and manipulate strings using indexing, slicing, and various string functions.
2. Develop and manipulate lists using operations, slices, methods, list comprehension, and looping.
3. Develop and manipulate tuples, dictionaries, and sets, distinguishing between mutable and immutable types.
4. Implement user-defined functions and categorize different types of function arguments, such as positional, keyword,

and default arguments.

5. Implement inheritance and classify different types of inheritance.
6. Develop polymorphism through method overloading, overriding, and operator overloading.
7. Write programs in Python to handle exceptions and create custom exceptions.

TEXT BOOKS:

1. Allen B Downey, Jeffrey Elkne, Chris Meyers, "How to Think Like a Computer Scientist: Learning with Python 3 Documentation", 3rd Edition, Green Tea Press, 2020.
2. Steven F. Lott, Dusty Phillips, "Python Object-Oriented Programming: Build robust and maintainable object-oriented Python applications and libraries"4th Edition, Packt Publishing Limited, 2021.

REFERENCE BOOKS:

1. R. Nageswara Rao," Core Python Programming", 3rd Edition, Dream tech Press, 2022.
2. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Publication, 2018.
3. Mark and Summerfield, "Programming in Python 3", 2nd Edition, Dorling Kindersley India Pvt. Ltd, 2019.

WEBSITES:

1. www.realpython.com/
2. www.w3schools.com/python/
3. www.geeksforgeeks.org/python-programming-language/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO2	2	1	-	-	-	-	-	-	2	2	-	2	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO4	3	2	1	-	-	-	-	-	2	2	-	2	-	3
CO5	3	2	1	-	-	-	-	-	2	2	-	2	-	3
Average	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**	**3**

24BTMC151 **SEMESTER-I**

WOMEN SAFETY AND SECURITY **1H - 0C**

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students:

- To highlight the social construction of gender in Indian society and the role of social institutions in the socialization process.
- To make aware about the practical issues concerning gender and politics.
- To classify the students in engendering national policies and programmes.
- To observe the liability of women and women's work in the context of globalization.
- To acquaint knowledge about the political participation of women and the gendered structures of governance and polity.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Infer into the basic concepts related to sex, gender, femininity etc.
- Demonstrate the rationale for women's studies
- Compare Gender Equality Issues and Movements in Women's Studies
- Summarize the Social construction of Gender, Gender Roles and Gender stereotyping.
- Illustrate Social Structures, Changing Status of Women in India.

Unit I: Fundamental Concepts of Women's Studies

Definition- Objectives of Women's Studies; Importance of Women's Studies; Women's Studies as an Academic Discipline; Role of UGC Centre for Women's Studies

Unit II: Social Empowerment

Women in Higher Education; Gender issues in Health, Environment, Family welfare Measures, Indecent representation of Women in media; Women in Difficult circumstances; Constitutional.

Unit III: Political Empowerment

Women leaders in politics- Women in Local Governance- Barriers- Reservation policies- Women's Political Rights, Property Rights - Violence against Women - Women's work.

TEXT BOOKS:

1. Amy S. Wharton. (2005). "The Sociology of Gender: An Introduction to Theory and Research". (Key Themes in Sociology) Blackwell Publishing, UK, Indian Reprint, Kilaso Books, New Delhi.
2. Devaki Jain and Pam Rajput (Ed). (2003). "Narratives from the Women‟s Studies Family: Recreating Knowledge, Sage, and New Delhi.
3. Jasbir Jain (Ed). (2005). "Women in Patriarchy: Cross Cultural". Rawat Publication.

24BTMC152 **பருவம் -I**

தமிழர் மரபும் பண்பாடும் **1H – 0C**

கற்பித்தல் நேரம்/வாரம்: **L:1 T:0 P:0** **மதிப்பெண்: இடைத்தேர்வு: 100 மொத்தம்:100**

பாடத்திட்ட பயன் விளைவு:

- வரலாற்றிற்கு முற்பட்ட தமிழகத்தை மாணவர்களுக்கு அறிமுகப்படுத்துதல்
- பழந்தமிழர் பண்பாடு சார்ந்த வாழ்க்கை முறையை மாணவர்கள் அறிய ஊக்குவித்தல்
- தமிழ் மொழியின் பழைமையும், திராவிட மொழிகளில் தமிழ்மொழியின் தனிச்சிறப்பையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்.
- தமிழர்களின் வாழ்வியல், தமிழர்கலைகள், ஆற்றங்கரைப்பண்பாடுகள் குறித்து மாணவர்கள் அறியச்செய்தல்.
- இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில் விருப்பப்பாடமாக இடம்பெறுகின்ற தமிழ்நாகரிகமும் பண்பாடும் குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்

பாடத்திட்டப் பொதுநோக்கம்:

1. இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற, ‘தமிழ்இலக்கியவரலாறு’ குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத்தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின்வளர்ச்சித்துறையாகிய, ‘அறிவியல்தமிழ்’; ‘இணையதமிழ்’ குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச்சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப்பேணுவதற்குக்கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மைவளர்ச்சி. மொழிபெயர்ப்புத்துறை சார்ந்த வேலைவாய்புத்திறன் பெற்றிருத்தல்.

அலகு:1 தமிழர் மரபு

மரபு-விளக்கம்-சங்ககால தமிழர் மரபு – திணைப்பகுப்பும் தமிழர் மரபும்-உலகப்பொதுமை – அகத்திணை மரபு – புறத்திணை மரபு- இடைக்காலத்தமிழர் மரபு – பிற்கால மரபும் மாற்றமும் – தற்கால தமிழர்மரபு - வளர்ச்சி.

அலகு: 2 தமிழர் பண்பாடு

பண்பாடு – விளக்கம் – பழந்தமிழர் பண்பாடு – இயற்கை சார்ந்த வாழ்வியல் – தமிழர் சமயம் – அரசியல் நிலை–சமூகப் பழக்கவழக்கங்கள் – நம்பிக்கைகள் – வாழ்வியல் அறங்கள் – வணிகம் போன்றவை.

அலகு:3 தமிழர் கலைகள்

தமிழகத்தில் கலைகளின் வளர்ச்சி – சிற்பக்கலை வளர்ச்சி –கோயில் கலை – கற்கோவில்கள் - ஓவியக்கலை – அழகுக்கலைகள் - கூத்துக்கலை – மருத்துவக்கலை – நாடகக்கலை– இசைக்கலை போன்றவை.

அலகு: 4 தமிழர் சமயம்

பழந்தமிழரின் சமயம் – சங்ககால சமயம் – தொல்காப்பியத்தில் சமயம் – சைவ சமயம் – வைணவம் – தமிழ்ப் பண்பாட்டில் பௌத்தம் – தமிழ்ப் பண்பாட்டில் சமணத்தின் தாக்கம்– தமிழ்ப் பண்பாட்டில் இசுலாம் மற்றும் கிறித்துவ சமயத்தின் தாக்கம்- தமிழர் பண்பாட்டில் விழாக்கள்- கோயில்களும் விழாக்களும்- சமூக ஒருங்கிணைப்பில் விழாக்களின் பங்கு- சங்க இலக்கியத்தில் விழாக்கள் பற்றிய குறிப்புகள்-இடைக்கால இலக்கியங்களில் விழாக்கள் பற்றிய செய்திகள் – விழாக்களின் சமூகப்பங்களிப்பு – தற்காலத்தில் தமிழர் விழாக்கள் - விளையாட்டும் விழாக்களும்.

அலகு: 5 இலக்கியங்களில் தமிழர் பண்பாட்டுப் பதிவுகள்

சங்க இலக்கியமும் வாழ்வியலும்-திருக்குறளில் வாழ்வியல் நெறிகள் – இரட்டைக் காப்பியங்களும் வாழ்வியலும் – சிற்றிலக்கியங்களில் வாழ்வியல் பதிவுகள்-இக்கால இலக்கியமும் வாழ்வியலும்.

பார்வைநூல்கள்:

1. தமிழ் இலக்கிய வரலாறு – தமிழண்ணல், மீனாட்சி புத்தக நிலையம்- மதுரை- இரண்டாம் பதிப்பு-ஜூலை – 2000.
2. தமிழர் நாகரிகமும் பண்பாடும், அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், சென்னை, திருத்திய பதிப்பு – 2022.
3. தமிழர் வரலாறும் பண்பாடும், நா. வானமாமலை, நியூசெஞ்சுரி புக் ஹவுஸ், சென்னை, ஆறாம்பதிப்பு - 2007 .
4. தமிழக வரலாறு மக்களும் பண்பாடும், கே.கே. பிள்ளை, உலகத் தமிழராய்ச்சி நிறுவனம், சென்னை.

SEMESTER II

B.TECH. - Food Technology	**2024 -2025**
24BTCC201	**SEMESTER-II**
TECHNICAL ENGLISH – II	**3H - 3C**
Instruction Hours/week: L:3 T:0 P:0	**Marks: :** Internal**:40** External**:60** Total**:100**
	End Semester Exam:3 Hours

OBJECTIVES:

- To make students understand the context of grammar and importance of Listening, Speaking, Reading and Writing
- To develop critical Listening Speaking Reading Writing skills
- To enhance student ability to listen vigilantly, read proficiently, innovative writing, and speak fluently

OUTCOMES:

Learners will be able to:

- Identify and recognize the aspects of writing, speaking, reading and listening
- Empathize the text critically in reading, writing, speaking and listening
- Relate grammatical structures in reading and listening and apply the structure in speaking and writing
- Apprehend speaking, listening, reading, writing skills in the social milieu
- Utilize the rules of writing, reading, listening and speaking in formal and informal situations

UNIT I **9**

Grammar : Prepositions – Adjectives – Adverbs
Reading : Reading comprehension: Skimming and Scanning
Writing : Letter writing (Formal and Informal) – Letter to Editor
Listening : Listening to Business talks – TED Talks

UNIT II **9**

Grammar : Use of sequence words – Modal Verbs
Reading : Mind Mapping (Structured thinking and related ideas)
Writing : Interpreting visual materials – Note Making – Recommendations
Listening : Listening to specific tasks – Focused Listening – Note Taking.
Speaking : Making presentations on given topics – Speaking in formal Situations

UNIT III **9**

Grammar : Contextual usage of Tenses – Connectives
Reading : Cohesion and Coherence in Reading
Writing : Paragraph writing: Compare and Contrast – Cause and Effect – Jumbled Sentences
Listening : Listening and responding to video lectures
Speaking : Role-play – Group Interaction

UNIT IV **9**

Grammar : WH Questions – Identifying Common Errors
Reading : Critical Reading Shifting facts from opinions
Writing : Resume writing with cover letter – Free writing
Listening : Watching videos or documentaries and answering
Speaking : Responding to questions – Mock Interviews

UNIT V **9**

Grammar : Use of Imperatives – Confusing words in English
Reading : Reading and making inference
Writing : Essay writing – Report – Proposals
Listening : Listening to different accents – Listening to Speeches
Speaking : Impromptu Speeches – Describing a process

TOTAL: 45

TEXT BOOKS:

1. Richards J C, Hull J, et al. “Interchange 3 Student's Book”, 5th Edition, Cambridge University Press, 2022.
2. Harding, Keith, and Appleby, Rachel, "International Express: Pre-Intermediate: Student's Book", 3rd Edition, Oxford University Press, 2019.

REFERENCE BOOKS:

1. Swan, Michael and Walter Catherine, “Oxford English Grammar Course”, 1st Edition, Oxford University Press, 2019.
2. Sudharshana N P and Savitha C, “English for Engineers”, 1st Edition, Cambridge University Press, 2018.
3. Brook-Hart G, “Business benchmark: Upper intermediate: Business vantage: Student’s book”, 2nd Edition, Cambridge University Press, 2021.

WEBSITE URLs:

1. www.myenglishpages.com
2. www.cambridgeenglish.org/learning-english/
3. www.eslvideo.com/index.php

CO PO MAPPING

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO2	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO3	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO4	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO5	-	-	-	-	-	-	-	2	2	3	-	2	1	1
CO	-	-	-	-	-	-	-	2	2	3	-	2	1	1

24BTCC202C **SEMESTER-II**

TRANSFORMS AND ITS APPLICATIONS **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To understand the concept of periodic functions and represent it as Fourier series.
- To provide knowledge of Fourier series techniques in solving heat flow problems and wave equations.
- To acquaint Fourier transforms techniques used in various applications.
- To impart the knowledge of Laplace Transforms and Inverse Laplace Transforms techniques and its applications.

COURSE OUTCOMES:

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

- Illustrate Fourier series representation of periodic functions.
- Apply Fourier series in one dimensional heat flow and wave equation**.**
- Make use of Fourier transform for converting elementary functions into frequency domain.
- Utilize Laplace Transform to convert time-domain systems into frequency-domain systems.
- Apply Inverse Laplace Transform in linear differential equations.

UNIT I FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series in the interval (0,2l) & (-l,l) – Half range sine series –Half range cosine series –Parseval's Identity – Harmonic analysis.

UNIT II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Fourier series solution for one dimensional wave equation – Fourier series solution for one dimensional heat equation with zero end conditions.

UNIT III FOURIER TRANSFORMS **12**

Fourier Integral Theorem – Fourier transform pair –Fourier sine and cosine transforms –Properties – Convolution theorem – Parseval's identity of Fourier transform.

UNIT IV LAPLACE TRANSFORM **12**

Transforms of standard functions – Properties of Laplace transform – Transforms of derivatives and integrals –Initial and final value theorem – Transforms of periodic functions.

UNIT V INVERSE LAPLACE TRANSFORM **12**

Inverse Laplace transforms of standard functions – Inverse Laplace transform using second shifting theorem – Method of partial fractions– Convolution– Solution of ordinary differential equations with constant coefficients using Laplace transforms

Total Hours: 45+15

TEXT BOOKS:

1. Boyce, Diprima and Meade, "Elementary Differential Equations and Boundary Value Problems", 12th Edition, John Wiley & Sons, 2021.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, 2017

REFERENCE BOOKS:

1. T. Hillen, "Partial Differential Equations", 2nd Edition, Friesen Press, 2019.
2. Dennis G. Zill, "Advanced Engineering Mathematics", 7th Edition, Jones and Bartlett Publishers, 2020.
3. Richard Haberman, "Applied Partial Differential Equations with Fourier Series and Boundary Value Problems", 5th Edition, Pearson, 2021.
4. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.

WEBSITES:

1. www.infocobuild.com/education/audio-video-courses/mathematics/Transform TechniquesForEngineers-IIT-Madras/lecture-01.html
2. www.infocobuild.com/education/audio-video-courses/mathematics/ordinary-and-partial-differential-equations-iit-roorkee.html
3. www.electrical4u.com/laplace-transformation/

CO PO MAPPING

CO - PO Mapping: (Low - 1; Medium - 2; High - 3)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C107.1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
C107.2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C107.3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C107.4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C107.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-

24BTCC203 **SEMESTER-II**

ENVIRONMENTAL STUDIES **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

(i) THEORY

COURSE OBJECTIVES:

The goal of this course is for students:

- To create a basic understanding about ecosystem and natural resources.
- To acquire knowledge on biodiversity conservation and pollution eradication.
- To introduce the roles and responsibilities about social issue and improvement in the interconnected world

COURSE OUTCOMES:

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

- Outline the ecological processes supporting the life system.
- Infer the importance of environment and impact of human activities on natural resources.
- Demonstrate the levels and values of biodiversity and its conservation.
- Summarize the problems of environmental pollution and its control measures.
- Interpret the remediation methods for social issues and degraded environment.

UNIT I – ENVIRONMENT & ECOSYSTEMS **9**

Environment Definition, Scope and importance; layers of atmosphere-Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II - NATURAL RESOURCES **9**

Natural resources - Renewable and Non - Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs,case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III - BIODIVERSITY AND ITS CONSERVATION **9**

Levels of biological diversity – genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT IV -ENVIRONMENTAL POLLUTION **9**

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, E-pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban, industrial and e-wastes. Role of an individual in prevention of pollution. Case studies.

UNIT V - SOCIAL ISSUES AND THE ENVIRONMENT **9**

Concept of sustainability, Goals and sustainable development-circular economy- Water conservation -Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko Silent valley, Bishnois of Rajasthan). Environmental ethics: Human population growth- Impacts on environment, human health and welfare-Variation among nations.

Total Hours: 45

TEXT BOOKS:

1. Anubha Kaushik., and Kaushik, C.P. 7Th Edition, 2021. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
2. Prabhakar S Mithra, "Methodologies for environmental studies", 1st Edition, Academic Aspirations, 2021.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Erach Bharucha, "A Textbook of Environmental Studies for UG Courses" 3rd Edition, University Press India ltd, 2021.
5. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

REFERENCE BOOKS:

1. G.Tyler Miller and Scott Spoolman, "Living in the Environment", 20th Edition, Cengage Learning, 2021.
2. Linda D Williams, "Environmental Science" 1st Edition, Tata McGraw Hill, 2017.
3. Sing, J.S., Sing. S.P. and Gupta, S.R. 2022. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
4. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S. Chand& Company Pvt. Ltd., New Delhi.
5. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.

WEB REFERENCES:

1. https://www.insightsonindia.com/2013/09/06/environment-biodiversity
2. https://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. https://www.msubbu.in/ln/environment/

CO PO MAPPING:

CO - PO Mapping: (Low - 1; Medium - 2; High - 3)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C104.1	3	2	1	1	-	1	1	1	1	-	-	1	1	1
C104.2	2	2	1	1	-	1	1	1	1	-	-	1	-	-
C104.3	2	2	1	1	-	1	1	1	1	-	-	1	-	-
C104.4	2	1	-	-	-	1	1	1	-	-	-	1	1	1
C104.5	2	1	-	-	-	1	1	1	-	-	-	1	1	1
C104	2.2	1.6	1.0	1.0	-	1.0	1.0	1.0	1.0	-	-	1.0	**1.0**	**1.0**

24BTFT204 **SEMESTER-II**

PHYSICS FOR FOOD TECHNOLOGY **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To make the students to understand the basics of phase diagrams and various materials
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

- Acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
- Familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
- Gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
- Realize with theories and applications of dielectric and ferromagnetic materials
- Familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

UNIT I PREPARATION OF MATERIALS **9**

Phases - phase rule – binary systems – tie line – lever rule – phase diagram – invariant reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of a critical nucleus – Thin films – preparation:

UNIT II ELECTRICAL PROPERTIES OF MATERIALS **9**

Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - Quantum free electron theory – tunneling - degenerate states – Fermi- Dirac statistics – density of energy states – electron in periodic potential – electron effective mass – concept of hole. Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III SEMICONDUCTING PROPERTIESMATERIALS **9**

Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative)-carrier concentration in metals - carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED - Solar cells.

UNIT IV DIELECTRIC AND MAGNETIC MATERIALS **9**

Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications- Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials.

UNIT V NEW MATERIALS AND APPLICATIONS **9**

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Metallic glasses – Shape memory alloys – Copper, Nickel and Titanium based alloys – grapheme and its properties – Relaxor ferroelectrics - Biomaterials – hydroxyapatite – PMMA – Silicone – Sensors: Chemical Sensors - Bio-sensors – Polymer semiconductors – Photoconducting polymers.

TEXT BOOKS*:*

- W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.
- V.Raghavan. Materials Science and Engineering: A First Course. PHI Learning, 2015.
- M.F.Ashby, P.J.Ferreira and D.L.Schodek. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers, 2011.

REFERENCES*:*

1. J.F.Shackelford. Introduction to Materials Science for Engineers. Pearson, 2015.
2. D.R. Askeland and W.J.Wright. Essentials of Materials Science and Engineering, Cengage Learning, 2013.
3. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4. Jean P.Mercier, G.Zambelli and W.Kurz, Introduction to Materials Science, Elsevier, 2002.
5. Yaser Dahman, Nanotechnology and Functional Materials for Engineers, Elsevier, 2017.

WEB URLs:

1. www.nptel.ac.in/courses/122104014/
2. www.nptel.ac.in/courses/118104008/
3. www.nptel.ac.in/courses/115101012/

CO - PO Mapping: (Low - 1; Medium - 2; High - 3)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C104.1	3	2	1	1	-	1	1	1	1	-	-	1	1	1
C104.2	2	2	1	1	-	1	1	1	1	-	-	1	-	-
C104.3	2	2	1	1	-	1	1	1	1	-	-	1	-	-
C104.4	2	1	-	-	-	1	1	1	-	-	-	1	1	1
C104.5	2	1	-	-	-	1	1	1	-	-	-	1	1	1
C104	2.2	1.6	1.0	1.0	-	1.0	1.0	1.0	1.0	-	-	1.0	**1.0**	**1.0**

B.TECH. Food Technology **2024-2025**

24BTFT205 **SEMESTER-II**

FUNDAMENTALS OF FOOD SCIENCE AND TECHNOLOGY **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To understand the history and evolution of food processing.
- To acquire knowledge on the structure and composition of foods.
- To discuss the nutritional quality and post-harvest changes of various plant foods.
- To study the structure and composition of various animal foods.
  To understand the functions of food.

COURSE OUTCOMES

Upon successful completion of the course, students will be able to,

- Understand the history, development and present status of Food Science and Technology.
- Explain the significance and basic concepts of the Food technology. Beware of the skills required to be a professional food technologist.
- Know the scope for self-employment as small, medium or large-scale entrepreneurs.
- Acquire knowledge on the principles of food preservation.
- Assess novel processed foods.

UNIT I INTRODUCTION **9**

Food- definition, food groups and nutritional aspects. Basic concepts of food science, food processing, Food technology and food manufacturing, Advancements and innovations in food processing and technology, Overview of preservation process.

UNIT II FOOD GROUPS **9**

Compositional, Nutritional and Technological aspects of Plant foods; Cereals and Millets, Pulses, Fruits and Vegetables - Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fiber. Compositional, Nutritional and Technological aspects of Animal foods; Flesh Foods-Meat, Fish, Poultry and egg.

UNIT III FOOD HANDLING AND STORAGE **9**

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, Refrigeration and freezing, cross- contamination prevention. Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT IV-PROCESSED FOODS **9**

Classification of processed food on the basis of extent and type of processing; canned foods, packaged snacks, frozen foods, breakfast cereals; Minimally processed foods, Preserved foods, Manufactured foods, Formulated foods, Food derivatives, Pharmaceuticals and Functional foods.

UNIT V-PROCESSED FOODS **9**

Classification of processed food on the basis of extent and type of processing; Minimally processed foods, Preserved foods, Manufactured foods, Formulated foods, Food derivatives, Pharmaceuticals and Functional foods.

TOTAL: 45

SUGGESTED READINGS:

1. Sri lakshmi, B.2005. Food Science,3rdedition. New Age International (P)Ltd. Publishers, New Delhi.
2. Manay N.S and Shadaksharaswamy, M.(2001).Foods facts and principles. Wiley Eastern Ltd. New Delhi, Bangalore, Bombay, Calcutta, Hyderabad.
3. R.P. Srivastava and SanjeevKumar.2002.Fruit and Vegetable Preservation: Principles and Practices,3rd Ed. International Book Distribution Co., Delhi.
4. Potter,N.N.,& Hotchkiss, J.H.(2012).Food science. Springer Science& Business Media.

CO PO MAPPING:

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	3	2
CO2	2	1	-	-	-	-	-	-	-	1	-	2	2	2
CO3	2	1	-	-	-	-	-	-	-	1	-	2	3	3
CO4	3	2	-	-	-	1	-	1	-	1	-	2	3	3
CO5	3	2	-	-	-	-	-	-	-	1	-	2	3	2
Avg.	**2.4**	**1.4**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**-**	**2**	**2.8**	**2.4**

24BTFT241 **SEMESTER-II**

BASIC ELECTRICAL & ELECTRONICS ENGINEERING (EC)

5H-4C

Instruction Hours/week: L:4 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3Hours

i) THEORY

COURSE OBJECTIVES:

- To impart the basic knowledge about the Electric circuits.
- To understand the concept of Electrical Machines and Transformers.
- To understand the working of Semiconductor devices
- To acquire knowledge about Digital circuits
- To impart the basic knowledge of Measuring Instruments and Electrical Installation.

COURSE OUTCOMES:

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

- Build the electric circuits with DC and AC excitation by applying various circuit laws.
- Explain the basic principles, construction and working of AC, DC Motor and transformer
- Identify the various characteristics of semiconductor devices and real time application of digital circuits.
- Explain the principle, construction and operation of moving coil and moving iron instruments, the electrical safety issues and protective devices.
- Compare the different types of Batteries & its application in Electric Vehicle and illustrate elementary calculations for energy consumption and battery backup.

UNIT I – Electric Circuits **9**

DC Circuits: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems in series and parallel combinations of resistors.

AC Circuits: Representation of sinusoidal waveform - peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. – simple problems in single-phase ac circuits consisting of RL, RC, RLC Network.

UNIT II - Electrical Machines **9**

Construction, working: DC machines (generator & motor) - BLDC motor – three phase and Single-phase induction motor. Magnetic materials, BH characteristics, Construction and working of single-phase transformer- emf equation.

UNIT III- Analog Electronics **9**

Construction and operation: PN diode, Zener diode and V-I characteristics – Bipolar Junction Transistor – FET – introduction to Operational Amplifier.

UNIT IV- Digital Electronics **9**

Number Systems — Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes - Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates – SOP, POS -Realization of logic gates.

UNIT V- Transducers and Electrical Installation **9**

Transducer–Classification of transducers- Piezoelectric transducer – Hall Effect transducers – Smart sensors – Switch Fuse Unit (SFU), MCB, ELCB - Earthing - Elementary calculations for energy consumption and battery backup.

Text Books

S. K. Bhattacharya, "Basic Electrical Engineering", Pearson, 2019.

E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

Reference Books

1. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. VN Mittle and Arvind Mittal, "Basic Electrical Engineering", McGraw Hill, 2006.

A. Sudhaka and Shyammohan S Palli, "Circuits and Networks", McGraw Hill, 2013.

3. R. Muthusubramanian and S. Salivahanan, "Basic Electrical and Electronics Engineering", TMH, 2014.

Web Links:

- www. nptel.ac.in.
- encyclopedia-magnetica.com/doku.php/co energy.
- https://en.wikibooks.org/wiki/electronics/measuring instruments.

(ii) Laboratory

List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law
2. Experimental verification of electrical circuit problems using Kirchhoff's Voltage law.
3. Experimental verification of electrical circuit problems using Kirchhoff's Current law.
4. Measurement of electrical quantities – voltage, current, power & power factor in R load.
5. Measurement of energy using single phase energy meter.
6. Speed control of DC Shunt Motor.
7. Verification of truth table of Logic Gates.

TOTAL: 30

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	2	2	-	1	-	-
CO2	3	2	1	-	-	-	-	-	2	2	-	1	-	-
CO3	2	1	-	-	-	-	-	-	2	2	-	2	-	-
CO4	2	1	-	-	-	-	-	-	2	2	-	2	-	-
CO5	2	1	-	-	-	-	-	-	-	1	-	2		
Avg.	**2.4**	**1.4**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1.8**	**-**	**1.6**	**-**	**-**

B.TECH. Food Technology		2024-2025
24BTCC211		SEMESTER-II
	COMMUNICATION SKILLS LAB	2H-1C
Instruction Hours/week: L:0 T:0 P:2		Marks: Internal: 100 Total:100
		End Semester Exam: 3 Hours

Pre-Requisites: None

OBJECTIVES:

- To learn different listening techniques for understanding different kinds of audio content
- To build on students' English language skills by engaging them in listening and reading activities
- To improve the communicative competence of learners in listening, speaking, reading and writing

OUTCOMES:

Learners will be able to:

- Identify the context, topic, and pieces of specific information of English through all the four skills
- Realize the purpose and clarity of facts and reflect their thoughts, opinions, knowledge through all the language skills
- Use effective skimming and scanning and listening techniques and acquire the gist from the context
- Practice communication more effectively with their peers, instructors, and colleagues
- Illustrate public speaking techniques, business writing, listening as well as professional speaking techniques

LIST OF EXPERIMENTS:

S.No.	SKILLS	TOPICS
1	Listening	Dialogues from TV/radio/Ted talk/Podcast
2	Listening	Listening for gist
3	Reading	Reading for detail, global understanding
4	Speaking	Presentations and interactive communication – Pair presentations
5	Listening	Listen and respond appropriately
6	Reading	Reading different genres
7	Writing	Documentary and Movie review
8	Writing	Informational or Analytical Reports
9	Speaking	Mock Interview
10	Speaking	Group Discussion

TOTAL: 30

B.TECH. Food Technology **2024-2025**

24BTFT212 **SEMESTER-II**

PHYSICAL SCIENCES LAB

2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:100** External**:0** Total**:100**

LIST OF EXPERIMENTS – PHYSICS

1. Determination of Band gap of a semiconductor.
2. Uniform bending – Determination of young's modulus.
3. Non-uniform Bending – Determination of young's modulus.
4. Laser - Determination of the wave length of the laser using grating
5. Laser – Determination of Particle size
6. Optical Fiber – Determination of Numerical Aperture and Acceptance angle of the optical fiber.
7. Air wedge – Determination of thickness of a thin sheet/wire.

B.TECH. Food Technology		**2024-2025**
24BTMC251		**SEMESTER-II**
	YOGA	**1H-2C**
Instruction Hours/week: L:0 T:0 P:4		**Marks:** Internal**:100 T**otal**:100**

COURSE OBJECTIVES:

The goal of this course, is for the students:

- To have knowledge of Physical fitness and exercise management to lead better quality life
- To enable to officiate, supervise various sports events and
- organize sports events
- To acquire the knowledge of Physical Education, Sports and Yoga and
- understand the purpose and its development
- To gain knowledge to plan, organize and execute sports events

COURSE OUTCOMES:

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

- Practice physical activities and yoga for strength, flexibility and relaxation.
- Use techniques for increasing concentration and decreasing anxiety for stronger academic performance.
- Perform yoga exercises in various combination and forms.
- Improve personal fitness through participation in sports and yoga activities.
- Follow sound nutritional practices for maintaining good health and physical performance.

Unit – I INTRODUCTION TO PHYSICAL FITNESS

Explain importance of physical education - Describe importance of Physical Fitness & Wellness - Explain the components of physical fitness - Demonstrate healthy life style - Prevent health threats by changing life style

Unit – II FUNDAMENTALS OF ANATOMY & PHYSIOLOGY IN SPORTS & YOGA

Explain importance of anatomy and physiology - Describe effects of exercise in various body systems - Describe concept of correct posture - Explain corrective measures for posture deformities.

Unit– III YOGA & PRANAYAMA

Explain importance of yoga - Perform various pranayama for increasing concentration - Use meditation and other relaxation techniques for improving concentration.

TEXT BOOKS:

1. Ajmer Singh, Modern Trends and Physical Education class 11 & class 12, Kalyani Publication, New Delhi ISBN: 9789327264319.
2. B.K.S. Iyengar, Light on Yoga, Thomson's Publication, New DelhiISBN: 8172235011 V.K.Sharma, Health and Physical Education, NCERT Books; Class11,12 Saraswati House Publication, New Delhi
3. Acharya Yatendra, Yoga and Stress Management, Fingerprint Publishing ISBN: 938905303X
4. Swami Vivekanand, Patanjali Yoga Sutras, Fingerprint Publishing ISBN 9389567351.
5. Ramdev, Pranayam Rahasya, Patanjali-Divya Prakashan, HaridwarISBN: 9788189235017
6. Ramdev, Yoga its Philosophy & Practice, Divya Prakashan, Haridwar.

SEMESTER- III

B. Tech. – Food Technology **2024-2025**

24BTFT301B **Semester- III**

NUMERICAL METHODS **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students,

- To explain the basic concepts of solving algebraic and transcendental equations.
- To solve the numerical techniques of interpolation in various intervals in real life situations.
- To analyze the student with an understanding of numerical techniques differentiation and integration which plays an important role in engineering and technology disciplines.
- To discuss the knowledge of various techniques and methods of solving ordinary differential equations.
- To illustrate the knowledge of various techniques and methods of solving various types of partial differential equations.

Course Outcomes

Upon completion of this course, students will able to,

- Apply the basic concepts of solving algebraic and transcendental equations practices.
- Explain numerical techniques of interpolation in various intervals in real life situations.
- Differentiate different numerical methods.
- Relate the knowledge of various techniques and methods of solving ordinary differential.
- Summarize the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS **9**

Regula Falsi Method - Newton Raphson method for solving algebraic and transcendental equations -Solution of a system of linear equations - Gauss elimination method - Gauss Jordan method Gauss-Seidel method

UNIT II INTERPOLATION **9**

Interpolations with unequal intervals-Lagrange's interpolation -Newton's divided interpolation - Interpolation with equal intervals-Newton's forward and backward interpolation

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION **9**

Approximation of derivatives using Newton's forward and backward interpolation - Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule

UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS **9**

Single step method- Euler's method-Taylor's series method-Fourth order Runge – Kutta method –Multi step method-Milne's predictor-corrector method.

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9**

Solutions of one-dimensional heat equation by Bender-Schmidt and Crank Nicholson methods – Numerical solutions of one-dimensional wave equation by explicit method

Total:45

SUGGESTED READINGS:

1. Steven C.Chapra and Raymond P.Canale, "Numerical Methods for Engineers", McGraw Hill Education, Seventh Edition (2015).
2. Curtis F. Gerald and Patrick O. Wheatley, "Applied Numerical Analysis", Addison Wesley, Thirteenth Edition (2004).
3. Richard L. Burden and J. Douglas Faires, "Numerical Methods", Brooks/Cole, 4th edition, 2012.

4. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley and Sons, Tenth Edition, 2011.

WEBSITES:

1. https://archive.nptel.ac.in/courses/111/107/111107105/
2. https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/resources/lecture-2-eulers-numerical-method-for-y-f-x-y/
3. http://www.infocobuild.com/education/audio-video-courses/mathematics/numerical-analysis-iit-madras.html
4. http://www.infocobuild.com/education/audio-video-courses/mathematics/NumericalMethods-FiniteDifference-IIT-Roorkee/lecture-06.html

CO- PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	1	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	1	-	-	1	1	-
CO3	3	2	1	-	-	-	-	-	1	-	-	1	1	-
CO4	2	1	-	-	-	-	-	-	1	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	1	-	-	1	1	-
Avg.	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	-	-	**1**	**1**	-

24BTFT302 POST- HARVEST TECHNOLOGY Semester- III
3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students,

- To discuss the basics of postharvest storage practices.
- To outline the postharvest losses of different food grains.
- To understand the proper separation and storage practices.
- To describe various constraints of milling and their economy.
- To explain different methods used for material handling systems.

Course Outcomes

Upon completion of this course, students will able to,

- Apply their knowledge of post-harvest storage practices.
- Explain knowledge on the reduction of post-harvest losses.
- Discuss new methods for the storage of food grains.
- Relate the different methods of milling and their economic importance.
- Describe the methods of material handling systems.

UNIT I - OVERVIEW OF POST-HARVEST TECHNOLOGY 9

Introduction to different agricultural crops, their cropping pattern, production, harvesting and post-harvest losses- Transpiration, water loss and deterioration in quality. Respiration, maturation, ripening, senescence and biochemical changes affecting quality and marketability. Ethylene effect – application and control. Temperature effect – heat, chilling and freezing injury, reasons for losses, the importance of loss reduction, Post- Harvest Handling operations.

UNIT II - CLEANING SORTING AND GRADING 9

Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Peeling Sorting, grading, methods of grading; Grading- Size grading, color grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care, and maintenance. Kinetics of quality changes: physical, chemical, sensory and nutritional changes during handling for processing

UNIT III - SEPARATION 9

Raw material processing of fruits, vegetables, grains, meat- Thermal processing, Magnetic separator, destoners, electrostatic separators, pneumatic separator - Principles of working, design and constructional details, operating parameters, maintenance. of various decorticators/dehullers/shellers.

UNIT IV-MILLING AND MATERIALS HANDLING 9

Milling, polishing, grinding, milling equipment, de huskers, polishers (abrasion, friction, water jet), flour milling machines, pulse milling machines, grinders, cutting machines, oil expellers, machine efficiency and power requirement Introduction to different conveying equipment used for handling of grains, fruits and vegetables; Post harvest treatment to increase shelf life i.e. freezing, chilling, dehydration, canning, thermal processing, active packaging, dipping, conventional heating, pulsed electric field, high hydrostatic pressure, cold plasma, image analysis, electronic noses, and near-infrared spectroscopy. Scope and importance of material handling devices

UNIT V - MATERIAL HANDLING SYSTEMS 9

Classification, principles of operation, conveyor system selection/design Belt conveyor: Principle, characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper. Chain conveyor and screw conveyor: Principle of operation, advantages, disadvantages, capacity and speed, inclined and vertical screw conveyors. Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types, power requirement Pneumatic conveying system: types, air/product separators; Gravity conveyor design considerations, capacity and power requirement.

TOTAL: 45

SUGGESTED READINGS:

1. Amalendu Chakraverty and R. Paul Singh. 2014. Post- Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.
2. Chakraverty. 2008. Post- Harvest Technology of Cereals, Pulses and Oilseeds, 3rdEd. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw- Hill Co., Inc., NY, USA.
4. James G. Brennan. 2006.Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
5. K.M. Sahay and K.K. singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	1	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	2	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.6**	**1**.7	-	-	-	-	-	-	-	-	**2**	-	**2**	**2**

24BTFT303 **FOOD PROCESS CALCULATIONS** **SEMESTER-III**

4H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To describe the basic units, dimensions and basic related functions involved in food process engineering.
- To recognize the various law governing the gases and vapors
- To explain the material balance and law of conservation of energy.
- To solve problems in Energy balance in heat exchangers.
- To define the types, properties, and agitation processes in fluids.

Course Outcomes:

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

- Outline the units and dimensions of various physical quantities.
- Identify the principles of stoichiometry and material balance applications.
- Built the material balance in food processing units.
- Apply the energy balance involved in food processing operations.
- Interpret the properties of agitation of flow through packings.

UNIT I - DIMENSIONS AND UNIT **12**

Fundamental-derived units. Definitions of some basic physical quantities – Force, momentum, pressure, work and energy, power, heat and enthalpy. Dimensional analysis-Rayleigh and Buckingham method of dimensional analysis. Mole - atomical molar mass. Moisture content. -water activity. Conversions and calculations of RPM- RCF, normality, molality, molarity, PPM and PPB, Fundamental Calculations.

UNIT II – STOICHIOMETRY **12**

Basic Principles of Stoichiometry - Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use – Data sources, Humidity: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity. basic chemical calculations: Ideal gas law- Ideal mixtures and solutions – Dalton's law of additive volumes, Henry's law, Raoult's law, Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching.

UNIT III - MATERIAL BALANCE **12**

Law of Conservation of mass- Process flow diagram-system boundaries - overall mass balance – component mass balance –basis and tie material- Continuous vs. Batch- Recycle and by pass-unsteady state -mass balance problems on concentration, dehydration, evaporation, crystallization, mixing –solvent extraction – multi stage process.

UNIT IV - ENERGY BALANCE **12**

Heat capacity – gases – solids – liquids -Latent heat – sensible heat -energy balance for a closed system and open system -total energy balances. Energy balance problems in heat exchangers –Drying. Use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

UNIT V – MIXING AND FLOW MEASUREMENTS **12**

Mixing and agitation dimensional analysis, Agitation – power requirement, Flow in packed columns, flow in fluidization columns, settling phenomena, Flow measurement, pumping of liquids and gases – equipment.

TOTAL: 60

SUGGESTED READINGS:

1. Bhatt, B.L and Vora, S.M., "Stoichiometry", Third Edition, McGraw-Hill, New York, 2004.
2. Venkata ramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India, New Delhi, 2011.
3. Romeo T. Toleda. (2000). "Fundamentals of Food Process Engineering ", Chapman & Hall, USA, CBS publications, New Delhi.
4. Smith, PG. (2004). "Introduction to Food Process Engineering ", Springer.
5. Paul Singh R and Dennis R. Heldman (2004) "Introduction to Food Engineering". Academic Press – Elsevier India Private Ltd. New Delhi.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	1
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	-	-	-	-	-	-	-	-	-	2	1
CO4	3	2	1	-	-	-	-	-	-	-	-	-	2	1
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	1
Avg.	**2.6**	**1.6**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**

24BTFT304	FLUID MECHANICS	Semester-III 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To explain the concepts of fluid mechanics.
- To identify the pressure variations in fluids and measurement devices.
- To analyze the fluid statics on variable surface conditions.
- To discover the equations of motion and kinetics of fluid flow.
- To predict the flow of fluids in various geometries of pipes.

Course Outcomes:

Upon successful completion of the course students will be able to:

- Interpret the various properties of fluids.
- Discover the pressure differences in fluids.
- Differentiate the different devices to measure the pressure of fluids.
- Solve the forces acting on bodies submerged in different positions in liquids.
- Demonstrate the basic design calculations for fluid flow in pipes

UNIT I - PROPERTIES OF FLUIDS **9**

Introduction- units and Dimensions – Properties of fluids-Density – Specific weight - Specific Volume- Specific gravity- equation of state – perfect gas - Viscosity- Thermodynamic properties- Compressibility and Bulk modulus- Surface tension and capillarity -vapor pressure and cavitation.

UNIT II - PRESSURE AND ITS MEASUREMENT **9**

Fluid pressure at a point- Pascal's law- Pressure variation in a fluid at rest-Absolute, Gauge, Atmospheric and vacuum pressures- Measurement of pressure Simple Manometers-Differential manometers, micro manometers, Mechanical gages – calibration

UNIT III - FLUID STATICS **9**

Hydro static forces on surfaces- Total pressure and center of pressure- Vertical plane surface submerged in liquid- Horizontal plane surface submerged in liquid- Inclined plane surface submerged in liquid- curved surface submerged in liquid, Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy – meta centre – metacentric height.

UNIT IV - BASIC CONCEPTS OF FLUID FLOW AND MEASUREMENT **9**

Kinematics of flow-Types of fluid flow-Rate of flow-continuity equation- continuity equation in three dimensions- velocity and acceleration velocity potential function and stream function- Dynamics of Fluid flow- Equations of motion- Euler's equation of motion- Bernoulli's equation- Practical applications of Bernoulli's equation – Venturimeter- Orifice meter Pitot tube. Rotameter, Flow measurement in channels – notches – rectangular, Cipolletti and triangular – float method.

UNIT V - FLOW THROUGH PIPES **9**

Reynolds Experiment, Darcy – Weisbach equation for friction head loss – Chezy's formula Laminar and turbulent flow- Loss of energy in pipes- Loss of energy due to friction- Pumps, fan, compressors, blowers – positive displacement pump-centrifugal pump – NPSH and cavitation- pump calculation. Hydraulic gradient and Total Energy line- Flow through pipes in series- Equivalent pipe-Flow through parallel pipes- Flow through branched pipes-Power transmission through pipes-Water hammer in pipes.

TOTAL: 45

SUGGESTED READINGS:

1. Bansal, R.K., (2011). "Fluid Mechanics and Hydraulic Machines",9th edition, Laxmi Publications, New Delhi.
2. Modi, P.N. and Seth, S.M., (2007). "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi.
3. Som, S.R and Biswas, (2007). "Introduction to Fluid Mechanics and Fluid Machines" 2nd edition,

Tata McGraw Hill.
4. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9th ed) Tata McGraw Hill, New Delhi, 1998
5. Grade, RJ.,"Fluid mechanics through problems". Wiley eastern Ltd., Madras,2002.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

24BTFT341	**FOOD MICROBIOLOGY (Theory and Laboratory)**	**SEMESTER-III 5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives:

The goal of this course is for students:

- To develop the knowledge of students in the basic Microbiology.
- To effectively understanding the food processing technology as well as food safety subjects.
- To identify the role of microbes used in food fermentation.
- To explain about the food borne illness and sanitation in food industries.
- To illustrate the microbial examination of foods.

Course Outcomes:

Upon successful completion of the course students will be able to:

- Utilize the general concepts and factors affecting the growth of microorganisms.
- Experiment with different methods of drying, additives and radiation to prevent microbial spoilage.
- Demonstrate the microbial cultures for preparing various fermented food products.
- Illustrate the pathogenesis of food borne pathogens and food poisoning.
- Evaluate the microorganism responsible for spoilage of foods and its assessments.

UNIT I - FOOD AND MICROORGANISMS **9**

General concepts about molds, bacteria and yeasts. Gram Positive and Gram-Negativebacteria Factors affecting the growth of microorganisms – pH, water activity, oxidation – reduction potential, nutrient content, inhibitory substances and biological structure –Microbial spoilage problems associated with typical food products, Food spoilage by microorganisms, beneficial microorganisms and its uses. control of microbial growth

UNIT – II CONTROL OF MICROBES **9**

Heat resistance of microorganisms and their spores, Determination of heat resistance Effect of high temperature on microbes – TDT, D value, Z value, 12D concept, F value**.** Use of antimicrobial chemicals- organic acids, sugars, benzoate, sorbates/propionates naturally occurring antimicrobials, Physical methods- low and high temperatures, drying, radiation and high pressure, Tolerance of microorganisms to thermal processing.

UNIT III - MICROBES IN FOOD FERMENTATION **9**

Importance of microbes in food fermentation- homo and hetero-fermentative bacteria, yeast and fungi, biochemistry of fermentations- pathways involved, lactic acid bacteria fermentations, alcoholic fermentations, yeast and fungal fermentations. Microbes associated with typical fermented foods- milk products, breads, idli, vegetables and meat products.

UNIT IV - FOOD BORNE ILLNESS AND SANITATION **9**

Food borne pathogens, food infections and food poisoning, microbial toxins. Food borne viruses; Helminths, nematodes and protozoa, poisoning by chemicals, Bacteriology of water supplies – Sewage and waste treatment and disposal-Microbiology of the food product - Good Manufacturing Practices (GMP) – Hazard Analysis and Critical Control Points (HACCP).

UNIT V - MICROBIAL EXAMINATION OF FOODS **9**

Detection and Enumeration of microbes in foods- Rapid and automated microbial methods, Indicator organisms, Applications of immunological techniques to food industry. Detections methods for E. coli, Yersinia, Campylobacter, Clostridium Botulinum, Rotavirus, Hepatitis A virus, Listeria monocytogenes from food samples.

TOTAL: 45

SUGGESTED READINGS:

1. Adams M.R and Moss M.O, (2007). "Food Microbiology", 2nd Edition, Third reprint, Panima Publishing Corporation, New Delhi,
2. William C Frazier and Dennis C. Westoff, (2008). "Food Microbiology", Special Edition, Springer, The Mc Graw-Hill Companies.
3. Montville, Thomas J. and Karl R. Matthews "Food Microbiology: An Introduction". ASM Press, 2005.
4. Doyle, Michael P. "Food Microbiology: Fundamentals and Frontiers". 2nd Edition, ASM Press, 2001.
5. Pawsey, R. K. "Case Studies in Food Microbiology for Food Safety and Quality". The Royal Society of Chemistry, 2001.
6. Banwart, G.J. "Basic Food Microbiology" 2nd Edition. CBS Publishers, 1998.
7. Jay, J.M. "Modern Food Microbiology".4th Edition. CBS Publishers, 2003.

SUGGESTED READINGS:

1. Doyle, Michael P. "Food Microbiology: Fundamentals and Frontiers". 2nd Edition, ASM Press, 2001.
2. Pawsey, R. K. "Case Studies in Food Microbiology for Food Safety and Quality". The Royal Society of Chemistry, 2001.

WEBLINKS:

1. https://onlinecourses.swayam2.ac.in/cec19_ag03/preview
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7329975/

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	2	-	3	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	2	-	-	-	-	-	-	-	-	2	-	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	-	-	-	-	-	-	-	-	2	-	2	2
Avg.	**3**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**2**	**2**

(ii) Laboratory

LIST OF EXPERIMENTS

1. Microscopy: working and applications.
2. Sterilization techniques and applications.
3. Preparation of culture media, broth and slants.
4. Staining methods: simple and differential staining.
5. Demonstration of bacterial motility by hanging drop method.
6. Microbiological examination of water quality by MPN method.
7. Bacteriological testing of milk.
8. Enumeration of microbes in spoiled food.
9. Production of wine and estimation of alcohol content.
10. Demonstration of beer production.

TOTAL: 30

24BTFT342	**FOOD CHEMISTRY (Theory and Laboratory)**	**SEMESTER-III 5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives:

The goal of this course is for students:

- To explain the properties of biomolecules and its reactions involved.
- To identify the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition.
- To Discuss and use effectively, food composition tables and databases.
- To differentiate the various physical and chemical properties of foods.
- To Illustrate the analysis of proteins and lipids.

Course Outcomes:

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

- Summarize the structure of molecules, its reactions and interactions of food components in food products
- Explain the use of food composition tables and databases.
- Interpret the physical and chemical properties of food.
- Demonstrate the analysis test of proteins and lipids.
- Describe the importance of minerals and vitamins in food.

UNIT I – CARBOHYDRATES **9**

Classification - mono and disaccharides, Oligosaccharides, Polysaccharides structure and properties; Chemical properties of carbohydrates dehydration, caramelization, Maillard reaction, hygroscopicity & solubility, optical rotation, mutarotation; sensory properties-sweetness index; Glucose syrup, high fructose corn syrup, Dextrose Equivalent, Degree of polymerization; Stages of sugar cookery, crystal formation, Non – enzymatic browning; Starch- amylose and amylopectin- properties, thickening &gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch- hydrolysates – Maltodextrins and dextrins; Pectins, gums & seaweeds- gel formation & viscosity. ; Emulsion– definition, theory.

UNIT II – PROTEINS **9**

Proteins in foods -classification, structure and properties of amino acids; Essential amino & non-Essential amino acids. Review of protein structure & conformation. Chemical and Physical properties of Proteins. Reactions of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation &stabilization, gel formation, emulsifying effect, thickening & binding, amino acids in Maillard reaction, denaturation; Food enzymes-classification, kinetics, production and applications; Mechanism of enzyme action. Determination of proteins in food.

UNIT III – LIPIDS **9**

Lipids in foods - occurrence, classification, structure of simple, compound and derived lipids. Nomenclature of fats. Non-glyceride components in fats& oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, isomerization, unsaturation; Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization; Hydrolytic rancidity & oxidative rancidity; radiolysis Shortening power of fats, tenderization, emulsification, frying – smoke point, autooxidation, polymerization; Fat replacements; Food sources, functional role and uses in foods.

UNIT IV - WATER, MINERALS AND VITAMINS **9**

Water: Structure of water molecule, Chemical and physical properties of water, Types of water: free, bound & entrapped water, water activity. Drinking water, mineral water, water hardness, water quality for food process in. Minerals & vitamins: Mineral & vitamin content of foods- Food and Pharmaceutical grades; Recommended daily intake, toxicities, deficiencies, factors affecting bioavailability, stability &degradation during processing.

UNIT V – COLOR, FLAVORS AND OTHER COMPONENTS **9**

Colour, flavour & aroma components: Naturally occurring colours, acids, other flavor & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables & fermented products; Synthetic colours and naturally similar /artificial flavours, Threshold values, off flavours & food taints. Naturally occurring toxic substances (trypsin inhibitors, phytins, tannins, oxalates, goitrogen, toxic amino acids, glucosinolates, aflatoxins), protease inhibitors, bioactive components: phytates, polyphenols, saponins, phytoestrogens etc. Processing and storage techniques of flavoring compounds. Changes (color, flavor and other components) during processing and storage.

TOTAL: 45

SUGGESTED READINGS:

1. Belitz H.-D, Grosch W and Schieberle P. (2004), Food Chemistry, 3rd Revised Edition, Springer-Verlag.
2. Meyer, Lillian Hoagland (1987), Food Chemistry, CBS Publishers
3. Chopra, H.K. and P.S. Panesar, (2010), Food Chemistry, Narosa
4. Vaclavik, V. A. and Christian E. W., (2003), Essentials of Food Science - 2nd Edition, Kluwer Academic, Springer.
5. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.
6. Thayumanavan, B, Krishnaveni, S and Parvathi, K. 2004. Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN: 81- 7515-45

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	2	-	2	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	1	-	-	-	-	-	-	-	-	2	-	2	2
CO4	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	3	1	-	-	-	-	-	-	-	-	2	-	2	2
Avg.	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**2**	**2**

(ii) Laboratory

List of Experiments:

1. Enzymatic Browning in foods.
2. Gelling properties of starch.
3. Study of gluten formation.
4. Foaming properties of proteins.
5. Iso-electric precipitation of casein.
6. Preparation of emulsions.
7. Estimation of free fatty acids.
8. Oxidative rancidity of fats.
9. Estimation of Carotenoids.
10. Rapid Detection of flavor Compounds.
11. Enzyme activity assay (protease / amylase).

TOTAL: 30

24BTMC351 **APTITUDE & REASONING** **SEMESTER-III**

1H-0C

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**
Exam:3 Hours

Course Objectives:
The goal of this course is for the students:

- To Categorize, apply, and use thought processes to distinguish between concepts
- of Quantitative methods.
- To Prepare and explain the fundamentals related to various possibilities and
- probabilities related to quantitative aptitude.
- To Critically evaluate numerous possibilities related to puzzles.
- To Understand and solve puzzle-related questions from specific and other competitive tests.
- To Solve questions related to Time and distance and time and work etc.

Course Outcomes:
Upon completion of this course, the students will be able to:

- Understand the basic concepts of quantitative ability
- Understand the basic concepts of logical reasoning Skills
- Acquire satisfactory competency in the use of reasoning
- Solve campus placements aptitude papers covering Quantitative Ability, Logical
- Gaun Reasoning Ability Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

UNIT - I 1. Quantitative Ability (Basic Mathematics)

1.1. Number Systems
1.2. LCM and HCF
1.3. Decimal Fractions
1.4. Simplification
1.5. Square Roots and Cube Roots
1.6. Problems on Ages
1.7. Surds & Indices
1.8. Percentages

UNIT – II 2. Quantitative Ability (Applied & Engineering Mathematics)

2.1. Logarithm
2.2. Permutation and Combinations
2.3 Probability
2.4 Profit and Loss
2.5 Simple and Compound Interest
2.6. Time, Speed and Distance
2.7. Time & Work
2.8. Ratio and Proportion
2.9. Area
2.10 Mixtures and Allegation

UNIT – III 3. Verbal - Aptitude

2.1 Words
2.2 Idioms
2.3 Phrases in Context
2.4 Reading comprehension techniques
2.5 Narrative sequencing
2.6 Data interpretation

SUGGESTED READINGS:

1. A Modern Approach to Verbal & Non-Verbal Reasoning By R S Agarwal
2. Analytical and Logical Reasoning By Sijwali B S
3. Quantitative aptitude for Competitive examination By R S Agarwal
4. Analytical and Logical Reasoning for CAT and other management entrance tests By Sijwali B S
5. Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4th edition
6. https://prepinsta.com/
7. https://www.indiabix.com/

24BTMC352A	**FOREIGN LANGUAGE –GERMAN**	**SEMESTER-III** **1H-0C**

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**
Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Learn design thinking concepts and principles
- Use design thinking methods in every stage of the problem
- Learn the different phases of design thinking
- Apply various methods in design thinking to different problems
- Identify a solution to any problem of life and business

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Demonstrate the critical theories of design, systems thinking, and design methodologies
- Define key concepts of design thinking
- Practice design thinking in all stages of problem solving
- Apply design thinking approach to real world problems
- Use the concept of design thinking in their business world.

UNIT-I: Herzlich willkommen! -Wie ist dein Name ? -Ich trinke gern Kaffee.-Wir konjugieren die Verben.

UNIT-II: A bit of history and ZAHLEN - Verben, W-Fragen, Ja-Nein Fragen, Imperativ-das Alphabet, die Woche, das Jahr -Was sind deine Hobbys ? Formular ausfÃ¼llen

UNIT-III: Mein Lehrbuch | Meine persÃ¶nlichen Daten-Mein Arbeitsbuch -Wir beginnen Lektion -Wir lesen Lektion 3

UNIT-IV: formeller Brief- Wie lernst du Deutsch ? -Wir hÃ¶ren ein deutsches Lied- Wir lernen HÃ¶rverstÃ¤ndnis | Wir beginnen Lektion

UNIT V: Eine E-Mail schreiben | Eine Wohnung beschreiben- Im Kaufhaus | Welche/Diese-Gesund und munter

SUGGESTED READINGS:

1. NETZWERK Deutsch als Fremdsprache A1(Goyal, New Delhi, 2015)
2. Schulz-Griesbach: Deutsch als Fremdsprache. Grundstufe in einem Band (for Grammar)

WEB RESOURCES:

- https://www.tatsachen-ueber-deutschland.de/en
- https://www.goethe.de/en/spr/kup/prf/prf/sd1/ueb.html

24BTMC352B	**FOREIGN LANGUAGE – FRENCH**	**SEMESTER-III**
		1H-0C

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**

Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Learn design thinking concepts and principles
- Use design thinking methods in every stage of the problem
- Learn the different phases of design thinking
- Apply various methods in design thinking to different problems
- Identify a solution to any problem of life and business

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Demonstrate the critical theories of design, systems thinking, and design methodologies
- Define key concepts of design thinking
- Practice design thinking in all stages of problem solving
- Apply design thinking approach to real world problems
- Use the concept of design thinking in their business world.

UNIT- I

Recognize the French letters, Identify the letter-combinations that are characteristic of the French language, Identify the remaining letter-combinations that are characteristic of the French language,

UNIT - II

Use the imperative in the affirmative form, Say the time in French, Talk about the weather in French, .Talk about actions that just happened, Speak about actions that are yet to happen.

UNIT – III

Learn a few basic and commonly used 2nd group verbs, Understand the concept of French ‘modal verb, Learn a few basic and commonly used 3rd group verbs, Learn what reflexive verbs, Distinguish between moods and tenses

UNIT – IV

Place an order in a restaurant, Learn a third past tense, Identify a direct object, Identify an indirect object, Use direct and indirect objects pronouns in a single sentence

BOOKS AND REFERENCES:

1. Alter Ego - Méthode de Français, A1 (2006): Berthet, Hugot et al., Hachette
2. Alter Ego – Cahier d’activités, A1 (2006): Berthet, Hugot et al., Hachette
3. Écho - Méthode de Français, A1 (2013): Girardet, Pecheur, CLE International

WEB RESOURCES:

- www.leo.org
- WWW. Nptel.com

24BTFT391	**FIELD PROJECTS/ INTERNSHIP**	**SEMESTER-III**
		0H-1C

Instruction Hours/week: L:0 T:0 P:0 **Marks:** Internal**:100** Total**:100**

The students will be directed to do an internship in their domain industry for 3 weeks Their internship work will be evaluated for forty percentages by internal examiner and sixty percentage by external examiner for End Semester Examination. End Semester Examination evaluation will be based on the report submitted by the student after the completion of their internship report.

Semester-IV

B.Tech. Food Technology **2024-2025**

24BTFT401A **PROBABILITY AND STATISTICS** **Semester-IV**

4H-4C

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To provide the required fundamental concepts of probability theory, Random variables and its distributions.
- To impart the knowledge of Measures of Central tendencies and Dispersions
- To impart the knowledge of correlation and Regression
- To inculcate the knowledge of testing of hypothesis using small and large sampling tests.

COURSE OUTCOMES:

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

- Infer the fundamentals of probability and random variables.
- Explain standard distributions of random variables.
- Make use of statistical data for finding the measures of central tendency and measures of dispersion.
- Interpret the data using correlation and regression.
- Apply small and large sample tests in testing of hypothesis.

UNIT I PROBABILITY AND RANDOM VARIABLES **12**

Concept of Probability – Addition and multiplication laws – Conditional probability – Total Probability – Baye's theorem and its applications – One dimensional Random Variables (Discrete and Continuous) – Mathematical Expectation.

UNIT II THEORETICAL DISTRIBUTIONS **12**

Discrete distributions – Binomial, Poisson, Geometric Distributions – Continuous distributions – Uniform, Exponential and Normal Distributions.

UNIT III DESCRIPTIVE STATISTICS **12**

Measures of Central Tendency – Mean, Median, Mode – Measures of Dispersion – Mean deviation – Standard deviation – Coefficient of variation

UNIT IV CORRELATION AND REGRESSION **12**

Correlation – Pearson's Correlation coefficient – Spearman's Rank correlation coefficient – Regression – Regression lines-Linear, Multiple Regression- Logistic Regression - Polynomial Regression.

UNIT V TESTING OF HYPOTHESIS **12**

Large sample tests based on normal distribution – Test for single mean – Difference between means – Proportion – Difference between proportions – Small sample test – Student-t test – Test for single mean – Difference between means – Snedecor's F test – Chi-square test for goodness of fit, independence of attributes.

Total Hours: 45+15

TEXT BOOKS:

1. Geoffrey Grimmett and David Stirzaker, "Probability and Random Processes", Oxford University Press, 4th Edition, 2020.
2. Allen Craig Rober V Hogg,Joseph W Mckean, "Introduction to Mathematical Statistics",Pearson,8th Edition,2021**.**
3. Gupta, S.C and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 1999.

REFERENCE BOOKS:

1. Sheldon M Ross, "Introduction to Probability and statistics for Engineers and scientists", Elsevier, 6thEdition, 2021.

2. Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, John Wiley, 7th Edition, 2019.
3. Freund John, E and Miller, Irvin, “Probability and Statistics for Engineering”, 5th Edition, Prentice Hall, 1994.
4. Jay, L.Devore, “Probability and Statistics for Engineering and Sciences”, Brooks Cole Publishing Company, Monterey, California, 1982.

WEB SITES:

1. www.britannica.com/science/probability
2. www.britannica.com/science/density-function
3. www.khanacademy.org/math/statistics-probability

CO- PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	-	-	1	1	-
CO2	2	1	-	-	-	-	-	-	1	-	-	1	1	-
CO3	2	1	1	-	-	-	-	-	1	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	1	-	-	1	1	-
CO5	2	1	-	-	-	-	-	-	1	-	-	1	1	-
Avg	**2.2**	**1.2**	**0.4**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**

24BTFT402 **THERMODYNAMICS** **SEMESTER-IV**
4H-4C

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To state the fundamentals and calculations involved in the Zeroth law of thermodynamics.
- To discuss the applications of the first law of thermodynamics.
- To illustrate the knowledge of the second law of thermodynamics and entropy.
- To describe the thermodynamic properties of pure substances, its phase change processes and to study the working principle of steam boilers.
- To explain the working principle of carnot, vapor compression, vapor absorption and air refrigeration systems.

Course Outcomes:

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

- Explain the laws, concepts and principles of thermodynamics.
- Apply first law of thermodynamics to closed and open systems.
- Discuss the PVT behavior of properties and heat effects.
- Solve problems related to cycles and cyclic devices using second law of thermodynamics
- Calculate the efficiency of refrigeration cycle

UNIT I – INTRODUCTION **12**

Thermodynamics, Terminologies, systems – classification – properties and state of a system. Thermodynamic process, cycle and equilibrium. Zeroth law of thermodynamics. Law of conservation of energy. Heat – specific heat – thermal capacity and water equivalent. Mechanical univalent of heat, work – power - universal gas constant. Internal energy, enthalpy and molar specific heat of a gas. First law of thermodynamics – Limitations of first law thermodynamics.

UNIT II – FIRST LAW OF THERMODYNAMICS **12**

Work done during a non-flow process - Work done for constant volume, constant pressure, constant temperature, adiabatic and polytropic process. Application of first law of thermodynamics to a steady flow system - boiler, condenser, evaporator, nozzle, turbine, rotary and reciprocating compressor.

UNIT-III-PVT BEHAVIOUR AND HEAT EFFECTS **12**

PVT behavior; description of materials – Ideal gas law, van der Waals, virial and cubic equations of state; Reduced conditions & corresponding states theories; correlations in description of material properties and behavior- Heat effects-latent heat, sensible heat, standard heats of formation, reaction and combustion.

UNIT IV- SECOND LAW OF THERMODYNAMICS **12**

Kelvin planck and Clausius statements. Heat engine, heat pump and refrigeration. Carnot's theorem, Thermodynamic temperature Scales,Mathematical statement of the second law Relation between heat and entropy – Importance and units of entropy- – Clausius inequality - available and unavailable heat energy. Calculation of ideal work, Lost work, thermodynamic property of fluids, Maxwell relations.

UNIT V - REFRIGERATION SYSTEMS **12**

Principles of refrigeration, choice of refrigerants, components of refrigeration cycle. Types of refrigeration: Carnot refrigeration, vapor compression cycle, air refrigeration cycle, absorption refrigeration cycle. Liquefaction processes; Steam-Power plant-Rankine cycle, Reheat cycle and regenerative cycle.

TOTAL: 60

SUGGESTED READINGS:

1. M. Smith, H.C. Van Ness and M.M. Abbott ((2005)), Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw-Hill International Edition.
2. Narayanan, K.V. (2013). A Text book of chemical engineering thermodynamics. 2nd Edition. PHI Learning Private Limited.
3. Rajput, R.K. (2009). Engineering Thermodynamics.3rd Edition. Laxmi, Publication. New Delhi.
4. Nag, P.K. (2017). Engineering Thermodynamics. 6th Edition. McGraw Hill Education (India) Private Limited.

CO – PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	2
CO3	2	2	1	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	1	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.8**	**1.8**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

24BTFT403 **PLANTATION PRODUCTS AND SPICE PROCESSING TECHNOLOGY** **Semester-IV** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To understand about the processing and chemistry of major and minor spices.
- To explain the chemistry and technology of coffee and tea.
- To illustrate the basic views on the chemistry and technology of cocoa and its products.
- To extend the views on quality analysis of spices and its technology.
- To summarize the technologies used in packaging, grading and quality analysis of spices.

Course Outcomes:

Upon completion of this course, students will be able to:

- Infer the production of major & minor spices and chemistry behind its production.
- Explain the manufacturing of major and minor spices and its chemistry.
- Learn about processing steps involved in different types of coffee and tea and quality grading parameters.
- Interpret the basic knowledge on manufacturing of cocoa products and its chemistry.
- Extend the views on packaging and quality aspects of spices.

UNIT I - IMPORTANCE AND PROCESSING OF MAJOR SPICES **9**

Post-Harvest Technology, composition, processed products of Pepper, Cardamom, onion, ginger and turmeric – Oleoresins and essential oils –Method of manufacture, Equipments, Chemistry of the volatiles, Flavor, Quality control of major spices, Spice oil and oleoresins. Types of dryers used in spice processing-Different uses of minor spices-milling of spices-selection of raw materials-Standards

UNIT II - IMPORTANCE AND PROCESSING OF MINOR SPICES **9**

Post-Harvest Technology, composition, processed products of Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove, Coconut, Oilpalm, Arecanut, Cashew and Vanilla, Oleoresins and essential oils– Method of manufacture Equipments, Chemistry of the volatiles, Flavor, Quality control of minor spices, microorganisms, plant suspension cultures.

UNIT III - PROCESSING OF COFFEE AND TEA **9**

A. **Coffee** – Occurrence – chemical constituents– harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting –Process flow sheet for the manufacture of coffee powder – Instant coffee, technology – Chicory chemistry - Quality grading of coffee.
B. **Tea-** Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process – Green tea manufacture – Instant tea manufacture – Grading of tea.

UNIT IV - CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS **9**

Occurrence – Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor manufacture Chocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates.

UNIT V - PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICESES **9**

Cleaning and grading of spices- packaging and storage of spices- grading specifications- AGMARK, ASTA, ESA specifications, process involved in the manufacture of essential oils- quality analysis of spices and their derivatives

TOTAL: 45

SUGGESTED READINGS:

1. Peter, K.V. Hand book of herbs and spices. Volume 2. Wood head publishing Ltd., 2004**.** eBook ISBN**:** 9780857095688
2. Chakravarty, A., Mujumdar, A.S., Raghavan, G.S.V., Ramaswamy, H.S. Handbook of post-harvest technology – cereals, fruits, vegetables, tea and spices. Marcel Dekker Inc., New York (Special Indian Reprint). 2010. ISBN 13: 9780824705145
3. Tainter, D.R. Grenis, A.T. Spices and Seasonings – A food technology hand book. 2nd edition. John Wiley and Sons, Inc., Canada. 2001. ISBN: 978-0-471-35575-5
4. Salunkhe, D.K. and Kadam S.S. Ed. 1998. Hand book of Vegetable Science and Technology, Marcel Dekker, New York, USA. ISBN: 0824701054
5. Minifie Bernard W. Chocolate, Cocoa and Confectionery Technology, 3rdEdition, Aspen Publication, 1999. ISBN: 9780834213012
6. Handbook on Spices, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004. ISBN: 8178330946
7. Banerjee B. 2002. Tea Production and Processing – 3rdedition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	1	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	2	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.6**	**1.7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**2**

24BTFT404 **HEAT AND MASS TRANSFER** **Semester-IV**

3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students to:

- To explain laws of heat conduction and theories of insulation.
- To summarize the different modes of convection heat transfer.
- To differentiate the different modes of radiation heat transfer.
- To classify the types of heat exchangers and their applications in the food industry.
- To summarize the diffusion mass transfer.

Course Outcomes:

Upon completion of the course, students will be able to:

- Explain the conduction mode of heat transfer in simple and composite systems.
- Interpret heat transfer coefficients for natural convection.
- Discuss the influence of radiation in food processing operations.
- Predict heat exchanger performance by using the method of heat exchanger effectiveness.
- Apply heat exchanger performance by using the method of log mean temperature difference.

UNIT I - HEAT TRANSFER – CONDUCTION **9**

Modes of heat transfer – Conduction, Convection and Radiation. Fourier's Law of Heat Conduction-Thermal Conductivity for gases, liquids and solids-Thermal diffusivity- Thermal Resistance-Steady heat conduction in simple geometries: Plane wall, hollow cylinder and hollow sphere through solids in series -plane wall and multilayer cylinder. Heat conduction through materials in parallel. Theory of insulation, critical radius of insulation.

UNIT II - HEAT TRANSFER – CONVECTION **9**

Convection heat transfer – forced and natural; Evaluation of convection heat transfer coefficient, Dimensionless numbers- Forced convection- Heat Transfer Coefficient for Laminar flow inside a tube -heat transfer coefficient for turbulent flow inside a pipe. – Heat Transfer outside various Geometries in Forced Convection – Flow parallel to flat plate - Natural convection from vertical planes and cylinders –boiling and condensation- mechanisms

UNIT III - HEAT TRANSFER – RADIATION **9**

Basics of Radiation heat transfer- Types of surfaces – Concept of Black and Grey body- Kirchhoff's Law-radiation from a body and emissivity (Stephan Boltzmann Law), absorptivity, reflectivity, transmissivity to a small object from surroundings, heat exchange through non-absorbing media –Planck's Distribution law-Wein's Displacement law-combined Radiation and Convection Heat Transfer.

UNIT IV - MASS TRANSFER **9**

Mass transfer – introduction – Fick's law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross-sectional area and diffusion coefficients for gases - molecular diffusion in liquids, biological solutions and gels. Concept of mass transfer coefficients, Interphase mass transfer and over all mass transfer coefficients in binary systems.

UNIT V - DISTILLATION AND CRYSTILLATION **9**

Vapor - Liquid - Equilibrium (VLE). Ideal solutions and Raoult's law, non-ideal solutions and Henry's law, relative volatility. Flash distillation, differential distillation - Rayleigh's equation, steam distillation. Principles of Crystallization – Purity of product, Equilibria and yield, Enthalpy balance, Factors governing nucleation and crystal growth, theory of crystallization.

TOTAL: 45

SUGGESTED READINGS:

1. Rao,D.G. Fundamentals of Food Engineering. PHI learning Pvt Ltd. New Delhi, 2009.
2. Mccabe W.L., Smit J.C and Harriott P. Unit Operations of Chemical Engineering. McGraw- Hill International. New York, 7th Edition, 2017.
3. Paulsingh R, Dennis R. Heldman. Introduction to Food Engineering. Academic press 5th edition. 2013.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

24BTFT441 **UNIT OPERATIONS IN FOOD PROCESSING** **Semester-IV**
(Theory & Laboratory) **5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives:

The goal of this course is for students:

- To discuss the various types of equipment involved in drying and dehydration.
- To explain the operations involved in mechanical separations.
- To choose the various attributes of evaporators in food processing.
- To distinguish the role of milling equipment in size reduction.
- To summarize the agitation and types of impellers employed in mixing.

Course Outcomes:

Upon completion of the course, students will be able to:

- Explain the models involved in the moisture and its measurements.
- Summarize the various dryers employed in drying of food.
- Demonstrate the filtration, sedimentation and centrifugal separations.
- Infer the heat transfer coefficients and economy of different types of evaporators.
- Discuss the energy and power requirement for the different size reduction operations.

UNIT I - DRYING AND DEHYDRATION **9**

Moisture and its measurements - direct and indirect methods – Equilibrium moisture – methods of determination – EMC Models – Henderson, Kelvin, PET and GAB models-importance of EMC- water activity – psychrometry — Drying theory – Drying rate – Mechanical Drying – hot air dryers – Types- fixed -fluidized bed – LSU drier-Spray drier- Osmotic dryer - vacuum shelf dryer - freeze dryer. Cleaning and Grading operations and equipments used in food industry

UNIT II - MECHANICAL SEPARATION **9**

Screening: Types, Equipments; Filtration: Filter media types and requirement – constant rate filtration – constant pressure filtration – filter cake resistance – filtration equipments – filter press – rotary drum filters – sedimentation – sedimentation of particles in gas - cyclones – settling under sedimentation - gravitational sedimentation-Stoke's law – sedimentation in cyclones. Centrifugal separations – rate of separation centrifuge equipment.

UNIT III – EVAPORATION **9**

Definition – liquid characteristics – Types of evaporators -single and multiple effect evaporators - once through and circulation evaporators – Agitated film evaporators. Performance – evaporator capacity – boiling point elevation and Duhring's rule.– Evaporators economy – enthalpy balance of single effect evaporator – multiple effect evaporator – methods of feeding. Capacity and economy of multiple effect evaporator

UNIT IV - SIZE REDUCTION **9**

Principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products – energy and power requirements – crushing efficiency – Rittinger's, Kick's and Bond's law – Size reduction equipments – crushers -Hammer mill – Ball Mill-Colloidal mill-attrition mills, grinders – construction and operation.

UNIT V – EXTRUSION **9**

Extrusion – methods – cold extrusion - Extrusion cooking – principles and types of extruders - single and double screw extruder- construction and working - Effect of different operational parameters – Effect on food - quality of the extruded products.

TOTAL: 45

SUGGESTED READINGS:

1. Rao DG. Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi, 2009.
2. Geankoplis CJ. Transport Processes and Separation Processes Principles. Prentice Hall India, New Delhi, 5th Edition, 2018.
3. Warren, L McCabe, J.C. Smith and Peter Harriot. Unit Operations of Chemical Engineering McGraw Hill International Edition, Singapore, 7th Edition, 2004.
4. Earle, R.L. Unit Operations in Food Processing". Pergamon Press. UK, 2nd Edition, 2003.
5. Khurmi, R.S. and J.K. Gupta. 2003. A Text book of thermal Engg., S. Chand & Co. Ltd., Ram Nagar,New Delhi.
6. Zeki Berk. 2009. Food Process Engineering and Technology. Academic press, New York, USA.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	1	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	1	-	-	-	2	2
CO3	1	-	-	-	-	-	-	-	1	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	1	-	-	-	2	2
CO5	1	2	-	-	-	-	-	-	1	-	-	-	2	2
Avg.	**1.8**	**2.3**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**2**

(i) Laboratory

List of Experiments:

1. Experiment on drying of food samples in tray dryer
2. Study of fluidized bed dryer and drying process
3. Study of working principle of spray dryer and spray drying process
4. Study of freeze dryer and freeze-drying process
5. Experiments on plate and frame filter press
6. Determination of particle size of granular foods by sieve analysis
7. Performance evaluation of ball mill
8. Performance evaluation of drop weight crusher
9. Experiments on ultra-filtration
10. Solving problems on single effect evaporator and multiple effect evaporators

TOTAL: 30

24BTFT442 **FOOD BIOCHEMISTRY AND NUTRITION** **Semester-IV**

(Theory & Laboratory) **5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives:

The goal of this course is for students:

- To explain the digestion, absorption and metabolic pathways of carbohydrates.
- To describe the digestion, absorption, synthesis and metabolic pathways of fatty acids, proteins, and amino acids.
- To illustrate the important aspects of food relating to nutrition.
- To summarize the diets suitable for managing specific nutritional disorders.
- To identify new range of food products and dietary management system for different age group people.

Course Outcomes:

Upon successful completion of the course students will be able to:

- Illustrate the structure of ATP and identify the major class of macromolecules to which ATP belongs.
- Prepare the stages in the catabolism of food molecules and describe what occurs during each stage.
- Summarize the biochemistry process, basic concept of human nutrition and the relationship of the consumption of foods to nutritional status and health.
- Explain the biological functions of foods for health in addition to nutritional values.
- Identify the dietary management system for nutrition and disorder with organs and inborn errors.

UNIT I – METABOLISM OF CARBOHYDRATES AND PROTEINS **9**

Carbohydrate – Digestion and absorption, physicochemical and metabolic functions, Glycolysis (EMP) pathway, CORI's cycle, Energy yield from glycolysis, TCA cycle, pentose phosphate pathway – Energetics, HMP or PP pathway, Gluconeogenesis, Glycogenolysis, Glycogenesis, oxidative phosphorylation. Proteins – Digestion and absorption, General metabolism of amino acids – trans deamination, transamination and oxidative deamination, Urea cycle, Metabolism of serine, cysteine, valine, leucine, isoleucine, tryptophan.

UNIT II-METABOLISM OF FATTY ACIDS, VITAMINS, MINERALS AND NUCLEIC ACIDS **9**

Fatty acids – Digestion and absorption, Synthesis of TAG's, Metabolism of adipose tissue – fatty liver and lipotropic factors, Cholesterol – biosynthesis and metabolism. - Metabolism of fat soluble and water-soluble vitamins. Metabolism of micro and macro minerals. Nucleic acids; physicochemical and metabolic functions, metabolism – metabolism of purine and pyrimidine nucleotides.

UNIT III-CONCEPTS OF FOOD AND NUTRITION **9**

Food as a source of nutrients, Food intake and regulations, Food groups, Utilization of nutrients and digestion process, calorific value of food, dietary need and recommended dietary allowances, Vegetarian diet – health, problems and advantages, Nutrition in phytochemicals and non- nutrient components, Malnutrition – PEM, Food fortification, Effect of processing on nutritive value of foods, vitamins and storage of nutrients, Food allergy, intolerance and sensitivity, Nutrigenomics, Molecular nutrition, e-Nutrition and personalized nutrition.

UNIT IV-NUTRITIONAL DISORDERS **9**

Dietary management –effects on metabolic processes and diet modifications: Overweight, underweight and obesity – definitions, types, causes, factors responsible, measurement of obesity, importance of weight regulation, diet during obesity, psychological disorders during dieting, practical suggestions for reducing weight: Burns – types and nutritional management, fat replacers, dietary management in acute diseases of the heart, cardiological society of India: use of artificial sweeteners,

UNIT V-SPECIALIZED NUTRITION **9**

Nutritional requirement for infants – food and feeding, nutritional requirement, complications commonly

occurring in late adulthood: Sports and fitness – measurement of body composition, energy from major nutrients, factors affecting fuel utilization, nutrition and athletic performance, effective hydration for fitness and sports, nutrition requirement for athletes, water and other fluids, sport supplements, broad guidelines for sports persons.

TOTAL: 45

SUGGESTED READINGS:

1. Sunetra Roday. Food Science and Nutrition. Oxford Education/Oxford University Press, 2nd Edition, 2012.
2. Shubhangini AJ. Nutrition and Dietetics. McGraw Hill education, 4th Edition, 2015.
3. Srilakshmi.B. 2011. Dietetics (sixth edition). New Age Intl. Publishers, New Delhi.
4. Vasudevan DM and Sreekumari S. Textbook of Biochemistry. Jaypee Brothers Medical Publsihers Pvt Ltd. New Delhi, 3rd Edition, 2001.
5. Norman. N. Potter and Joseph H. Hotchkiss. 1996. Food Science, 5thredition, CBS publishers and Distributors, New Delhi.
6. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, US.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	2	-	2	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	1	-	-	-	-	-	-	-	-	2	-	2	2
CO4	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	3	1	-	-	-	-	-	-	-	-	2	-	2	2
Avg.	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**2**	**2**

Laboratory List of Experiments

1. Estimation of proteins by Lowry's method.
2. Estimation of proteins by Biuret method.
3. Estimation of amino acid by ninhydrin method.
4. Estimation of total carbohydrate by anthrone method.
5. Estimation of reducing sugar by dinitro-salicylic acid (DNS) method.
6. Estimation of ascorbic acid content in the food.
7. Estimation of ash content and preparation of sample for AAS analysis.
8. Estimation of fat by Soxhlet method.
9. Estimation of cholesterol by Zak's method.
10. Estimation of Protein using Bradford's method

TOTAL: 30

24BTFT411 **COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY** **Semester-IV 3H-2C**

Instruction Hours/week: L:0 T:0 P:4 **Marks:** Internal**:100** Total**:100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To achieve socio economic development through active community engagement.
- To improve the quality of both teaching and research for better understanding of issues in the society.

COURSE OUTCOMES:

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

- Explain the role of community engagement in the development of the nation.
- Understand the social problems, social contribution of community networking and various government schemes supporting the community engagement.
- Understand the role of Indian citizens towards community development by adopting a village and carrying out the field work

UNIT I INTRODUCTION **5**

Concept, Ethics and Spectrum of Community engagement- Local Community-Appreciation of rural society- Rural and local economy and livelihood – Rural development programs and Rural institutions Introduction-State of the Art-Examples of Recent Research and Development Challenges and Future Trends Introduction-State of the Art-Examples of Recent Research and Development Challenges and Future Trends

UNIT II SOCIAL PROBLEMS **5**

Inequality in America- The Working Poor and Hunger- Homelessness- Inequity in Education- Racism- Crime and Punishment- Refugees and Immigration- Social contribution of community networking-Contribution of self-help groups- Various government schemes

UNIT III FIELD WORK **20**

Spreading awareness about the electrical safety, government schemes in renewable energy, Skill development for employment opportunities.

TEXT BOOKS:

1. Principles of Community Engagement, 2nd Edition, NIH Publication No. 11-7782, Printed June 2011

WEB SITES:

2. https://onlinecourses.swayam2.ac.in/ugc23_ge04/preview.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	1	1	-	-	1	-	-
CO2	-	-	-	-	-	1	1	1	1	-	-	1	-	-
CO3	-	-	-	-	-	1	1	1	1	-	-	1	-	-
Average	-	-	-	-	-	1	**1**	**1**	**1**	-	-	**1**	-	-

24BTMC451	FOUNDATION OF ENTREPRENEURSHIP	Semester-IV 1H-0C

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students:

- To equip and develop the learners entrepreneurial skills and qualities essential to undertake business.
- To impart the learners entrepreneurial competencies needed for managing business efficiently and effectively.
- To understand basic concepts in the area of entrepreneurship
- To develop personal creativity and entrepreneurial initiative
- To adopt the key steps in the elaboration of business

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Gain entrepreneurial competence to run the business efficiently.
- Undertake businesses in the entrepreneurial environment
- Prepare business plans and undertake feasible projects.
- Be efficient in launching and develop their business ventures successfully
- Monitor the business effectively towards growth and development

Unit I -ENTREPRENEURAL COMPETENCE

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur.

Unit II -ENTREPRENEURAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development

Unit III -BUSINESS PLAN PREPARATION

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership

Unit IV -LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization - Operations Planning - Market and Channel Selection - Growth Strategies

Unit- V MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Effective Management of small Business - Case Studies.

SUGGESTED READINGS

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2016.
2. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
3. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011.
4. Donald F Kuratko,T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning, 2012.

24BTMC452	ESSENCE OF TRADITIONAL INDIAN KNOWLEDGE AND HERITAGE	Semester-IV 1H-0C

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students:

- To impart a holistic understanding about Indian Culture and Thoughts from a Historical perspective.
- To encourage critical appreciation of the Indian thoughts and cultural manifestations.
- To introduce the students to important concepts from the diverse intellectual traditions of India.
- To make use of Indian cultural heritage and various epistemological inquiries.
- To gain knowledge of Indian heritage.

COURSE OUTCOMES:

Upon completion of this course the students will be able to:

- Understand the cultural diversity
- Infer the need of cultural unty
- Know the Dravidian culture
- Realize the power of Indian educational system called gurukul
- Come to know the concepts of vedic thought

UNIT I Introduction to Indian thought and Culture

Plurality of Indian culture - Cultural Diversity and Cultural Unity -Different manifestations of Indian Culture: Indus valley culture -Vedic culture and Dravidian culture. -The Medieval Bhakti Culture.

UNIT II Traditional knowledge Systems of India

Introduction to the Traditional Indian Education system of Gurukul - Parampara -Understanding Indian Philosophy: Vedic thought and the nine schools of philosophy - Indigenous Knowledge and Women in India.

SUGGESTED READINGS:

1. Chatterjee, Satishchandra and Dhirendramohan Datta. (2007) Introduction to Indian Philosophy. Rupa Publications, New Delhi.
2. Husain,S. Abid. (2003). The National Culture of India. National Book Trust.

Semester-V

B. Tech. - Food Technology **2024-2025**

24BTFT501 **REFRIGERATION AND COLD CHAIN MANAGEMENT** **Semester-V**

3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

END SEMESTER EXAM:3 HOURS

COURSE OBJECTIVES:

The goal of this course is for students:

- To recall various concepts behind refrigeration of food.
- To define the various aspects of cold storage.
- To explain the overall attributes of air conditioning in food industries.
- To summarize the food freezing concept and equipment involved.
- To illustrate the cold chain management in small- and large-scale refrigerators.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Explain refrigeration of food and its operational components.
- Illustrate food refrigeration in plants, stores and logistics.
- Apply food freezing concepts and techniques.
- Discuss the food safety aspects of chilled foods and frozen foods.
- Interpret the cold chain management system in the food distribution sector

UNIT I - PRINCIPLES OF REFRIGERATION **9**

Refrigeration – Ton of refrigeration, refrigeration effect, refrigeration cycles, Vapour Compression and Vapour Absorption cycles, - simple vapour compression cycle Refrigerants, characteristics of different refrigerants, net refrigerating effect - units of refrigeration Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls, application of refrigeration.

UNIT II - COLD STORAGE **9**

Insulation, properties of insulating materials, air diffusion equipment, Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages,Freezer room Temperatures, Cooling towers: introduction, Construction and Working; ColdStorage practice, Stacking and handling of materials, Optimum temperatures of storage fordifferent food materials

UNIT III - AIR-CONDITIONING **9**

Psychrometry, Psychrometric Processes, Simple Air Conditioning System –State and Mass Rate of Air. Evaporative, winter and All Year Air Conditioning Systems. Design Conditions. Load Calculation and Psychrometry of Air Conditioning Systems –Design of Air conditioning apparatus – Transmission and Distribution of Air. Selection of Air Conditioning System.

UNIT IV - FREEZING AND CHILLING OF FOODS **9**

Freezing equipment, freezing time, Freezing curve, Freezing rates, growth rate of ice crystals, crystal size and its effect of texture and quality of foods, Freezer types, Individual quick freezing. Cryogenic Freezing, freezing practice as applied to different food sectors. Chilling equipment for liquid foods. Secondary refrigerants, Evaporative cooling and direct expansion techniques in chilling. Chilled food transport and retail cabinets - Basics of Chilled food microbiology, Packaging of Chilled foods.

UNIT V - COLD CHAIN MANAGEMENT **9**

Supply chain system - Important Factors to consider- logistic supply- Protocols for Domestic, Sea and Air freight- Traceability and barcode – Product Temperature and Moisture monitoring- Refrigeration systems and Refrigerant types during field chilling, Chilling and freezing, Time –temperature –correlation-the kinetic approach, ; Role of packaging in cold chain– MAS, MAP, CAS, CAP, transportation via land, air and sea. Grocery stores and display cases, Home refrigerators - Cooling chain summary – Storage and packaging.

TOTAL:45

SUGGESTED READINGS:

1. Clive. V. J Dellino. Cold and Chilled Storage Technology. Chapman Hall India. 2nd Edition, 2012.
2. C.P. Arora. Refrigeration and Air conditioning. Tata McGraw Hill, 3rd Edition, 2008.
3. Da-Wen Sun. Handbook of Frozen Food Processing and Packaging. CRC Press 2ndEdition, 2011.
4. Florkowski W.J, Shewfelt R.L, Brueckner B and Prussia S.E. Post Harvest Handling and System Approach. Academic Press, 3rd Edition, 2014.
5. Colin Dennis and Michael Stringer. Chilled Foods – A Comprehensive Guide Brown. M Wood Head Publishing, 3rd Edition, 2008.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	1	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	2	-	-	-	-	-	-	-	-	-	-	2	2
Average	**2.4**	**1.8**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT502	**DAIRY TECHNOLOGY**	**Semester-V** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60**-Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To outline the concepts of physicochemical and functional properties of milk constituents.
- To demonstrate the construction and working of dairy processing equipment.
- To summarize the process involved in packaging and storage of milk.
- To explain the production of milk and milk-based products.
- To recall the working principle and construction of equipment like spray drier, drum drier.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Infer the physical, chemical and functional properties of milk.
- Interpret the dairy processing equipment for specific applications.
- Apply the processes involved in packaging and storage of milk.
- Understand the manufacturing processes of various dairy products.
- Classify the different types of dehydrated milk products

UNIT I - DAIRY CHEMISTRY AND MICROBIOLOGY **9**

Introduction - Basic dairy terminology - milk as raw material– types-composition - Physical, Chemical and Thermal properties of milk-nutritive value –– contaminants - microbiology of milk- milk collection - cooling and milk transport – milk reception - Quality control tests application of enzymes in the dairy industry.

UNIT II - DAIRY PROCESSING AND EQUIPMENT'S **9**

Processing of Milk, calculation and standardization of raw milk, storage tanks, Pasteurization – HTST –LTLT - UHT methods - Sterilization, Homogenization-theory- Working principle – efficiency, Filtering and Clarification of Milk-Cream separating Centrifuges- principles – gravity and centrifugal separation – centrifugal separator – parts-construction and working principle– separation efficiency.

UNIT III - BOTTLE, CAN WASHING AND FILLING EQUIPMENT'S **9**

Plant piping – Pumps - Bottle washers- and cappers- can washers-types of can washers equipment's maintenance and sanitation-factors affecting washing operation – Fillers - types of fillers, filling process, pouch filling form fill seal machines - aseptic filling, factors affecting filling accuracy - cleaning and sanitization - CIP cleaning- types of CIP systems – Energy use in Dairy plant - sources of energy - Control of energy losses and Energy conservation.

UNIT IV - MILK PRODUCT PROCESSING **9**

Traditional dairy products, Technology of traditional Indian dairy products. Technology of milk and milk products, Manufacturing of Butter – theory- churning process - operation of butter churn – over run–– batch and continuous methods of butter making. Ghee – methods of manufacture-Cheese – classification – cheddar and cottage cheese - equipment's – cheese vats and press – construction details. Ice cream - ingredients – preparation of ice cream mix - freezing – calculation of freezing point and refrigeration - batch and continuous freezers-Special milks - Quality aspects of dairy products.

UNIT V - FERMENTED AND DEHYDRATED DAIRY PRODUCTS **9**

Fermented products – Yogurt – Curd – cultured buttermilk – Bulgarian buttermilk – Kefir – paneer - Concept of Probiotics and prebiotic foods- Dehydrated dairy products- milk powder, whey powder, dehydrated cheese. Vacuum Evaporators - drying of milk - drum drier and spray drier - components - construction and working principles.

TOTAL:45

SUGGESTED READINGS:

1. Walstra, P., "Dairy Technology Principles of Milk properties and processes". Marcel Dekker, 1999.
2. Tomar S. An Introduction to Dairy Technology. Pragun Publication, 2012.
3. NIIR Board. Modern Technology of Milk Processing and Dairy Products. NIIR ProjectConsultancy Services, 4th Edition, 2013.
4. Tufail Ahmad. Dairy Plant Engineering and Management. Kitab Mahal Publishers. NewDelhi, 2016.
5. Tufail Ahmad. Dairy Plant Engineering and Management. Kitab Mahal Publishers. NewDelhi, 2016.
6. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rdimpression, 2006.
7. Walstra P, Wouters JTM, Geuris TJ. DairyTechnology. Taylor& Francis, 2005.
8. Frazier WC and Westhoff DC. Food Microbiology. McGraw Hill. 11th reprint, 2017.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Average	**2.4**	**1.8**	-	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT541	**FOOD ANALYSIS**	**Semester-V**
	(Theory & Laboratory)	**5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

(i) **Theory**

COURSE OBJECTIVES:

The goal of this course is for students:

- To illustrate the sampling and proximate analysis of food substances.
- To infer the physical, chemical, quality standards and adulterants of lipids, protein and carbohydrate.
- To summarize the different spectroscopic techniques involved in food analysis.
- To explain the various chromatographic methods employed in analysis of foods.
- To outline the techniques on electrophoresis, refractometry, polarimetry and biosensors.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Estimate the proximate composition of the given food sample.
- Interpret the physical, chemical and quality standards of lipids, proteins and carbohydrates.
- Summarize the composition of foods using spectroscopic methods.
- Identify the food materials using chromatographic techniques.
- Demonstrate the tests on food substances using the principles of electrophoresis, refractometry, polarimetry and biosensors.

UNIT I - SAMPLING AND PROXIMATE ANALYSIS **9**

Concepts of food analysis; Rules and regulations of food analysis; Principles and methodology involved in analysis of foods: Rheological analysis, textural profile analysis of foods; Sampling methods - Sample preparation for analysis; Statistical evaluation of analytical data - Official Methods of Food Analysis. Proximate analysis: Moisture in foods - determination by different methods - ash content of foods, wet, dry ashing, microwave ashing methods; Significance of Sulphated Ash, water soluble ash and acid insoluble ash in foods; titratable Acidity in foods, determination of dietary fiber and crude fiber.

UNIT II - LIPIDS, PROTEIN AND CARBOHYDRATE ANALYSIS **9**

Determination of Total fat in foods by different methods: thin layer chromatography (TLC), gas chromatography (GC), and high-pressure liquid chromatography (HPLC). Analysis of oils and fats for physical and chemical parameters, Quality standards, and adulterants; different methods of determination of protein and amino acids in foods: Kjeldahl method, Bradford and total amino acid content methods; determination of total carbohydrates, starch, disaccharides and simple sugars in foods: gravimetric methods, spectrophotometry & colorimetry, titration methods.

UNIT III – SPECTROSCOPIC TECHNIQUES **9**

Basic Principles of spectroscopy– UV Spectroscopy and Instrumentation-Fluorescence Spectroscopy- infrared spectroscopy- Spectrophotometric analysis of food additives and food components -IR Spectroscopy in online determination of components in foods; AAS and ICP-AES in mineral elements and toxic metals analysis; use of fluorimeter in vitamin assay- specific use of Tintometer in vanaspathi analysis.

UNIT IV - CHROMATOGRAPHIC TECHNIQUES **9**

Basic Principles, detection of adulterants in foods by paper chromatography and thin layer chromatography, column chromatography for purification analysis; analysis of food additives, sugars, phytochemicals and aflaotoxins, contaminants and other food components by HPLC, Separation of amino acids by two-dimensional paper chromatography, Identification of sugars in fruit juice using TLC; Separation of pralines by ion-exchange chromatography, GC analysis of fatty acids, cis, trans Isomers - volatile oils, flavours and pesticides, contaminants and other volatile derivatives of food components; Significance MS detector in HPLC and GC.

UNIT V - ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY **9**

Basic Principles, application of electrophoresis in food analysis, refractive indices of oils and fats, total soluble solids

in fruit juice and honey, Identification of organic acids by paper electrophoresis; Gel-electrophoresis for analytic techniques, specific rotation of sugars, estimation of simple sugars and disaccharides by polarimeter; Immunoassay techniques and its applications in foods. Introduction to sensors and Instrumentation of sensors - biosensors - electronic nose and electronic tongue.

TOTAL:45

SUGGESTED READINGS:

1. Nielson, S. Suzanne. Food Analysis. Springer, 5th Edition, 2017.
2. Wood R, Foster L, Damant A and Key Pauline. Analytical Methods for Food Additives. CRCWood head Publishing 2004.
3. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis: Theory and Practice",3rdEdition, Springer, 2004.
4. Nollet, Leo M.L. "Handbook of Food Analysis" 2nd Edition, Vol. 1-3. Marcel Dekker, 2004.
5. Hurst, Jeffrey W. "Methods of Analysis for Functional Foods and Nutraceuticals" 2nd Edition, CRC Press, 2008.
6. Bhalla, N., Jolly, P., Formiasano, N. Estrela, P. Introduction to biosensors, Essays in Biochemistry. 2016.

CO-PO Mapping

CO No	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	2	-	-	-	-	-	-	-	-	-	-	2	2
Average	**2**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

(ii) Laboratory

List of Experiments:

1. Estimation of iodine value in lipids.
2. Estimation of saponification value in lipids.
3. Estimation of reducing sugars by Lane and Eynon's method.
4. Estimation of Iodine content in iodized salt.
5. Estimation of total extractives in tea.
6. Determine the swelling ratio and extract release.
7. Estimation of fat in milk by Gerber's method.
8. Estimation of curcumin in turmeric.
9. Estimation of gingerol in ginger.
10. Rapid detection of food adulterants.
11. Demonstration of nitrogen estimation by Kjeldhal method.

TOTAL:30

24BTFT542	**FRUITS AND VEGETABLES PROCESSING TECHNOLOGY**	**Semester-V 5H-4C**

Instruction Hours/week: L:3 T:0 P:02 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students:

- To describe the processing of fruits and vegetables by chemical methods.
- To identify the preservation of fruits and vegetables by drying and dehydration.
- To discuss the various unit operations and fermented processes involved in fruits and vegetables.
- To illustrate the canning and bottling operations in fruits and vegetables.
- To explain the set of parameters influencing the aseptic processing of fruit juices.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Identify the nutritionally important fruits and vegetables and understand its maturity indices and its processing methods.
- Demonstrate the manufacture, preservation and packaging of jam, jelly, marmalade, pickles and preserves.
- Explain the different types of driers involved in the production of dehydrated fruit products.
- Illustrate the minimal processing and fermentation methods of fruits and vegetables.
- Show the canning and bottling operations of fruits and vegetables.

UNIT I – PROCESSING BY CHEMICAL METHOD **9**

Importance and scope of fruit and vegetables preservation. Nutritive value, nutraceutical properties – Harvesting of fruits and vegetables – Maturity indices. Technological processes for industrial manufacture of selected foods of commercial importance from plants and animal sources viz., Carbonated beverages, Fruit beverages; Hydrogenated vegetable oil, Tea, Coffee, Cocoa; Margarine. Methods of fruit and vegetable preservation - Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt – Brining - Preparation of pickles, chutney and sauces, ketchup. Machineries involved in processing of fruits and vegetables products.

UNIT II - PRESERVATION BY DRYING AND DEHYDRATION **9**

Drying and dehydration – sun drying, mechanical dehydration – merits and demerits, factors affecting drying. Types of driers - Solar, cabinet, fluidized bed drier, spouted bed drier, heat pump drier, vacuum drier. Freeze drying and dehydro freezing- mechanism and advantages. Preparation of product. Changes during drying and dehydration. Problems related to storage of dried and dehydrated products.

UNIT III - MINIMAL PROCESSING AND FERMENTATION **9**

Storage and handling of fresh fruits and vegetables. Processing and preservation of fruits and vegetable juices Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal Processing of Fruits and Vegetables. Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetables. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

UNIT IV- CANNING AND BOTTLING **9**

Canning - principles, steps involved in canning, types of cans– preparation of canned products - packing of canned products - spoilage of canned foods, Acidification and pH Control, Packaging. Advantages and disadvantages. Pasteurization and sterilization. Bottling of fruit and vegetable. Fruit Pulper: Design and working principle. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

UNIT V - ASEPTIC PROCESSING **9**

Aseptic processing and Bulk packing of Fruit juice concentrates. Aseptic heat exchangers for sterilizing and concentrating the product. Aseptic fillers. Tetra pack for small quantities, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipments (including aseptic tank) and machines- Micro-processor-controlled systems employed for AP, Dole system and Scholle system for bulk storage in Bag and

Boxes and Bag & Drums. Storage of Aseptically packed products.

TOTAL-45

SUGGESTED READINGS:

1. Hui Y. H. Hand Book of Vegetable Preservation and Processing. Mercel Dekker, New York,2nd Edition, 2015.
2. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology. Marcel Dekker Press, USA, 2003.
3. P. Fellows. Food processing Technology: Principles and Practice". Wood Head publishingLimited, Cambridge, England, 4th Edition, 2016.
4. James G. Brennan. Food Processing Hand book. Wiley-Ych Verlag Gmbh & Co KgaA,Weinheim, Germany, 2006.
5. R.P. Srivastava and Sanjeev Kumar. Fruit and Vegetable Preservation: Principles and Practices, 3rd Ed. International Book Distribution Co., Delhi. 2002.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	1	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	2	-	2	2
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Average	**1.8**	**1.6**	-	-	-	-	-	-	-	-	**2**	-	**2**	**2**

(ii) Laboratory:

List of Experiments:

1. Preparation of RTS beverage.
2. Preparation of squash/cordial.
3. Preparation of jam - mixed and individual fruits.
4. Preparation of jelly/marmalades/ nectar.
5. Preparation of ketchup and tomato sauce.
6. Preparation of pickles.
7. Preparation of sauerkraut.
8. Preparation fruits-based wine.
9. Osmotic concentration/dehydration of fruits and vegetables.
10. Basic physicochemical and sensory analysis for food samples.

TOTAL:30

24BTMC551	**CRYPTOGRAPHY & CYBER SECURITY**	**Semester-V** **1H-0C**

Instruction Hours/week: L:1 T:0 P:0 **Marks:** Internal**:100** Total**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course for students is:

- To know about various encryption techniques and understand the concept of public key cryptography.
- To study about message authentication and hash functions and impart knowledge on Network security.
- To learn about the introduction of cyber security and learn various malware threats and hiding files.
- To expose various ethical hacking devices.

COURSE OUTCOMES:

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

- Classify the symmetric encryption techniques and illustrate various public key cryptographic
- techniques.
- Analyse the tools and methods used in cybercrime.
- Identify risk management processes, risk treatment methods, organization of information security and
- classify cyber security solutions and information assurance.
- Identify structure and methods of cyber security
- Experiment with different cybercrimes and hacking methods

UNIT 1 INTRODUCTION TO CRYPTOGRAPHY **9**

Computer Security Concepts – The OSI Security Architecture – Security Components, Security, Attacks – Security Services, Security Mechanism – A Model for Network Security – Classical encryption techniques: Substitution, Classical Encryption techniques – Block Cipher Principles, Data Encryption Standard-Symmetric chipper Model, Substitution Techniques, Transposition techniques.

UNIT II PUBLIC KEY CRYPTOGRAPHY AND RSA **9**

Principle of Public Key Crypto System-Cryptography Number Theory- Public Key Cryptography, Key Establishment Protocols, Introduction, Key transport based on symmetric encryption, RSA Key Management, Diffie-Hellman key Exchange, Quantum computers, Shor's algorithm, future demise of RSA, Quantum cryptography, Quantum key distribution and reconciliation.

UNIT III CRYPTOGRAPHIC AND DATA INTEGRITY **9**

Cryptographic and Data Integrity Algorithms, Interactive protocols, Touch of complexity theory, Interactive proof systems, electronic cash, Private information retrieval, Applications of cryptographic hash functions Requirements and security, Digital Signature Standard, Digital watermarking, digital fingerprinting, Steganography.

UNIT IV INTRODUCTION TO CYBER SECURITY **9**

Introduction to Cyber Security – Importance and challenges in Cyber Security – Cyberspace – Cyber threats – Cyber warfare – CIA Triad – Cyber Terrorism – Cyber Security of Critical Infrastructure–
Cyber security -Organizational Implications.

UNIT V HACKERS AND CYBER CRIMES **9**

Types of Hackers – Hackers and Crackers – Cyber-Attacks and Vulnerabilities – Malware threats – Sniffing – Gaining Access – Escalating Privileges – Executing Applications – Hiding Files – Covering Tracks – Worms – Trojans – Viruses – Backdoors.

TOTAL: 45

SUGGESTED READINGS:

1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI, 4th ed, 2006, ISBN-10: 0131873164 ISBN-13: 978-0131873162
2. Atul Kahate, "Cryptography and Network Security", McGraw Hill, 3 rd Edition 2003, ISBN13: 978-1259029882
3. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publisher, First Edition, 2011.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106106129
2. https://onlinecourses.swayam2.ac.in/cec20_cs15/preview

B.Tech. Food Technology **2024-2025**

24BTFT511 **SKILL DEVELOPMENT I** **Semester-V**
2H-1C

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:100 Total: 100**
End Semester Exam: 3 Hours

Course Objectives:

The goal of this course is:

- To introduce sensory evaluation techniques and consumer testing methodologies to assess the quality and acceptability of new products.
- To equip students with knowledge about the selection and role of ingredients, formulation techniques, and food processing technologies in creating new food products.
- To highlight the importance of packaging and shelf-life considerations in product development.

COURSE OUTCOMES:

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

- Be able to conceptualize and develop a new food product based on market trends and consumer needs.
- Demonstrate the ability to formulate food products by selecting appropriate ingredients and processing techniques.
- Conduct sensory and consumer testing to evaluate product quality and acceptability.
- Understand the role of packaging in extending shelf life and maintaining product quality.
- Apply regulatory standards, safety measures, and quality management practices in the commercialization of food products.

Unit I: Introduction to Food Product Development **9**

Introduction to Food Product Development. Innovation in Food Products. New Product Development (NPD) Process, Idea generation, Concept development and screening, Feasibility analysis.

Unit II: Ingredients, Formulation, and Processing **9**

Ingredient Selection. Formulation Techniques. Product Testing and Prototyping, Prototype development and testing, Pilot plant trials: scaling from lab to production, Equipment used in processing food products (mixers, homogenizers, dryers.

Unit III: Sensory Evaluation and Consumer Testing **9**

Sensory Characteristics- Role of sensory evaluation in product development, Methods for sensory analysis (triangle test, hedonic scale, descriptive analysis). Consumer Testing Methods - Designing consumer trials, Market research tools (focus groups, surveys, product testing).

Unit IV: Packaging and Shelf-Life Considerations **9**

Packaging Technologies for New Food Products-Selection of packaging materials (biodegradable, rigid, flexible), Role of packaging in product safety, quality, and consumer appeal, Sustainable and innovative packaging solutions. Shelf-Life Estimation.

Unit V: Regulatory, Safety, and Commercialization Aspects **9**

Regulatory Compliance in Food Product Development-Food safety regulations and standards (FDA, FSSAI, EFSA), Labelling requirements: nutritional information, ingredients, allergens, Intellectual property rights (IPR), patents, and trademark.

TEXT BOOKS:

1. Food Product Development by M. Earle and R. Earle. ISBN: 978-0415237801
2. New Food Product Development: From Concept to Marketplace by Gordon W. Fuller. ISBN: 978-1498729112
3. Food Packaging: Principles and Practice by Gordon L. Robertson. ISBN: 978-1466550312

REFERENCE BOOKS:

1. Handbook of Food Product Development edited by Anne E. Murcott and Warren Belasco. ISBN: 978-1573560288
2. Sensory Evaluation Techniques by Gail Vance Civille and B. Thomas Carr. ISBN: 978-1498795752

CO PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	1	1	-	-	1	1	1
CO2	3	2	-	-	-	-	-	1	1	-	-	1	1	1
CO3	3	2	-	-	-	-	-	1	1	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	-	-	1	1	1	1
CO5	3	2	-	-	-	-	-	-	-	-	1	1	1	1
Average	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	1	**1**	1	1

24BTFT591	**FIELD PROJECTS/ INTERNSHIP**	**SEMESTER-V** **0H-1C**

Instruction Hours/week: L:0 T:0 P:0 **Marks:** Internal**:100** Total**:100**

The students will be directed to do an internship in their domain industry for 3 weeks Their internship work will be evaluated for forty percentages by internal examiner and sixty percentage by external examiner for End Semester Examination. End Semester Examination evaluation will be based on the report submitted by the student after the completion of their internship report.

SEMESTER VI

B.Tech Food Technology		**2024-2025**
24BTMC651	**UNIVERSAL HUMAN VALUES**	**Semester-VI**
		2H-2C
Instruction Hours/week: L:2 T:0 P:0		**Marks:** Internal**:40** External**:60** Total**:100**
		End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of the course is for the students to

- Distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- Initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
- Understand the meaning of happiness and prosperity for a human being.
- Understand harmony at all the levels of human living, and live accordingly.

COURSE OUTCOMES (COs)

Upon completion of the course, students will be able to

- Understand the significance of value inputs in a classroom and start applying them in their life and profession
- Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
- Understand the value of harmonious relationship based on trust and respect in their life and profession
- Understand the role of a human being in ensuring harmony in society and nature.

UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 9

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF 9

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I' , Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP 9

Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (*SarvabhaumVyawastha*)- from family to world family!

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE 9

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 9

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

Total: 45 hours

SUGGESTED READINGS

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
6. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkan
7. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
8. A N Tripathy, 2003, Human Values, New Age International PublisherSubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

24BTFT641	**FOOD ADDITIVES (Theory & Laboratory)**	**Semester-VI 5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

(i) **Theory**

COURSE OBJECTIVES:

The goal of this course is for students:

- To understand the need of food additives in the development of valuable food products.
- To describe the types, chemical properties, levels of addition and toxicity of acidulants.
- To discuss the types, chemical properties, levels of addition and toxicity of humectants.
- To outline the types, chemical properties, levels of addition and toxicity of fat substitutes and replacers.
- To summarize the types, chemical properties, levels of addition and toxicity of sweeteners, chelating agents, anti-browning agents and nutritional additives.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Illustrate the classification, safety levels and toxicity of food additives.
- Interpret the properties, levels of addition and toxicity data of various food additives.
- Discover the importance of additives in maintaining or improving food quality.
- Identify the various instant premixes by addition of preservatives within the permissible limits.
- Explain the principles of food additives to study the toxicity, identify and design newer products, with better quality using additives which are economical and safe.

UNIT I – INTRODUCTION **9**

Introduction to Food Additives, Scope of food additives, Functions and uses of Food Additives, Classification-Intentional & Unintentional Food additives, Types of food additives Toxicology and Safety Evaluation of Food Additives: Effects of Food Additives; Food Additives generally recognized as safe (GRAS); Tolerance levels & Toxic levels in Foods, Acceptable daily intake of food additives, Legal and regulations -INS numbering system of food additives, Role of JECFA in safety assessment of food additives and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.

UNIT II - ACIDITY REGULATORS AND PRESERVATIVES **9**

Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case study: 1. Food Additives in Food Products: A Case Study, 2. Assessing dietary risks caused by food additives: A case study of total diet in Vietnam

UNIT III - EMULSIFIERS, STABILIZERS AND THICKENERS **9**

Role of emulsifiers, different classes of emulsifiers, emulsion, surface tension, oil in water and water in oil emulsion, and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications, merits and demerits, safety aspect

UNIT IV – ANTIOXIDANTS AND ANTI-CAKING AGENTS **9**

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; water soluble and oil soluble antioxidants and their chemical structure, mechanism of action, permitted levels and food application. Anti-caking agents – definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application, safety aspect.

UNIT V - COLOR AND NATURAL AND ARTIFICIAL SWEETENERS **9**

Coloring agents, uses– Types: Natural and synthetic food colors, their chemical structure, stability, permitted list of colors, usage levels and food application. Natural and Artificial Sweeteners – types, list, structure, taste profile, permitted list, usage levels and food applications.

TOTAL:45

SUGGESTED READINGS:

1. Mahindru, S. N. "Food Additives- Characteristics Detection and Estimation", TATA McGraw Hill, 2000.
2. Wilson, R. "Ingredient Handbook Sweeteners", Blackwell, 2007.
3. Emerton, V. "Food Colors", Blackwell, 2008
4. Peter A Williams and Glyn O Philips, "Gums and stabilizers for the Food Industry", RSC, 2006.
5. Branen, A. L. "Food Additives" 2nd Edition, CRC press, 2002.
6. https://www.researchgate.net/publication/334238157_Assessing_dietary_risks_caused_by_food_additives_A_case_study_of_total_diet_in_Vietnam
7. https://www.researchgate.net/publication/332473047_Food_Additives_in_Food_Products_A_Case_Study.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	-	-	-	-	-	-	-	-	-	-	**2**	**2**

ii) Laboratory:

List of Experiments

1. Estimation of Sulphur-Di-Oxide.
2. Estimation of Sodium Benzoate.
3. Estimation of Sorbic Acid.
4. Estimation of Butylated hydroxyl toluene.
5. Estimation of Propyl Gallate.
6. Determination of Saccharin.
7. Estimation of capsaicin.
8. Estimation of salt in pickled products.
9. Identification of adulterants in solid foods.
10. Identification of adulterants in liquid foods.

TOTAL:30

24BTFT642	**BAKERY AND CONFECTIONARY TECHNOLOGY (Theory & Laboratory)**	**Semester-VI 5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3 Hours

(i) Theory

COURSE OBJECTIVES:

The goal of this course is for students:

- To summarize the principles of baking on bread and cake.
- To explain the baking skills in the production of biscuits and cookies.
- To outline the various types of sugar and flour based confectionary products.
- To interpret the working of equipment used in baking processes.
- To outline the packaging materials and quality control systems applied in food industry.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Identify the different types of breads, cakes, biscuits and cookies.
- Summarize the preparation of biscuits and cookies. the various types of confectionary products.
- Explain the different types of confectionary products and their importance.
- Illustrate the different types of machineries for baking.
- Choose the appropriate packaging materials and audit quality standards required for baking and confectionary.

UNIT I BAKING PRINCIPLES, BREAD AND CAKE **9**

History of baking, structure and composition of wheat kernel, Types of wheat, Dough rheology, baking principles, classification of baked goods- Role of ingredients and its chemistry. Types of flour, enrichment of flour and bread, Bread-role of Ingredients, Varieties of bread. Methods of bread preparation, qualities of a good loaf, bread spoilage and diseases and remedies. Advantages and disadvantages of various methods of bread-making. cake- types of cakes - role of ingredients-essential and optional ingredients - cake mixing methods – Preparation. Fancy cakes and preparation– Bread, cake- faults and remedies.

UNIT II BISCUIT AND COOKIES **9**

Biscuits and cookies - role of ingredients. Types of biscuit dough – Developed dough, soft dough, semi-sweet and enzyme modified dough - consistency of the dough and its importance. Preparation methods of biscuits and cookies. Selection and preparation of mould. Cookies classification - Quality control for biscuits and cookies. Types and techniques of icing, frostings and fillings. Faults and causes

UNIT III CONFECTIONERY PRODUCTS **9**

Introduction - importance of sugar confectionery. Stages of Sugar. Boiling-Ingredients used in confectionery. Role of chemical additives in confectionery. Processing of raw materials – cocoa and chocolate. Types of confectionery products-chocolate, hard boiled candies and soft-boiled candies, caramels toffees, fondants, fruit drops, fudge.

UNIT IV BAKERY EQUIPMENTS **9**

Machineries for a bakery unit - Bulk handling of ingredients, Dough mixers, Dividers, rounding, sheeting, and laminating machines. Ovens and Slicers, Packaging materials and equipment. Mixing and forming characteristics of mixtures-measurements of mixing – particles mixing- rates of mixing, energy input in mixing, liquid mixing-power & Froude number-mixing equipment- liquid, powder and particles mixtures, dough and paste mixtures, emulsification and homogenization. Forming-Pie & biscuit formers- Bread and confectionery moulders. Encrusting machines – Introduction, Construction – General structure, Feed system; Moulding – extrusion nozzle moulding, flourless encrusting moulding, encrusting disk moulding,

UNIT V PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT 9

Packaging requirements and materials. Standards and regulations for bakery and confectionery products. Production standards and quality control - Good Manufacturing Practices (GMP) and other practices. Selection of packaging materials and standards for baked products. Recent packaging techniques to extend the shelf life of the product. Technologies-MAP, hermetic packaging, convenient intelligent and smart packaging.

TOTAL: 45

SUGGESTED READINGS:

1. Amsterdam, Cakes and pastries, Time - life books, 1985.
2. Baker's Handbook on Practical Baking, US Wheat Associates, New Delhi, 1994.
3. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
4. Pomeranz. Y. Modern Cereal Science and Technology, MVCH Publications, New York, 1987.
5. Samuel A. Matz., Equipment for Bakers, Pan Tech International Publication, 1988.
6. Manley, Duncan., Biscuit Doughs Manual 2, Woodhead Publishing Ltd., England, 1998

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	2	-	-	-	-	-	-	-	-	-	2	2
Average	**2**	**1.16**	**2**	-	-	-	-	-	-	-	-	-	**2**	**2**

(ii) Laboratory:

List of Experiments

1. Study of ingredients (major and minor): characteristics of flour, yeast, shortening, sugar, egg and salts.
2. Experiment on leavening action of baking powder, sodium- bicarbonate and ammonium-bicarbonate.
3. Determination sedimentation value of flour
4. Estimation of water absorption power (atta, and maida)
5. Determination dough rising capacity of yeast
6. Preparation of cake - different types
7. Preparation of biscuits-different types.
8. Preparation of bread-different types.
9. Preparation of toffees, fondant, fudge and chewing gum.
10. Preparation of sugar boiled confectionary.

TOTAL: 30

24BTFT601	**FOOD SAFETY REGULATIONS**	**Semester-VI** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To identify the food safety and hygiene during food processing.
- To summarize the functions, responsibilities and concepts of various food regulatory bodies.
- To summarize the overall functions and responsibilities of food authority of India.
- To describe the need, limitations and standards for labelling of various food products.
- To illustrate the importance and implementation of HACCP in food industries.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Describe the food hazards, physical, chemical and biological in the food industry.
- Summarize the functions, responsibilities and concepts of various food regulatory bodies.
- Explain the overall functions and responsibilities of food authority of India.
- Apply the overall requirements needed for labeling of various food products.
- Illustrate and implement the HACCP system in the food industries.

UNIT I – FOOD SAFETY **9**

Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection. Laws relating to Food Processing Industries in India - FPO, MMPO, PFA, AGMARK, Essential Commodities Act, BIS.

UNIT II – GLOBAL REGULATIONS **9**

Food and Agriculture Organization - FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC) - Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India - ISO 22000 – Importance and Implementation.

UNIT III - FOOD STANDARD AUTHORITY OF INDIA (FSSAI) **9**

Food safety and Standards Act – organizational chart – role of individual authority – principles to be followed – Provisions as to articles of food –imported items –Licensing and registration of food business – Food safety officer and their powers – Analysis of food – regulations regarding labs involved in food analysis.

UNIT IV - FOOD LABELLING **9**

Need for labeling – Developing labeling standards at the world level – Limitations of labeling safety issues – Labeling regarding methods of processing -Products derived from modern biotechnology – organic produce -Genetically modified foods – EU rules on nutritional labeling – US rules on nutritional labelling – Health claims – Approach of US and EU. Innovative approaches in labelling.

UNIT V – CRITICAL CONTROL PONITS **9**

Concept of HACCP – PRPs - Assembling the team – Product description – Describing the product's intended use – Establishing a process flow diagram – on site confirmation - Listing potential hazards and control measures - Determination of critical points – decision tree for CCP - Establishing monitoring procedures- establishing corrective actions – establishing verification. Relevance of VACCP and TACCP in food industry.

TOTAL:45

SUGGESTED READINGS:

1. Kees A. van der Heijden and Sanford Miller. International Food Safety Handbook Science,1999.
2. Government of India. Guide to the Food Safety and Standards Act. Tax-mann Allied ServicesPvt. Ltd. 2006.
3. Mehta R. and George J. Food Safety Regulation Concerns and Trade- The DevelopingCountry Perspective. Published by Macmillan India Ltd., New Delhi, 2005.
4. Barach JT. FSMS and Food Safety Systems: Understanding and implementing the rules.Wiley, Ist Edition, 2017.
5. Fortin ND. Food Regulation. Wiley, 2nd Edition, 2016.
6. Shaw IC. Food Safety: The science of keeping food safe. Wiley-Blackwell Publishing. 2ndEdition, 2018.
7. Mariott NG, Schilling MW and Gravani RB. Principles of Food Sanitation. Springer, 6thEdition, 2018.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT611	**SKILL DEVELOPMENT II** **FOOD QUALITY DETECTION AND ANALYSIS**	**Semester-VI** **2H-1C**

Instruction Hours/week: L:0 T:0 P:2 **Marks:** Internal**:40 External: 60 Total: 100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is:

- To provide students with a deep understanding of the importance of food quality and safety, and the various factors influencing it.
- To introduce advanced techniques for detecting food contaminants, adulteration, and foodborne pathogens.
- To provide knowledge on nutritional quality assessment and the impact of processing on nutrient retention.
- To familiarize students with non-destructive testing methods, food authentication, and traceability systems in food quality control.

COURSE OUTCOMES:

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

- Understand the fundamental concepts of food quality, safety standards, and the detection of food contaminants and adulterants.
- Be proficient in conducting physical, chemical, and microbiological analyses to evaluate the quality of food products.
- Utilize sensory evaluation techniques to assess the sensory attributes of food products.
- Apply advanced and non-destructive methods for the detection and analysis of food quality.
- Implement food authentication techniques and traceability systems to ensure food quality and safety in the supply chain

Unit I: Introduction to Food Quality and Safety

Food Quality Concepts-Definition and importance of food quality, Quality attributes: sensory, nutritional, chemical, physical, and microbiological, Relationship between food quality and food safety, Food Safety Standards and Regulations- Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP).

Unit II: Physical and Chemical Analysis of Food

Physical Quality Parameters- Texture analysis (rheology, texture profile analysis), Color measurement (spectrophotometry, colorimetry), Particle size analysis and its significance. Chemical Analysis Techniques- Proximate analysis: moisture, protein, fat, carbohydrates, and ash content, Analytical techniques for food composition: chromatography (GC, HPLC), spectroscopy (UV, IR, NMR), and mass spectrometry

Unit III: Microbiological Analysis of Food

Microbial Quality Indicators- Types of spoilage and pathogenic microorganisms in food, Microbiological safety parameters (TPC, coliform count, yeast, and mold), Importance of microbiological criteria in food safety.

Unit IV: Sensory and Nutritional Quality Evaluation

Sensory Evaluation of Foods-Importance of sensory attributes (appearance, flavor, texture, taste), Sensory testing methods: affective, discrimination, and descriptive tests, Setting up a sensory evaluation lab and conducting consumer tests.

Unit V: Advanced Techniques in Food Quality Detection

Advanced Analytical Techniques-DNA-based methods (PCR, qPCR) for detecting foodborne pathogens and GMOs, High-throughput screening methods (biosensors, lab-on-chip technologies). Detection of food fraud and adulteration using isotopic and molecular techniques.

TEXT BOOKS:

1. Food Quality Assurance: Principles and Practices by Inteaz Alli. ISBN: 978-0367388770
2. Food Analysis by S. Suzanne Nielsen. ISBN: 978-1441914781

3. Principles of Food Sanitation by Norman G. Marriott and Robert B. Gravani. ISBN: 978-0387250250.

REFERENCE BOOKS:

1. Handbook of Food Analysis by Leo M.L. Nollet. ISBN: 978-0367571004
2. Microbiological Analysis of Foods by S. Suzanne Nielsen. ISBN: 978-1441914781

CO PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	1	-	-	1	1	1	1
CO2	3	2	-	-	-	-	-	1	-	-	1	1	1	1
CO3	3	2	-	-	-	-	-	1	-	-	1	1	1	1
CO4	3	2	-	-	-	-	-	-	-	-	1	1	1	1
CO5	3	2	-	-	-	-	-	-	-	-	1	1	1	1
Average	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	1	**1**	1	1

24BTFT691	**MINI PROJECT (Theory & Laboratory)**	**Semester-VI 3H-2C**

Instruction Hours/week: L:1 T:0 P:2 **Marks:** Internal**:100** Total**:100**

The students will be directed to do a mini project in their domain field for 3 months. Their project work will be evaluated for forty percentages by internal examiner and sixty percentage by external examiner for End Semester Examination. End Semester Examination evaluation will be based on the report submitted by the student after the completion of their project report.

Semester-VII

B. Tech. – Food Technology **2024-2025**

24BTFT701 **PROFESSIONAL ETHICS AND IPR** **Semester-VII**
3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To summarize the importance of awareness in engineering ethics.
- To discuss the role of moral and social values and loyalty.
- To outline the needs of IPR in general & engineering.
- To discuss the protection of research work and investment in R&D by IPR.
- To summarize the role of IPR in creation of new and better products.

Course Outcomes:

Upon completion of this course, students will be able to:

- Explain the engineering ethics.
- Illustrate the Moral, Social Values and Loyalty.
- Discuss that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Demonstrate that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property right to be promoted among students in general & engineering in particular.
- Discuss that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT I ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self–interest – customs and religion – use of ethical theories.

UNIT II FACTORS OF CHANGES **9**

Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws. Social changes – Meaning and nature – Theories.

UNIT III- INTELLECTUAL PROPERTY **9**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV- PATENT RIGHTS **9**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V- NEW DEVELOPMENTS IN IPR **9**

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 45

SUGGESTED READINGS:

1. Sharma S. Entrepreneurship Development. PHI Learning Pvt. Ltd. 2016.
2. Charles E Harris and Michael J Rabins. Engineering Ethics – Concepts and Cases. Wadsworth Thompson, Cengage Learning. New Delhi, 2013.
3. Whitebeck C. Ethics in Engineering research and Practice. Cambridge University Press, 2nd Edition, 2011.
4. Halbert, "Resisting Intellectual property", 2007. Taylor & Francis Ltd.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	3	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Avg.	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**2.2**	**-**	**-**

24BTFT702	**PROCESS ECONOMICS AND PLANT LAYOUT DESIGN**	**Semester-VII 3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students:

- To infer the different specifications and processes involved in the design and development of food processing plant.
- To explain the processes involved in layout design.
- To illustrate the projects and cost estimation of designing food plant.
- To outline the product cost and plant overheads.
- To summarize the profitability analysis in food processing industry.

Course Outcomes

Upon completion of this course, students will be able to,

- Construct the well-equipped food processing plant for effective processing along with the government regulations and specifications for plant layout.
- Identify the capital investments and methods of cost estimation of designing food plants.
- Summarize the overall production cost, profitability and factors involved in the cost estimation of products manufactured.
- Identify the problems involved in deciding the level of manufacture of a food product.
- Construct own industry or plan turn-key projects based on the request from customers.

UNIT I - FOOD PROCESS DESIGN DEVELOPMENT **9**

Technical feasibility survey of Food Industry, process development, - Food Process flowsheets, Hygienic food process design – CIP Systems- Working principles and operatingprocedures. Equipment design and specifications – Computed-aided process design – Design considerations for location of food plants, Principles of spread-sheet aided process design (Basic concepts only).

UNIT II - PLANT LAYOUT **9**

Basic concepts of plant layout and design with special reference to food process industries, Marketability of the product, availability of technology, raw materials, equipments, Types of layouts, Design considerations for location of food plants land and utilities, site characteristics, waste disposal, Government regulations and other legal restrictions, community factors and other factors affecting investment and production costs. Preparation of flowsheets for material movement and utility consumption in food plants Plant Layout based on process and product. Systematicplant layout, Richard Muther's Simple Systematic Plant Layout.

UNIT III - PROJECT EVALUATION AND COST ESTIMATION **9**

Introduction to economics, equipment symbols, flow sheet symbols, electric symbols, graphic symbols for piping systems, standards for space requirement, Capital investments – fixed capital investments including land, building, equipments and utilities, installation costs (including equipments, instrumentation, piping, electrical installation and other utilities), working capital investments. Methods of Cost estimation– Cost Indices.

UNIT IV - PRODUCT COST AND PLANT OVERHEADS **9**

Resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.). – Process Profitability - Guidelines for good maintenance & safety precautions; Lubrication & lubricants; Work place improvement through '5S', Application to a Food Processing plant Hygiene and sanitation requirement in food processing, payroll overheads, warehouse and storage facilities etc. Depreciation, Amortization and methods of determining the same. Introduction to Food Safety Management System.

UNIT V - PROFITABILITY ANALYSIS **9**

Analysis of supply and market equilibrium: Law of supply, price elasticity of supply, equilibrium of demand and supply, Return on original investment, interest rate of return, accounting for uncertainty and variations and future developments. Cash flow diagram and its importance – Optimization techniques - Linear and Dynamics programming, Optimization strategies

TOTAL: 45

SUGGESTED READINGS:

1. Peters and Timmer haus. Plant design and Economics for Chemical Engineers. McGraw Hill5thEdition, 2017.
2. Rudd D F and Watson C C. Strategy of Process Engineering. John Wiley & Sons Inc. 2013.
3. Maroulis Z.B. and Saravacos G.D. Food Process Design. Marcel Dekker Inc, 2003.
4. Towler G and Sinnott R.K. Chemical Engineering design principles, practice and Economics of Plant and Process. 2nd Edition. Elsevier, 2012.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	1	1	1	1	1	1
CO2	2	1	1	-	-	-	-	-	1	1	1	1	1	1
CO3	3	2	2	-	-	1	1	1	-	1	1	1	1	1
CO4	2	1	1	-	-	-	-	1	-	1	1	1	1	1
CO5	2	1	1	-	-	-	1	1	-	1	1	1	1	1
Avg.	**2.2**	**1.2**	**1.2**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

24BTFT741	**FOOD PACKAGING TECHNOLOGY (Theory and Laboratory)**	**Semester-VII 5H-4C**

Instruction Hours/week: L:3 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

2024-2025

(i) Theory:

Course Objectives:

The goal of this course is for students:

- To describe the functions of packaging along with the influence of various factors on food.
- To explain the various factors of different packaging materials, include metallic cans and glass.
- To explain the types, production and applications of paper, paperboards and polymers in food packaging.
- To summarize the filling, sealing, labeling, barcodes and printing on packages along with the legislative requirements.
- To outline the various types of innovative packaging technologies to improve the shelf life of the products.

Course Outcomes:

Upon completion of this course, students will be able to:

- Discuss the need and functions of packaging as a solution to various factors affecting food.
- Compare different packaging materials, their manufacturing process and equipment involved.
- Interpret the various closures and sealing mechanisms for different packaging materials.
- Compare the different printing and labeling methods with legislative requirements.
- Illustrate the innovations in food packaging and their applications.

UNIT I – INTRODUCTION **9**

Functions of packaging, Effect of environmental factors - light, Oxygen, Moisture, Temperature, mechanical forces and biological factors on quality of food - general principles of control of the spoilage agents - General Approach, analysis of storage requirement, accelerated storage studies: Vacuum and Inert Gas Packaging- Retort packaging, principles, application -Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates

UNIT II - METAL CANS AS PACKAGIN **9**

Metallic can types - Tin cans and Aluminum cans. Specialty of Open top sanitary cans, Lacquers and their use, Three piece cans and Two piece cans, Aerosol Cans, Basics of Canning operations – Can Reformer, Flanger, Seaming, Can closures. Glass jars and Bottles in food packaging, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers -Design features effect of these materials on packed commodities.

UNIT III - FLEXIBLE FILMS PACKAGING **9**

Formation of Films and pouches, Plastics used and their Specific applications - Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Poyvinylidene Chloride, Polyvinyl chloride, Copolymers their applications. Co- extruded films and Laminates. Rigid and Semi rigid plastic packaging – fabrication methods – Thermo forming, Blow moulding, Injection moulding, Extrusion. Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging and their applications.

UNIT IV - FILLING AND SEALING OPERATION **9**

Closing and sealing of rigid containers. Filling and sealing of Flexible plastic containers, Hot wire sealing, hot bar sealing and impulse sealing – differences and relative advantages, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements. Filling and sealing of pouches, pouch from fill seal machines – Applications of form fill seal machines.

UNIT V – ADVANCES IN FOOD PROCESSING **9**

Aseptic Packaging. Active packaging, Moisture control, CO2 and Oxygen scavenging. Modified atmosphere packaging – principles, applications. Biodegrdable packaging, Permeability of gases in packs. Antimicrobial Packaging, Edible packaging films and coating. Packaging for non-thermal food processing. Sensors in food packaging with their applications, Intelligent Packaging – Time-temperature indicators, RFID, Tamper evident packaging.

Total :45

SUGGESTED READINGS:

1. Coles R and Kirwan J. Food and Beverage Packaging Technology. Wiley-Blackwell Publishing. 2nd Edition, 2011.
2. Coles, R., Dowell, D.M., Kirwan, J. Food Packaging Technology, Black Well Publishing Ltd, 2009.
3. Gordon L. Robertson. Food Packaging Principles & Practice. CRC Press, 2016.
4. Kit L Yam and Dong Sun Lee. Emerging Food Packaging Technologies: Principles and Practice. Wood head Publishing Ltd, 2012.
5. Robertson, G. L. 2001. Food Packaging and Shelf life: A Practical Guide. Narendra Publishing House

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	1	-	-	-	2	1	2	1	1
CO2	3	1	-	-	-	1	1	-	-	2	-	2	1	1
CO3	3	1	-	-	-	1	1	-	-	2	-	2	1	1
CO4	2	3	-	-	-	1	-	-	-	2	-	2	1	1
CO5	3	1	-	-	-	1	2	-	1	2	1	2	1	2
Avg.	**2.8**	**1.4**	**-**	**-**	**-**	**1**	**1.3**	**-**	**1**	**2**	**1**	**2**	**1**	**1.2**

(ii) Laboratory

List of experiments

- Measurement of thickness of packaging material
- Measurement of basic weight and grammage of paper and paperboards
- Measurement of water absorption of paper and paper boards (cobb tests)
- Study of vacuum packaging and machine, bottle filling machine and form-fill seal machine.
- Determination of lacquer integrity test.
- Determination of water vapor transmission rate of packaging material
- Determination of grease resistance of papers used in food industry – butter paper and toffee wraps
- Determination of adhesive tests of tapes
- Experiment on sealing of plastic cups
- Estimation the shelf-life of edible coated food samples**.**

24BTFT791	**PROJECT WORK PHASE I (Theory & Laboratory)**	**Semester-VII 8H-4C**

Instruction Hours/week: L:0 T:0 P:8 **Marks:** Internal**:100** Total**:100**

The students will be directed to do a project work which will be Phase I of their main projects works that will be performed in the eighth semester. Their projects will be evaluated Continuous Internal Assessment. End Semester Examination evaluation will be based on the report submitted by the student after the completion of their project report.

Semester VIII

B. Tech. - Food Technology **2024-2025**

24BTFT891	**PROJECT WORK PHASE II (Theory & Laboratory)**	**Semester-VIII 16H-8C**

Instruction Hours/week: L:0 T:0 P:16 **Marks:** Internal**:160 External: 240** Total**:400**
End semester Exam: 3 Hours

The students will be directed to do a mini project in their domain field for 3 months. Their project work will be evaluated for forty percentages by internal examiner and sixty percentage by external examiner for End Semester Examination. End Semester Examination evaluation will be based on the report submitted by the student after the completion of their project report.

PROFESSIONAL ELECTIVE – I

SEMESTER – V

B. Tech. – Food Technology	**2024 - 2025**
24BTFT5E01	**Semester-V**
LIPID PROCESSING TECHNOLOGY	**3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To explain the physical and chemical properties of fats and oils.
- To identify the extraction and refining processes of various oils and fats.
- To classify the packaging, quality standards of fats and oils.
- To explain the industrial applications of oils.
- To discuss the quality standards and specifications followed in oil processing industries

Course Outcomes:

Upon completion of this course, students will be able to:

- Illustrate the importance of fats and oils.
- Describe the manufacturing process of oils and fats.
- Apply knowledge on manufacture of designer fats.
- Infer the quality attributes of oils and fats.
- Identify the suitable packaging materials.

UNIT I - PHYSICAL AND CHEMICAL PROPERTIES **9**

Introduction - Fats and oils – formation – functions of oil in human body - fatty acids – double bonds and their position in oil – Geneva type classification - sources of vegetable oils – production status-oil content – coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil – physical and chemical properties of fats and oils - chemical reactions of oil.

UNIT II - EXTRACTION METHODS **9**

Oil extraction methods –mechanical expression – ghani, power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance solvent extraction process – batch and continuo us-continuous solvent extraction process for rice bran, soy bean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils – palm oil, virgin coconut oil – extraction process.

UNIT III - REFINING OF OILS **9**

Refining of oils – objectives – characterization - degumming – Zeneath process – deacidification process – continuous acid refining-bleaching of oil – continuous bleaching process – decolourising agents-deodorization process winterization processes-hydrogenation of oil –selectivity – catalyst –batch type hydrogenation – production process-partial sterilization, emulsification, chilling, kneading and rolling, incorporation of salt, colouring substances production of special fats – butter – types - production and storage.

UNIT IV - PACKAGING OF EDIBLE OILS **9**

Packaging of edible oils – requirements – types – tinplate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches – packaging for Vanaspati and ghee changes during storage of oil –rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing.

UNIT V - QUALITY STANDARDS **9**

Industrial applications of fats and oils – quality regulations - manufacture of soap, candle, paints and varnishes - ISI and Agmark standards – site selection for oil extraction plant- safety aspects- HACCP standards in oil industries.

TOTAL: 45

SUGGESTED READINGS:

1. Harry Lawson, (1997) "Food oils and Fats - Technology, Utilization and Nutrition", CBS Publishers and Distributors, New Delhi.
2. Gunstone F.D., (2008) "Oils and Fats in Food Industry", Blackwell Publishing, United Kingdom, ISBN – 13: 9781405171212.
3. Gunstone F.D., (2011) "Vegetable Oils in Food Technology: Composition, Properties and Uses", 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681.
4. Bailey's Industrial Oil & Fat Products, Daniel Swern, 2000, 4th ed.John Wiley & Sons.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	1	-	-	-	-	-	-	-	-	-	2	-	2	2
CO4	2	2	-	-	-	-	-	-	-	-	-	-	3	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.6**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2.4**	**2.2**

24BTFT5E02 **Semester- V**

FOOD PROCESSING AND PRESERVATION **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To discuss the principles, applications and effect on foods of high- pressure processing.
- To illustrate the principle, types, effects and limitations of radiation processing of foods.
- To explain the complete processes of osmotic dehydration of foods.
- To demonstrate the ohmic heating and ultrasound processing of foods.
- To summarize the application of pulsed light and hurdle technology in food processing.

Course Outcomes:

Upon completion of this course, students will be able to:

- Illustrate the overall processes involved in the high-pressure processing of foods.
- Explain the multiple aspects of radiation processing of foods.
- Apply the principle, mechanism, applications and limitations of osmotic dehydration of foods.
- Infer the application of ultrasound in processing and preservation of food.

UNIT I -GENERAL ASPECTS OF FOOD PROCESSING AND PRESERVATION **9**

Introduction to Food Processing and importance of food processing sectors, Present status of food industry in India, Types and basic principles involved in food processing and preservation through technology interventions.

UNIT II- MODE OF FOOD PRESERVATION **9**

Physical- water activity, pH control, Chemical – Chemical preservatives, types, usage of chemical preservatives in various food products, Regulations and guidelines, Biological methods- Fermentation- principle- advantages and disadvantages.

UNIT III – TRADITIONAL METHODS OF PRESERVATION **9**

Method and working principle of food preservation- Curing, Smoking, Pickling, Boiling, Blanching, Dehydration, Sugaring, Drying, Freezing- Application- Advantages and Disadvantages of traditional method of preservation.

UNIT IV – MODERN PRESERVATION TECHNOLOGIES **9**

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, irradiation, high pressure, high frequency, pulsed electric field, hurdle technology, Membrane technology, Plasma technology- Working Principle-process flow- application-advantages and disadvantages.

UNIT V – PRESERVATION BY CANNING AND PACKAGING TECHNOLOGY **9**

Basic packaging materials, types, design of packaging, packaging for different types of foods, retort pouch packing. Canning- working principle- materials used-applications- advantages and disadvantages.

SUGGESTED READINGS:

1. Sivasankar, B. “Food Processing and Preservation”. Prentice Hall of India, 2002.
2. .Khetarpaul, Neelam. “Food Processing and Preservation.” Daya Publications, 2005
3. Singh, M.K. “Food Preservation” Discovery Publishing, 2007.
4. Fellows, P.J. “Food Processing Technology: Principles and Practice”. 2nd Edition, CRC Wood Head Publishing, 2000.
5. GopalaRao, Chandra. “Essentials of Food Process Engineering”. B.S. Publications, 2006.

REFERENCES:

1. Rahman, M. Shafiur. “Handbook of Food Preservation”. Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. “Food Preservation Techniques”. CRC / Wood Head Publishing, 2003.
3. Ranganna, S. “Handbook of Canning and Aseptic Packaging”. Tata McGraw-Hill, 2000.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

CEREALS AND PULSES TECHNOLOGY **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To explain the processing of major cereals like paddy, maize, etc.
- To describe the milling techniques of cereals and pulses.
- To outline the byproducts obtained during processing along with their uses.
- To discover value-added products from maize.
- To illustrate various aspects of the milling of pulses.

Course Outcomes:

Upon completion of the course, students will be able to:

- Explain the processing of major cereals like paddy, maize, etc.
- Describe the milling techniques of cereals and pulses.
- Outline the byproducts obtained during processing along with their uses.
- Prepare value-added products from the byproducts obtained during milling.
- Discover value-added products from maize.

UNIT I - PADDY PROCESSING **9**

General aspects of cereals; Morphology, Classification and types - Chemical composition - Structure and Composition of paddy – Cleaning of paddy - Pre-Cleaners, -Paddy Parboiling Processes. Physico-chemical changes during parboiling – effect of parboiling on cooking qualities - Parboiling methods - Methods of grain drying- LSU, rotary, columnar, recirculatory dryers – Byproducts of paddy processing - Paddy husk and its uses as husk ash, activated carbon, furfural and other by products – Value added products.

UNIT II - RICE MILLING **9**

Rice milling flow chart - Modern Rice Milling equipments - Engelberg Huller, Under runner disc shellers, rubber roll sheller and Centrifugal dehusker- Paddy Separators – Satake and Schule Designs – Rice Polishers - Cone polishers and other types - Bran and Brokens separators - Rice mill yields and loss due to brokens at different stages of milling – milling efficiency -Use of Rice Bran in Edible oil Industry.

UNIT III - WHEAT MILLING **9**

Structure and composition of wheat – flow chart for wheat milling – milling process - equipments used in wheat milling – parboiling of wheat – bulgur wheat – products and byproducts of wheat.

UNIT IV - PROCESSING OF MAIZE/CORN **9**

Structure and composition of maize – Corn-milling (wet and dry)- Precleaning-cleaning equipment degermination and dehusking- Products of milling – Flour – Semolina-Cornflakes - Brewers' grits etc and their applications - Branand Fibre separation - Gluten and Starch Separation - Equipment used - Starch conversion into other value-added products – Acid Hydrolysis, Enzyme Hydrolysis, Isomerization processes - Processing for Dextrose, Malto Dextrin and other products - Extraction and refining of Corn oil in brief.

UNIT V - MILLING OF PULSES **9**

Structure and composition – Unit operations of pulse milling – domestic and commercial scale pulse milling methods – Dry and wet milling,CFTRI, CIAE, Jadavpur methods - Process flow chart – Pulse milling machineries - dehusking in Pulse Pearler - splitting of pulses in Pulse splitter - Mini dhal mill - working principle -advantages and disadvantages – pulse milling efficiency - Grindingof split pulses - pulse flour products - their applications and equipments used.

TOTAL: 45

SUGGESTED READINGS:

1. KM. Sahay and KK. Singh. Unit operations of Agricultural Processing, Vikash Publishing house PVT Ltd. Delhi, 2nd Edition, 2004.
2. Chakraverty, A. Post-Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 3rd Edition, 2018.

3. Karel Kulp and Joseph P Pante. Handbook of Cereal Science and Technology, Mercel Dekker, USA, 2nd edition, 2000.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

24BTFT5E04 **Semester- V**

MILLING TECHNOLOGY **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To discuss about the structure and properties of grains and cereals.
- To summarize milling process and equipments used for rice.
- To explain the process of milling and separation of wheat and corn.
- To identify the steps in involved in milling of pulses along with equipments.
- To explain about the properties of oil seed and their extraction and refining techniques.

Course Outcomes:

Upon completion of this course, students will be able to:

- Explain the importance of grains and cereals along with storage.
- Identify the byproducts obtained from rice milling and its wastes.
- Summarize detailed knowledge of Wheat and corn milling and its waste utilization.
- Identify the techniques and processes involved in pulse milling.
- Describe about the extraction, separation, and refining of oil seed milling.

UNIT I - GRAIN PROPERTIES **9**

Importance of grains and cereals - definitions, Grain structure, physicochemical properties of grains and its nutritional value. Storage of cereal grains in relation to maintaining grain quality – types of storage structures for different grains

UNIT II - RICE MILLING **9**

Rice milling flow sheet, Explanation of steps in milling operations-Cleaning, Parboiling- Physio – chemical changes during Parboiling and effects of qualities of rice. Methods of Parboiling, Milling, Shellers, Paddy Separator, Whitener, Polisher, Grader, and modern rice mill, Byproducts from rice milling and waste utilization. Rice economy in India.

UNIT III - WHEAT MILLING **9**

Wheat milling flow sheet. - Explanation of steps in milling, Cleaning Principles of Parboiling of wheat- Methods of Parboiling, Sifters, De-stoners, Roller milling – Break rolls, and reduction rolls, Sifting and purifying, plan sifters. Bran separation. Efficiency of milling process. By products from wheat milling and waste utilization. Wheat economy in India.

UNIT IV - PULSE MILLING **9**

Importance of legumes. Milling and processing of Legumes- Methods of milling (dry and wet) of pulses. Processing methods- dehulling losses and effect of dehulling on nutritive value. Grading methods, cooking quality, pulse economy in India.

UNIT V - OIL SEED MILLING **9**

Oil seed processing- natural sources of oil. Physio-chemical properties, mechanical extraction - Oil processing machinery, solvent extraction, factors influencing extraction, types of solvents. Refining of oil Principles and process controls, hydrogenation, winterization, Purification of oil – gravity settling, filter press; changes during storage. Oil seed flour concentrates and isolate. Utilization of oil seed meals of different food uses. Importance and application of oils in food and health. Quality of oil – different standards.

TOTAL: 45

SUGGESTED READINGS:

1. Kulp K and Pont J G, ―Handbook of Cereal Science and Technology, Second Edition, Chips Ltd. USA, 2000.
2. Khader, Vijaya and Vimala, V., ―Grain Quality and Processing, Agrotech Publishing, Udaipur, 2007.
3. Harry Lawson. ―Food Oils and Fats, Technology, Utilization and Nutrition, CBSPublishers and Distributors, New Delhi, 1997.
4. Chakraverty, A. ―Post Harvest Technology of Cereals, Pulses and Oil Seeds, Third Edition, Oxford & IBH publishing & Co., New Delhi, 2000.

5. Sahay, K.M. and Singh. K.K. Unit operations of Agricultural Processing, Vikas Publishing House, New Delhi, 1996.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

24BTFT5E05 **Semester- V**

TECHNOLOGY OF OIL SEEDS PROCESSING **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hour

Course Objectives:

The goal of this course is for students:

- To discuss about the nutritional value and future roles of oil seeds.
- To explain the importance of milling at different scale of operations.
- To identify the equipment involved in oil seed milling processes.
- To describe the refining in oilseed processing.
- To discuss about the use of oil seeds meals in protein products and byproducts.

Course Outcomes:

Upon completion of this course, students will be able to:

- Explain the composition, nutritional values and classification of oil seeds.
- Identify the problems affecting milling and develop new methods in different scales of operations.
- Infer knowledge about the principles and working of oil seed milling equipments.
- Interpret the importance of refining stage in oil processing.
- Identify the use of higher protein products and their byproducts.

UNIT I – INTRODUCTION **9**

Present status and future prospects of oilseeds; Morphology of oilseeds; Classification and types of oilseeds; Chemical composition, nutritional value and anti- nutritional compounds in oilseeds; Methods of removal of anti- nutritional compounds.

UNIT II - OILSEED PROCESSING **9**

Oil seed milling: Ghanis, hydraulic presses, expellers, solvent extraction methods, machines, Milling quality, milling efficiency, factors affecting milling quality and quantity; Problems in oil milling industry.

UNIT III - STAGES OF REFINING **9**

Refining of oils and its types: Degumming, neutralization, bleaching, filtration, deodorization, winterization and their principles and process controls; Hydrogenation of oils; Purification of oil – gravity settling, filter press. Rancidity of oils & its prevention; Aflatoxin in oil bearing materials.

UNIT IV - PACKAGING AND STORAGE **9**

Packaging and storage of edible oils. New technologies in oilseed processing; Oilseed economy in India. Industrial applications of oils - quality regulations, Protein texturization, fiber spinning.

UNIT V - UTILIZATION OF BY PRODUCTS **9**

Utilization of oil seed meals for different food uses: Oil seeds as direct edible products. High protein products like protein concentrates and isolates; Oil cake analysis; defating of oil meals / cakes; Oil meal/ cake as raw material for animal / poultry feed; Oil cake export - By-products of oil milling and their value addition.

TOTAL: 45

SUGGESTED READINGS:

1. Guriqbal Singh, Harbhajan Singh Sekhon, Jaspinder Singh Kolar and Masood Ali. 2005. Pulses. Agrotech Publishing Academy, Udaipur.
2. Chakraverty. 2008. Post- Harvest Technology of Cereals, Pulses and Oilseeds, 3rdEd. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Frank D. Gunstone. 2008. Oils and Fats in the Food Industry. John Wiley and Sons, Ltd., West Sussex, UK.
4. Fereidoon Shahidi. 2005. Bailey's Industrial Oil & Fat Products, 6th Ed., Vols. 1 to 6. John Wiley and Sons, Inc. Hoboken, New Jersey, USA.
5. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy.2003. Handbook of Post- Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices.Marcel Dekker,

Inc., NY, USA.

6. K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing, 2nd Ed. Vikas Publishing House Pvt. Ltd., Noida.

CO-PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

Professional Elective – II

B. Tech. – Food Technology **2024 - 2025**

24BTFT5E06 **Semester- V**

DESIGN AND FORMULATION OF FOODS **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hour

Course Objectives:

The goal of this course is for students:

- To explain the importance of nutrition and nutritive value of different foods in relation with health.
- To illustrate the terms, principles and steps involved in menu planning.
- To explain the vital role of geriatric and therapeutic balanced diet in human life.
- To identify the methods involved in the measurement and estimation of energy requirements in individuals.
- To summarize the concepts of nutraceuticals designing and Anti-nutritional factors.

Course Outcomes:

Upon completion of this course, students will be able to:

- Explain the nutritional value of different food groups.
- Identify the nutritional requirements of infants, preschool going children and athletes.
- Summarize the principles of menu planning process and understand and use the concept of food exchange lists.
- Describe therapeutic diets for diseases like diabetes, and CHD.
- Discuss the overall terms and methods applied in the measurement and estimation of energy.

UNIT I - NUTRITION AND BALANCED DIET **9**

Nutritive value and anti- nutritional factors present in cereals, pulses, oil seeds, fruits, vegetables, fish, meat and eggs- effect of processing on nutritive value of foods- Principles of Nutrition and Health-Food Preparation and Service: Principles and Methods. Basic terms used in study of food and nutrition, BMI and Nutritional Status, Understanding relationship between food, nutrition and health. Nutritional labelling in India

UNIT II - MENU PLANNING **9**

Explanation of terms- Principles of planning menus- Steps involved in planning menus- Food guide pyramid-Infant Foods: Formulation of weaning foods, Protein energy malnutrition- Formulating diet for preschool going (2-5 years) children-Food Selection and Meal Planning for different age groups. Factors affecting meal planning.

UNIT III - BALANCED DIET **9**

Diets during normal life cycle- Concept of Balanced Diet-Nutrition from infancy to adolescence- Nutritional requirements of different age groups- Geriatric nutrition- Nutrition for athletes- Therapeutic Diet: Diet therapy and types of therapeutic diet- Diet for diabetic mellitus- Diet for cardio vascular disease- Diet for gastro intestinal disease.

UNIT IV - ENERGY REQUIREMENT **9**

Definition- units of energy- Energy content of foods- Physiological fuel value- Measurement of energy expenditure- BMR- Thermic effect of food- SDA- Methods of measurement- Factorial methods of estimating energy requirement of individuals- Regulation of energy metabolism. Factors affecting absorption of the following in brief: Energy, Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C, Minerals – calcium, iron, iodine, fluorine, copper and zinc.

UNIT V - FUNCTIONAL AND SPECIAL FOODS **9**

Concepts for functional foods design, prebiotics & probiotics- nutraceuticals- designer foods- Anti-Nutritional Factors in Foods: Trypsin inhibitors, Phytins, Tannins, Oxalates, Goitrogens, Aflatoxins, and Process induced toxins- Space Foods-Army foods- Athlete Foods-Packaged food supply in Flights.

TOTAL: 45

SUGGESTED READINGS:

1. C Gopalan, BV Ramshastri, S C Balasubramaniam, 1989, Nutritive Value of Indian Foods Nation Institute of Nutrition, Hyderabad.
2. M Swaminathan, 1974, Essentials of Nutrition, Ganesh Co.
3. K.H. Steinkrauss, 1995, Handbook of Indigenous Fermented Foods, Marcel Dekker.
4. J Pokorny, N Yanishlieva, and M Gordon, 2001, Antioxidants in Food, Published by Woodhe Publishing Limited, Abington Hall, Abington.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.6**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

24BTFT5E07 **Semester- V**

FUNCTIONAL FOODS AND NUTRACEUTICALS **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives:

The goal of this course is for students:

- To discuss the historical reviews, teleology, models, classification and sources of nutraceuticals.
- To explain the role of flavonoids and carotenoids as antioxidant agents.
- To illustrate the metabolism, mechanism, sources and analysis of omega-3 fatty acids & CLA.
- To summarize the health implications of lycopene, garlic, olive oil, nuts, prebiotics and probiotics.
- To discuss the various aspects of herbs, stability testing, marketing strategies and regulatory issues in nutraceutical and functional foods.

Course outcomes:

Upon completion of this course, students will be able to:

- Illustrate the historical, technological aspects and classification of nutraceuticals.
- Explain the significance of flavonoids and carotenoids as antioxidants.
- Identify the potential health benefits, sources, mechanism of action and metabolism of omega- 3 fatty acids and CLA.
- Describe therapeutic diets for diseases like diabetes, and CHD.
- Summarize the role of herbs as a nutraceutical and conduct the accelerated shelf- life testing of various nutraceuticals and functional foods.

UNIT I - NUTRACEUTICALS: HISTORICAL, TECHNOLOGICAL ASPECTS AND CLASSIFICATIONS **9**

Nutraceuticals- concept and definition – Historical Reviews- Traditional Medicine - Teleology of nutraceuticals - Organization models for nutraceuticals- Recent scientific discoveries – Classification of Nutraceuticals based on the sources, function and targeted health benefits- Nutraceuticals in specific foods - Mechanism of Action - Chemical nature - Relation of functional foods and nutraceutical (FFN) to foods and drugs.

UNIT II - FLAVANOIDS AND CAROTENOIDS AS ANTIOXIDANTS **9**

Introduction -Flavonoids, Health benefits, specific flavonoids; Flavonoids and Lipoprotein oxidation - Evidence for specific Antioxidant mechanisms of Flavonoids - Antioxidantrole as nutraceuticals and functional foods- health benefits of antioxidants - -lowering effect of citrus flavonoids - Dietary carotenoid and carotenol absorption - Metabolism of Carotenoids – Carotenoids as anticancer agents. absorption - Approaches to measurement of absorption - Metabolism of Carotenoids – Carotenoids as anticancer agents.

UNIT III - OMEGA-3 FATTY ACIDS AND CLA **9**

Introduction to Lipoprotein metabolism – PUFA – Types - Cardiac Arrhythmias - Preventative role of n-3 fatty acids in cardiac arrhythmias -Mechanism of action on n-3PUFA's – Health benefits of omega-3 fatty acids - Chemistry and Nomenclature of CLA – Analysis of CLA in food and biological samples - CLA Isomers and Biological Activity – Biological actions and potential health benefits of CLA – Mechanisms of CLA action – Potential adverse effects of CLA, Applications of CLA in foods.

UNIT IV - LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS **9**

Lycopene – structure - Uses and presence in foods - Garlic – Chemistry – Implication in Health -Olive oil – CHD – Cancer - Nuts – Nutrient components and Composition –CHD epidemiological evidence, Human nutritional studies on nut consumption and serum lipid changes, Mechanism of action- Probiotics-importance of microbiome -criteria – probiotic products – Microbiology of the gastrointestinal tract - Prebiotics – effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases- future for probiotics and prebiotics.

UNIT V - HERBS AS FUNCTIONAL FOODS, STABILITY, TESTING AND MARKETING ISSUES FOR NUTRACEUTICALS AND FUNCTIONAL FOODS **9**

Herbal medicine – Herbs as ingredients in functional foods –Regulatory Compliance and Standards-Factors affecting the stability of bioactive compounds Kinetic modelling of chemical reactions – Accelerated shelf life testing - Cruciferous vegetables and cancer prevention – Dietary fiber and coronary heartdisease - Evolution of marketing

environment for Functional foods and nutraceuticals -Regulatory background - Introduction to consumer marketing issues for nutraceuticals.

TOTAL: 45

SUGGESTED READINGS:

1. Shi, John, Fereidoon Shahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor & Francis, 2007.
2. Watson, Robald Ross "Functional Foods and Nutraceuticals in Cancer Prevention". Blackwell Publishing, 2007.
3. Gibson, G.R. and C.M.Willams. "Functional Foods: Concept to Product". Woodhead, 2000

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.5**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

24BTFT5E08 **Semester-V**

SNACK FOOD TECHNOLOGY **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hour

Course Objectives:

The goal of this course is for students:

- To explain the diversity and common features of snack foods.
- To discuss different techniques of snack food manufacture.
- To identify the types of packages used for snack foods.
- To classify value added products from traditional Indian snack foods.
- To describe various equipment's used for the preparation of snack foods.

Course Outcomes:

Upon completion of the course, students will be able to:

- Explain the wide diversity and common features of snack foods.
- Discover knowledge of the different techniques of snack foods manufacture.
- Identify various types of packages used for snack foods.
- Illustrate the unique features of traditional Indian snack foods.
- Demonstrate different equipments used for preparation of snack foods

UNIT I – INTRODUCTION **9**

Introduction - Importance and scope of snack food technology. Present status of snack foods industries. Nuriontional aspects of snacks- Trends and varieties of snacks.

UNIT II – GRAIN BASED SNACKS **9**

Various types of snack foods - Technology for grain-based snacks: whole grains – roasted, toasted, puffed, popped and flakes, coated grains-salted, spiced and sweetened; flour based– batter and dough based snack foods - Soft dough biscuits- Hard dough biscuits. Savory products; - formulated chips and wafers, instant premixes of traditional Indian snack foods.

UNIT III – FRUITS AND VEGETABLE BASED SNACK **9**

Technology for fruit and vegetable-based snacks: Chips, wafers, fruit base confectionery bars. Technology for baked snack. Dehydrated fruits and vegetables.

UNIT IV – REGIONAL SNACK FOODS **9**

Regional snack foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

UNIT V – EQUIPMENTS **9**

Equipment's used for preparation of snack foods. Packaging of snack foods Laws and regulations.
Fassi guidelines- HACCP- GMP.

TOTAL: 45

SUGGESTED READINGS:

1. Edmund WL.1996 Snack Foods Processing. AVI Publ.
2. Frame ND. 1994.The Technology of Extrusion Cooking. Blackie Academic.
3. Gordon BR.1997 Snack Food.AVI Publ.
4. Samuel AM.1996. Snack Food Technology. AVI Publishers.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	1	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.6**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

Semester-VI

24BTFT5E09	**ANALYTICAL METHODS FOR FOOD PRODUCTS**	**3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60** Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To explain about the techniques of water analysis.
- To illustrate the methods involved in the analysis of plantation products.
- To demonstrate a different knowledge on analysis methods of fruit and vegetable products.
- To summarize the basic analysis concepts of bakery products.
- To outline the processes involved in livestock food product analysis.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the various food analysis techniques.
- Identify the methods used for water evaluation.
- Summarize the analysis methods involved in plantation and fruit products.
- Illustrate the basic concepts of bakery and confectionary product analysis.
- Interpret the various strategies involved in the product analysis and its standard methods.

UNIT I - ANALYSIS OF WATER **9**

Parameters tested as per FSSAI Regulations- Organoleptic and Physico-chemical Parameters- Colour, Odour, pH, Taste, Turbidity, General Chemical parameters- Ammoniacal nitrogen, Anionic surface active agent, Boron, Nitrate, Chloride, Magnesium, Fluoride, Total hardness, Alkalinity, Sulphates, Residual free chlorine& Chloramines Sulphide , Cyanide, Calcium, Total Dissolved Solids, Phenol, Sodium , Hexavalent chromium ,Total solids, Nitrite , Mineral Oil, Estimation of Anions in Drinking water by Ion Chromatography, Metals A By AAS- By Flame AAS (Zn, Mg, Ca,), By Graphite furnace AAS(Al, Cu, Fe, Mn, Se, Ag, Cd, Pb, Hg, Mo, Ni, As, Cr), By Cold Vapour AAS (Hg) B. By ICP-MS (Zn, Mg, Ca, Al, Cu, Fe, Mn, Se, Ag, Cd, Pb, Hg, Mo, Ni, As, Cr, Hg), Toxic substances- Pesticide Residues, Polychlorinated Biphenyls, Polyaromatic Hydrocarbons, IS protocol 10500 and 14543.

UNIT II-ANALYSIS OF PLANTATION PRODUCTS **9**

Tea & Coffee- Preparation of sample, Moisture content, Total ash, Water soluble ash, Determination of Caffeine content by different methods, microscopic examination, Determination of solubility in boiling water, Determination of Iron filings and size of the particles, Test for presence of added colouring matter - Spices- Sample preparation, Determination of moisture, Acid insoluble ash, Determination of Cold Water Extract, Determination of Alcohol Soluble Extract , Calcium Oxide, Non Volatile Ether Extract, Volatile Oil, Crude Fibre, Allyl isothiocyanate in Mustard, p-hydroxybenzyl isothiocyanate in white mustard, Microscopic Examination of Spices, Black Pepper- Determination of Bulk density, Light berries, Piperine content, Turmeric- Determination of curcumin content, Starch content, Detection of chromate content, Detection of Argemone seeds in Mustard, Detection of Mineral Oil in Black Pepper, Detection of Papaya seeds in Black Pepper, Detection of Turmeric in Chillies and Coriander, Detection of Oil Soluble Colour, Determination of Light and Heavy Filth in Spices and Condiments, Determination of capsaicin content in chilli powder.

UNIT III - ANALYSIS OF FRUIT & VEGETABLE PRODUCTS, OILS & FATS **9**

Thermally Processes fruits and vegetables- Physical examination, Determination of Vacuum, Drained weight, Internal conditions of can, Determination of sodium chloride in brine; Jams and Jellies- Insoluble matter, pH, Titratable Acidity, Volatile oils, Total sugars, Vitamin C, Determination of fruit content.

UNIT IV - ANALYSIS OF BAKING AND CONFECTIONERY PRODUCTS **9**

Bread- Sample preparation, Determination of alcoholic acidity, Acid-insoluble ash, Non-Fat milk, solids in milk bread, Biscuits- Determination of acidity of extracted fat, Confectionery- Preparation of Sample, Determination of Moisture, Determination of Sulphated Ash, Determination of Sulphated Ash on salt free basis, Determination of Ash in dil. HCl, Test for presence of added synthetic colour, Determination of Total Protein, Determination of Fat, Determination of Reducing Sugar, Determination of Sucrose, Determination of Sulphur dioxide, Determination of Lead, Copper and Zinc.

UNIT V - ANALYSIS OF MEAT AND FISH PRODUCTS **9**

Preparation of Sample for Meat and Processed Meat products, Determination of Nitrite in Processed animal foods, Determination of Ascorbic acid, Alternate method for Determination of Ascorbic acid, Determination of Total Phosphorous, Test for presence of Polyphosphates, Determination of Glucono-delta-lactone, Additional tests, Determination of physico-chemical quality of meat and meat products- pH, Extract Release Volume (ERV), Meat Swelling Capacity (MSC), Total Volatile Basic Nitrogen (TVBN), Picric Acid Turbidity (PAT), Determination of dye reduction capacity. Preparation of sample for Fish and Processed Fish, Frozen Fish- Determination of Histamine, Dried fish- Moisture content, Sodium chloride content, Acid insoluble ash. Milk & Milk products- Preparation of sample, Detection test for adulterants and contaminants, Alkaline phosphatase test, Turbidity test, Determination of Total solids, Determination of fat.

TOTAL:45

SUGGESTED READINGS:

1. FSSAI Lab Manual 6, "Manual of Methods of Food Analysis- Meat& Meat Products/ Fish & Fish Products", 2016.
2. FSSAI Lab Manual 3, "Manual of Methods of Food Analysis- Cereal & Cereal Products", 2016.
3. FSSAI Lab Manual 4, "Manual of Methods of Food Analysis- Beverages, Sugar & Confectionery Products", 2016.
4. FSSAI Lab Manual 10, "Manual of Methods of Food Analysis- Spices and Condiments", 2016.
5. FSSAI Lab Manual 5, "Manual of Methods of Food Analysis- Fruit & Vegetable Products", 2016.
6. FSSAI Lab Manual, "Manual of Methods of Food Analysis- Water", 2016.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	-	-	-	-	-	-	-	1	2	2
CO2	2	2	1	2	-	-	-	-	-	-	-	1	2	2
CO3	2	1	1	2	-	-	-	-	-	-	-	1	2	2
CO4	2	1	1	2	-	-	-	-	-	-	-	1	2	2
CO5	2	1	1	2	-	-	-	-	-	-	-	1	2	2
Avg.	**2**	**1.16**	**1**	**2**	-	-	-	-	-	-	-	**1**	**2**	**2**

Semester-VI

24BTFT5E10 **BEVERAGE PROCESSING TECHNOLOGY** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVE:

The goal of this course is for students:

- To explain the types of ingredients used in beverage production.
- To apply knowledge on processes involved in carbonated beverage production.
- To interpret the processes and unit operations involved in noncarbonated beverage production.
- To summarize the various equipment's used and ingredients for the production of alcoholic beverages.
- To infer the quality standards, regulations and sanitation for beverage processing industries.

COURSE OUTCOME:

Upon completion of this course, students will be able to:

- Calculate and formulate the beverages using various ingredients.
- Demonstrate various unit operations involved in the food beverage manufacturing.
- Summarize the various production techniques in beverages.
- Explain the knowledge obtained to produce nonalcoholic beverages.
- Describe the quality parameters of all beverages.

UNIT I - INGREDIENTS IN BEVERAGES **9**

Beverage-definition-ingredients- water, quality evaluation and raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavoring agents, colors – natural and artificial, Micro and Nano-emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT II - CARBONATED BEVERAGES **9**

Procedures- ingredients- preparation of Syrup making, carbonation of soft drinks. Carbonation equipment's and machineries- -containers and closures. low-calorie and dry beverages; isotonic and sports drinks; Fruit based carbonated beverages, carbonated water.

UNIT III - NON-CARBONATED BEVERAGES **9**

Beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy based beverages, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages. bottled. Water; mineral water, natural spring water,flavored water

UNIT IV - ALCOHOLIC BEVERAGES **9**

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipment's used for brewing and distillation, wine and related beverages, distilled spirits.

UNIT V -FOOD ADDTIVES AND MISCELLANEOUS BEVERAGES AND QUALITY CONTROL **9**

Sweeteners, colourants, acidulants, clouding, clarifying and flavouring agents, preservatives for beverages. Carbon di oxide and carbonation. Quality tests and control in beverages. Miscellaneous beverages- coconut water, coconut milk, sweet toddy, sugarcane juice and flavoured syrups -Quality control, Filling-inspection and quality controls-sanitation and hygiene in beverage industry-Quality of water used in beverages threshold limits of ingredients. FSSAI, EFSA and FDA regulations.

TOTAL:45

SUGGESTED READINGS:

1. L. Jagan Mohan Rao and K. Ramalakshmi (2011) "Recent trend in Soft beverages", Woodhead Publishing India Pvt. Ltd.
2. Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.
3. Mitchell, Alan J. (1999) "Formulation and Production Carbonated Soft Drinks". Springer Science & Business Media.
4. Woodroof, Jasper Guy, and G. Frank Phillips. (1981) Beverages: carbonated and noncarbonated. AVI Pub. Co.

5. Ashurst, P.R, "Chemistry and technology of Soft drink and fruit juices", 2nd edition, Blackwell Publishing Ltd. 2005.
6. Steen, D.P and Ashurst, P.R, "Carbonated soft drinks – Formulation and manufacture", Blackwell Publishing Ltd. 2000.
7. "Brewing yeast and fermentation Chris Boulton and David Quain", Blackwell Science Ltd Prevention of Food Adulteration Acts and Rules Manual".
8. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	2	2
CO2	2	2	1	-	-	-	-	-	-	-	-	1	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	1	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	1	2	2
CO5	2	1	1	-	-	-	1	-	-	-	-	1	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	**1**	-	-	-	-	**1**	**2**	**2**

PROFESSIONAL ELECTIVE - III

B. Tech. - Food Technology **2024 - 2025**

Semester-VI

24BTFT6E01 NEW PRODUCT DEVELOPMENT AND SENSORY SCIENCE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60** Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To explain about the importance and applications of sensory analysis.
- To illustrate the methods and different types of tests used for sensory analysis.
- To describe a different knowledge on assessors and its role on sensory valuation.
- To apply the basic concepts of product development along with their success and flaws.
- To identify the processes involved in product development.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the applications of sensory analysis.
- Identify the methods used for various sensory evaluations.
- Summarize the assessor's role in sensory test.
- Explain the basic concepts of product development.
- Relate the various strategies involved in the new product development process.

UNIT I - INTRODUCTION TO SENSORY ANALYSIS **9**

Background and importance of Sensory Analysis, Definition of Sensory Analysis, Fields of Application of Sensory Analysis, Legislation on Sensory Analysis, Sensory perception and the organs of senses, relationship between sensory analysis and product development.

UNIT II - METHODOLOGY OF SENSORY ANALYSIS **9**

Preparation of trial, Location of test and tasting Rooms, Sample preparation, supplies and equipment, materials, preparation procedure, sample preparation, order, coding, number of samples, product sampling Sensory evaluation techniques, Types of tests Differentiation sensory tests, Variables and scales, Descriptive sensory tests Affective sensory tests. Factors affecting sensory verdicts, physiological factors, psychological factors, poor physical condition.

UNIT III – ASSESSORS **9**

Selection, training and monitoring, Assessors, Types of assessors: trained and untrained, Factors influencing sensory evaluations, features of assessors, Applications and Advances in Electronic-Nose Technologies, Aroma Types and Characteristics, Conceptual Development of the Electronic Nose and instrumentation, Data Analysis for Electronic Noses, E nose applications. Computer aided sensory evaluation of food & beverage, statistical analysis of sensory data.

UNIT IV – CONCEPTS **9**

Concept of product development - product success and failure, factors for success, process of product development, managing for product's success. Innovation strategy - possibilities for innovation, design thinking for new products, prototype, building up strategy, product development programme.

UNIT V - PRODUCT DEVELOPMENT PROCESS **9**

The product development process - Open Innovation Stage Gates Processes - product strategy, product design and process development, product commercialization: creating market demand, product launch and evaluation. Legal issues in product development: Intellectual property rights

TOTAL:45

SUGGESTED READINGS:

1. Meilgaard Morten; Sensory evaluation techniques Stone Herbert; Sensory evaluation practices. ISBN: 0-12-672690-6
2. Schaffner, D. J., W. R. Schroeder e M. D. Earle; Food Marketing: An International Perspective 2nd ed, McGraw Hill, 2003. ISBN: 978-0072952889
3. Varela, P. e G. Ares; Novel Techniques in Sensory Characterization and Consumer Profiling, CRC Press, 2014. ISBN: ISBN 9781466566293

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	1	2	2
CO4	3	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	3	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2.33**	**1**	**1**	-	-	-	-	-	-	-	-	**1**	**2**	**2**

24BTFT6E02 MARKETING MANAGEMENT AND INTERNATIONAL TRADE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60** Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To summarize the concepts in marketing management and realize its scope.
- To explain the consumers buying behavior and information systems in marketing.
- To apply the marketing processes and classify the types of food consumption across the globe.
- To interpret the concepts involved in international marketing and trading.
- To explain the major role of government in trading process.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the concepts of marketing and market Structure.
- Interpret the policies in marketing planning and advertisements.
- Infer the overall concepts involved in international marketing and trade developments.
- Apply the role of export and import strategies and government roles in marketing.
- Summarize the marketing principles, its structure and government policies in export and import tradings.

UNIT I - CONCEPTS OF MARKETING AND MARKET STRUCTURE 9

Concept of marketing, functions of marketing, Concepts of marketing management, scope of marketing management, Marketing management process, Concepts of marketing- mix, elements of marketing- mix, Types of marketing channel, Concept of market structure, Marketing environment -Micro and macro environments.

UNIT II - CONSUMERS BUYING BEHAVIOR 9

Consumers buying behaviour, consumerism, Marketing opportunities analysis: marketing research and marketing information systems, Market measurement- present and future demand, market forecasting, Market segmentation – bases of market segmentation- industrial market segmentation, targeting and positioning, Allocation and marketing resources.

UNIT III - MARKETING PLANNING PROCESS AND ADVERTISING 9

Marketing planning process, Product policy and planning: product-mix, product line, product life Cycle, New product development process, Product brand, packaging, services decisions, Marketing channel decisions. Retailing, wholesaling and distribution, Pricing decisions, Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry, Promotion-mix decisions, Advertising, how advertising works, deciding advertising objectives, Advertising budget, Advertising message, media planning, personal selling, publicity, sales, promotion. World consumption of food: Patterns and types of food consumption across the globe.

UNIT IV - INTERNATIONAL MARKETING AND TRADE 9

International marketing and international trade, salient features of international marketing Composition & direction of Indian exports, international marketing environment.

UNIT V - EXPORTS AND ROLE OF GOVERNMENT AGENCIES IN TRADE 9

Exports- direct exports, indirect exports, Licensing, Joint ventures, Direct investment, product price, place and promotion elements. Export trends and prospects of food products in Indian Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc. WTO and world trade agreements related to food business.

TOTAL: 45

SUGGESTED READINGS:

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithileshwar Jha. 2013. Marketing Management: A South Asian Perspective, 14th Ed. Pearson Education.
2. Willium J. Stanton. 2010. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.
3. C.N. Sontakki. 2014. Marketing Management. Kalyani Publishers, New Delhi.
4. John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. 2013. International Business, 15th Ed.,

Pearson Education. Aswathappa. International Business. Tata McGraw-Hill Education, New Delhi.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	1	-	-	-	-	-	1	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	1	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	1	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1**	-	-	-	-	-	**1**	-	-	-	-	**2**	**2**

24BTFT6E03 **FOOD PROCESS AUTOMATION** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60** Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To infer the automated evaluation of food quality
- To summarize the concepts for data acquisition
- To outline the modelling strategies
- To classify and predict samples for quality
- To interpret food process quality control using predictive models

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Summarize the food quality measurements using automation.
- Illustrate the techniques for data acquisition.
- Compare and contrast theoretical and empirical modelling.
- Interpret the various methods to grade food samples.
- Demonstrate the methods for process control.

UNIT I –INTRODUCTION **9**

Food quality, automated evaluation of food quality, food quality quantization and process control, typical problems in food quality evaluation e.g., beef quality evaluation; food odor measurement, continuous snack food frying quality.

UNIT II – DATA ACQUISITION **9**

Sampling elaboration with examples, concepts and systems for data acquisition such as: ultrasonic signal acquisition for beef grading, electronic nose data acquisition for food odor measurement, snack food frying data acquisition for quality process control, Image acquisition: elaboration with examples

UNIT III - DATA ANALYSIS AND MODELLING **9**

Data preprocessing, Static data analysis, Dynamic data analysis, Image processing: Image segmentation, Image feature extraction etc. Modeling strategies: Theoretical and empirical modeling, Static and dynamic modeling, Linear statistical modeling, ANN modeling etc.

UNIT IV – PREDICTION **9**

Prediction and classification, Sample classification for beef grading, examples such as, based on linear statistical and ANN models, electronic nose data classification for food odor pattern recognition, Snack food classification for eating quality evaluation based on linear statistical and ANN models, One-step-ahead prediction.

UNIT V CONTROL **9**

Process control, Internal model control, Predictive control, Neuro-fuzzy PDC for snack food frying process, Systems integration: Food quality quantization systems integration, Food quality process control systems integration, Food quality quantization and process control systems development.

TOTAL:45

SUGGESTED READINGS:

1. Jain, M. K., Iyengar, S. R. K. and Jain, (New Age International, 2007)
2. Sastry, S. S. Introductory M ethods of Nnmerical Analysis.(Prentice I fall of India, 2007)
3. I . Atkinson, K. Elementary Numerical Analy,is, (Wiley, 2006)
4. Grewal, B.S. Numeril·a/ Metlwc/s in £,,g ;,,eering mu/ Sciena, (Khanna Publishers, 2005)
5. Rao, K. S. Numerical Methodsfo r Scie111is1s an</ Engineers, (Prentice I fall of India , 2007)

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT6E04 **ENERGY CONSERVATION IN FOOD DESIGN** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:100 External: 60** Total**:100**
End Semester Exam:3 Hour

COURSE OBJECTIVE:

The goal of this course is for students:

- To explain the fundamentals of energy flow in an food industry.
- To illustrate the conservation technologies applied to food processing facilities.
- To demonstrate the energy saving opportunities in a food plant.
- To interpret the energy saving ways in emerging food processing systems.
- To outline the conversion of Food processing wastes into energy.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Summarize the importance of sustainability in food industry.
- Explain the thermodynamic cycles applied to food industry for improved efficiency.
- Infer the energy consumption pattern to save energy.
- Illustrate the energy efficiency and conservation in food processing.
- Interpret the food conversion technique for reuse.

UNIT I –INTRODUCTION **9**

Fundamentals of Engineering Analysis and Management: Fundamentals of Meat Transfer, Fluid Mechanics, and Thermodynamics in Food Processing, Fundamentals of Energy Auditing, Sustainability in the Food Industry.

UNIT II-ENERGY CONSERVATION TECHNOLOGIES APPLIED TO FOOD PROCESSING FACILITIES 9

Energy Conservation in Steam Generation and Consumption System, in Compressed Air System, in Power and Electrical Systems, in Heat Exchangers, Wastc-lleat Recovery and Thermal Energy Storage in Food Processing Facilities, novel Thermodynamic Cycles Applied to the Food Industry for Improved Energy Efficiency.

UNIT III- ENERGY SAVING OPPORTUNITIES IN EXISTING FOOD PROCESSING **9**

Facilities: Energy Consumption pattern, Energy Conservation in Grains and Oilseeds Milling Facilities, in Sugar and Confectionary Processing Facilities, in Fruit and Vegetable Processing Facilities, in Dairy Processing Facilities, in Meat Processing Facilities, in Bakery Processing Facilities.

UNIT IV- ENERGY CONSERVATION IN EMERGING FOOD PROCESSING SYSTEMS **9**

Membrane Processing of Foods, Energy Efficiency and Conservation in Food irradiation, in Pulsed Electric Fields Treatment, in High- Pressure Food Processing, in Microwave Heating, in Supercritical Fluid Processing.

UNIT V- CONVERSION OF FOOD PROCESSING WASTES INTO ENERGY **9**

Food Processing Wastes and Utilizations, Anaerobic Digestion of Food Processing Wastes, Fermentation of Food Processing Wastes into Transportation Alcohols, Bio-diesel Production from Waste Oils and Fats, Thermo-chemical Conversion of Food Processing Wastes for Energy Utilization.

TOTAL:45

SUGGESTED READINGS:

I. Wang, L. Energy Efficiency& Management in Food Processing (CRC Press, 2009)
2. Singh, R. P.Energy in Fo()(/ Processing, (Elsevier Publishing Co.. 1986)
3. I . Mattsson, B.and Sonesson, U.Environmemally Friendly Food Processing, (CRC Press, 2003)

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	2	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	1	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	2	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

24BTFT6E05 **PROCESS CONTROL FOR FOOD ENGINEERS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40 External:60** Total**:100**
End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students to:

- To summarize the fundamentals of sensors and control concepts.
- To explain the concepts of system analysis and control.
- To summarize the knowledge about the working of various sensors.
- To illustrate mathematical model for a system.
- To interpret the suitable control schemes of particular system.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Summarize the mathematical model of a system.
- Describe the response of different order systems for various test inputs.
- Analyze the stability of the system.
- Apply the knowledge of various Measuring Instruments design a simple Instrumentation system.
- Infer the Mathematical Model of a physical system. Analyze and decide suitable control schemes for a particular system.

UNIT I - INTRODUCTION TO PROCESS CONTROL **9**

Introduction – measurement system - characteristics of instruments, static and dynamic characteristics System – steady state design – process control – process control block diagram – definition of a process, measurement, controller, and control element, loop – damped and cyclic response- feedback control – transient responses – lap lace transform of simple functions – step function, exponential function, ramp function and sine function.

UNIT II - CONTROL SYSTEMS **9**

Open and closed loop systems, servo - mechanisms, hydraulic and pneumatic control systems, two-way control, proportional control, differential control and integral control. Control valve – Construction and working of pneumatically operated valve and spring-diaphragm Actuator.

UNIT III - STABILITY ANALYSIS **9**

Signal flow graph – Mason's Gain formula, Block diagram algebra. Stability – concept of stability, definition of stability in a linear system, stability criterion, characteristic equation, Routh test for stability

UNIT IV - PRESSURE AND TEMPERATURE SENSORS **9**

Pressure measurement – Construction and working of capacitive pressure sensor, Inductive pressure sensor, strain gauge, pressure sensor, diaphragm, bourdon tube, differential pressure cell Temperature sensors –Construction and working of RTD, Thermistors, Thermocouples, bimetallic strips.

UNIT V - LEVEL SENSOR **9**

Simple float systems, capacitive sensing element, radioactive methods (nucleonic level sensing) – ultrasonic level sensor. Measurement of density – U-type densitometer, Buoyancy meter Measurement of composition – Electrical conductivity cell, non- dispersive photometers, pH meter, Gas chromatograph, Mass spectrometer.

TOTAL:45

SUGGESTED READINGS:

1. J.F Richardson A D. G. Peacock, Coulson & Richardson's (2006),"Chemical Engineering", Volume3, Butherworth – Heinemann, an imprint of Elsevier.
2. Donald R. Coughanowr. (2008), "Process System analysis and control" Mc- Graw Hill International Edition, Second Edition, singapore.
3. Nagoorkani. A (2012),"Control Systems", RBA publications, 2nd edition, ninteenth reprint.
4. S. Baskar (2004)," Instrumentation control system measurements and controls"Anuradha Agencies Publishers.
5. Nagrath, M and Gopal, I.J (2003), "Control Systems Engineering", Wiley Eastern Limited, Third Edition

Reprint.
6. Renganathan (2003), "Transducer engineering, Allied publishers, New Delhi.
7. Patranabis (2004), "Principles of industrial instrumentation", Prentice Hall India. Patranabis, D., (1997) Second Edit Tata McGraw Hill Publishing Co. Ltd. New Delhi. ISBN 0074623346.
8. Bakshi.U.A and A.V.Baksi 2004. Measurements and Instrumentation. Technical Publications Pune.
9. E.O.Doeblin. Measurement Systems application and design, McGraw-Hill Publishing Company Limited.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

PROFESSIONAL ELECTIVE – IV

B. Tech. Food Technology **2024-2025**

Semester-VI

24BTFT6E06 **WASTE MANAGEMENT IN FOOD INDUSTRIES** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External: **60**Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To summarize importance of treating waste product from food industry.
- To explain the treatment methods and recycling of waste product from food industry.
- To identify the effective utilization or disposal of food waste.
- To explain the characterization and chemical properties of food waste.
- To relate or minimize the impact of food waste on the environment.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Explain the awareness of importance in treating waste product from food industry.
- Explain the knowledge of Treatment methods and recycling of waste product from food industry.
- Relate the handling of industrialwaste with necessary precautions to avoid infection and cross contamination.
- Summarize the methods of treatment.
- Interpret the controlling of environmental pollution by proper treatment of food waste.

UNIT I - ENVIRONMENTAL POLLUTION AND FOOD WASTE CHARACTERIZATION 9

Environmental problems – Pollution –types of pollution: air, water, soil, noise, and radiation pollution, Pollution due to Food Industry wastes, remedial measures; Classification and characterization of waste from various food industries: solid and liquid wastes. Need for treating waste from various food industries, characteristics and impact on environmental quality.

UNIT II – WASTE FROM FOOD INDUSTRIES AND BY-PRODCUT UTILIZATION 9

Key drivers for waste management and co-product recovery in food processing: Waste minimization, management-Wastes from fruit and vegetable processing, meat and poultry processing, fish processing, dairy processing, cereal processing and beverage processing industries– characteristics and effect on soil, water and air quality – by-product utilization.

UNIT III - WASTEWATER MANAGEMENT IN FOOD INDUSTRIES 9

Separation technologies for food wastewater treatment and product recovery: Principal of physical methods: separation, separation and recovery technologies screening, sedimentation, filtration, back washing, membrane separation. Principles of Chemical treatment - coagulation, flocculation, precipitation, flotation, disinfection and fluoridation. Principles of biological treatment-aerobic process, activated sludge process, trickling filters, anaerobic digestion, UASB reactor.

UNIT IV – SOLID WASTE MANAGEMENT IN FOOD INDUSTRIES 9

Solid waste management techniques – Principles and practices, 4R concept. Landfilling, burial, Composting, methods of composting, vermicomposting, burning, disposing, Incineration, pyrolysis, briquetting, setting up biogas plants, recycling – value addition – SCP, enzymes, pectin and other products

UNIT V-ENVIRONMENTAL PROTECTION AND POLLUTION CONTROL IN FOOD INDUSTRIES 9

International and national scenario on disposal of waste from food industries. Green chemistry - Principles and application in food Industries - CDM - Eco friendly products in food industry - Biocolorants - Eco friendly packaging - ¬Eco labeling – Occupational and Bio safety in food industries. Global treaties, conventions – National and State Level Organizations – Environmental Laws and Acts; Regulatory issues with food industry waste.

TOTAL:45

SUGGESTED READINGS:

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press,2008.
2. S.N. Jogdhand, Environmental Biotechnology: Industrial PollutionManagement, (III ed), Himalaya Publishing House, New Delhi, 2010.
3. Lawrence K.Wang, Yung-Tse Hung, Howard H.L and Constantine Yapijakis, Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006.
4. Singh, N Shree and Tripathi D Rudra, Environmental Bioremediation Technologies, SpringerVerlag Publishers, 2007.
5. D. Hamilton and Stephen Crossley, Pesticide Residues in Food and Drinking Water - HumanExposure and Risks, John Wiley & Sons Publishers, 2003.
6. Vasso Oreopoulou and Winfried Russ. "Utilization of by-products and Treatment of Waste inthe Food Industry". Springer, 2007.
7. Patwardhan., Industrial Waste Water Treatment, Prentice-Hall of India Pvt Ltd, 1st edition, 2008.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

Semester-VI

24BTFT6E07 **FOOD COLORANTS AND FLAVORANTS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60**Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVE:

The goal of this course is for students:

- To explain different food colors.
- To explain properties and application of food colors.
- To describe different food flavors and its application.
- To explain the applications of food colors and its emerging techniques.
- To describe the Quality control techniques and regulations involved in colors and flavors.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Summarize the synthetic and natural food colors.
- Explain the importance of food colors and their applications in different fields.
- Interpret the various food flavors and their application.
- Infer the applications of food coloring and its advancement.
- Explain the regulations involved in the safer use of colors and flavors in foods. Infer the importance of food colorants and flavorants.

UNIT I - FOOD COLOURS **9**

Introduction – Types based on sources: Natural and Synthetic food Colors – Class and description of food colors-Physical form of food colors – Stability, storage and solubility of food colors – Regulations and safety assessment – Labeling requirements for food containing color additives – Adulteration and misbranding of color additives in foods.

UNIT II - PROPERTIES AND ANALYSIS OF FOOD COLOURS **9**

Food color stability, Importance of food colors for food products - Methods of analysis for food colour - Quality and safety assessment – Applications of natural and synthetic food colours, Identification of Natural Colours, Isolation and Estimation of Synthetic Food Colours,

UNIT III - FOOD FLAVOURS **9**

Introduction: flavour and flavour enhancer – Classification - flavor forms: water soluble liquid flavours – oil soluble liquid flavours, emulsion-based flavours, dispersed flavours, spray dried flavours – commercial considerations -Flavor characteristics – Flavor compounds - Natural and artificial flavoring materials - Flavoring constituent of various foods like meat, fish, milk, vegetables, fruits, fats & oils, spices & herbs, cereals and pulses. Changes in flavouring components and characteristics during cooking/processing of various foods, flavour release from foods, determination of flavours using chromatography, Effects of storage, processing, transportation and environmental conditions on flavor Components/constituents.

UNIT IV - FOOD FLAVOR: APPLICATIONS AND RECENT DEVELOPMENT **9**

Applications in different industries: Culinary and Meat Products, bakery products, snack foods, sugar based confectionary products, dairy products and soft drinks. Recent developments in flavor research, processing and technology.

UNIT V - FOOD FLAVOR: QUALITY CONTROL **9**

Flavouring and coating technologies for preservation and processing of foods. Quality Control – analytical, sensory and adulteration testing. Measurement of flavour, particularly for wine, tea, coffee, species and condiment, consumer acceptance.

TOTAL:45

SUGGESTED READINGS:

1. Spices and Flavor Technology. J.S. Pruthi, ICAR Publications, 2nd Edition, 1998.
2. Fenaroli, G, Handbook of flavour ingredients, CRC Press. Bota Rica, New York, 2005.

3. Yamanishi, T, Recent advances in flavour researches, Dekker, New York, 2005.
4. Andrew J. Taylor and Robert S. T. Linforth, Food Flavour Technology, Blackwell Publishing Ltd, 2010.
5. Suvendu Bhattacharya, Conventional and Advanced Food Processing Technologies, Wiley Publishers, 2015.
6. Heath, HB, Flavour chemistry and technology, CBS Publ., New Delhi, 2005.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT6E08 BIOLOGICALLY ACTIVE PHYTOCHEMICALS IN FOODS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60**Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To summarize Treatment methods and recycling of waste product from food industry
- To effective utilization or disposal of food waste
- To understand the characterization and chemical properties of food waste
- To control or minimize the impact of food waste on the environment
- To prepare value added products from food processing, industrial wastes.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

- Summarize on the importance in treating waste product from food industry.
- Apply the knowledge of treatment methods and recycling of waste product from food industry.
- Illustrate on the industrial waste with necessary precautions to avoid infection and cross contamination.
- Interpret the the sludge and effluents discharged from food industries meet the limitation by law.
- Explain on the control of environmental pollution by proper treatment of food waste.

UNIT I –BIOSYNTHESIS AND SIGNIFICANCE 9

Phytochemicals in food and their characteristics– the plants as chemical factories. synthesis of isotopically Labeled Phytoestrogens; Significance of phytochemicals in human nutrition.

UNIT II –ANALYSIS OF PHYTOCHEMICALS 9

Qualitative and quantitative methods, phytoestrogens in plants-isoflavones- flavonols– polyphenols-tannins-saponins-lignans, Multiresidue method for penicillins and cephalosporins in Bovine muscle.

UNIT III -ANTIOXIDANT ACTIVITY AND THEIR ASSESMENT 9

In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different methods to evaluate the antioxidant. Prediction of the antioxidant activity of natural phenolics from electrotopological state indices. Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV – BIOAVAILABILITY 9

Factors affecting bioavailability, chemical and characterization of cell histochemical wall polysaccharides in almond seed in relation to lipid bioavailability

UNIT V- OPTIMISING PHYTOCHEMICAL 9

Optimizing phytochemical release by process technology, Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

TOTAL:45

SUGGESTED READINGS:

1. Gilbert, John and H. Z. Senyuva “Bioactive Compounds in Food”. Blackwell
2. Meskin, Mark S., W.R. Bidlack and R.K. Randolph. “Phytochemicals : Nutrient-Gene Interactions”. CRC / Taylor & Francis, 2006.
3. Premier, Robert. “Phytochemicals in Food”. Blackwell, 2010.
4. Johnson, Ian and Gary Williams. “Phytochemical Functional Foods”. CRC Press, 2003.

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	1	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	2
Avg.	**2**	**1.16**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT6E09 LIVESTOCK AND MARINE TECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**: 60**Total**:100**

End Semester Exam:3 Hour

COURSE OBJECTIVES:

The goal of this course is for students:

- To define meat composition, structure, chemistry and microbial safety of meat.
- To outline the various methods involved in the slaughtering and carcass processing of meat.
- To summarize the variety of meat products, equipment employed and safety of meat processing plant.
- To explain the overall processing of poultry meat and their products.
- To infer the processing of different marine based products.

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Explain the chemical composition, structure, color, flavor, and microbial safety of meat.
- Demonstrate the various technological ideas in preparation of various types of meat products and design of equipment used for processing meat.
- Infer the HACCP and GMP of meat processing.
- Describe the processing of poultry meat, meat products and egg products.
- Interpret the production, processing, spoilage, preservation and storage of marine products.

UNIT I - CHEMISTRY AND MICROBIOLOGY OF MEAT 9

Meat composition from different sources; Definitions and measurements, Explanation of muscle structure and compositions and its modifiers, White and Red Meat, Description of animal fat and its modifiers, description of bone and its modifiers; Post mortem muscle chemistry, Meat color, flavors of meat products, meat microbiology and safety. - Preslaughter operations and slaughtering operations for animals – Kosher/ Halal - Evaluation of animal carcasses - properties and shelf life of meat- Mechanical deboning - grading and aging - Eating and cooking quality of meat - Meat tenderization.

UNIT – II PRESERVATION OF MEAT 9

Preservation of meat by chilling - freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives - Preparation, preservation and equipment for manufacture of smoked meat and its quality evaluation- Preparation, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation - Preparation, preservation and equipment for manufacture of meat sausages and their quality evaluation - Abattoir design and layout.

UNIT III - MEAT PRODUCTS 9

Canned meat, Frozen meat, Cooked and Refrigerated meat, Dried and preserved meat, cured meat, prepared meat products, Production methods for Intermediate moisture and dried meat products, Different kinds of sausages – Equipment used for all the process operations; Safety standards in meat, poultry and egg industry: Good manufacturing practice (GMP)/ HACCP /ISO/MFPO/FSSAI.

UNIT IV – PROCESSING AND PRESERVATION OF POULTRY PRODUCTS AND EGGS 9

Poultry industry in India, microbiology of poultry meat, spoilage factors; Poultry meat processing operations in detail along with equipment used. Packaging of poultry products, refrigerated storage of poultry meat, – Egg- Structure of Egg - Chemical composition of egg- Nutritive value and Functional Properties of Egg - Preservation of Eggs - Shell Egg Preservation - Liquid Egg Preservation - Microbial Spoilage of Eggs - Evaluation of Egg Quality – Interior and Exterior quality - Grading of Eggs, egg products, Whole egg powder, Egg yolk products.

UNIT V - FISH AND OTHER MARINE PRODUCTS PROCESSING 9

Commercially important marine products from India, Basic biochemistry, spoilage factors of fish, field refrigeration and icing practice, merits and demerits, Use of dry ice and liquid nitrogen as preservation elements, use of Refrigerated Sea Water (RSW) for preservation, Changes during storage in RSW and CSW; Freeze preservation; freezing of prawn and shrimp, weighing, filling and glazing, Individual quick freezing-relative merits and demerits, canning operations, Salting and drying of fish, pickling and preparation of fish protein concentrate and fish oil. - HACCP - implementation of HACCP in fish and marine processing - Quality control and standards for fish, prawn and other sea foods - EU hygienic regulations in fish and marine industry.

TOTAL:45

SUGGESTED READINGS:

1. Hui, Y.H., Nip, W.K., Rogers, R.W. Meat Science and Applications". Marcel Dekker Inc. New York, 1st Edition, 2001.
2. Sabel Guerrero and Hui YH. Handbook of Poultry Science Technology Volume-1. Wiley Publishing. 1st Edition, 2010.
3. Sabel Guerrero and Hui YH. Handbook of Poultry Science Technology Volume-2. Wiley Publishing. 1st Edition, 2010.
4. Mead, G. C.2004. Poultry meat processing and quality. CRC Press. Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, England.
5. Balachandran, K. K. Post-Harvest Technology of Fish and Fish Products. Daya Publishing House, New Delhi, 2002.
6. Hall, G.M. 1997. Fish Processing Technology, 2nd Ed. Chapman & Hall, London, UK.
7. Chichester, C.O. and H.D. Graham. 1973. Microbial safety of Fishery products. Academic Press, New York

CO -PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	2
Avg.	**1.83**	**1.4**	-	-	-	-	-	-	-	-	-	-	**2**	**2**

24BTFT6E10 **NOVEL FOOD PROCESSING TECHNOLOGIES** **3H-3C**

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives:

The goal of this course is for students:

- To understand the concepts of novel food processing techniques.
- To explain the principle and working behind the novel processing techniques.
- To understand the application of such processes in food industry.
- To outline the concepts involved in food printing and meat analogues.
- To explain the major role of e-nose and e-tongue in sensory evaluation.

Course outcomes:

Upon completion of this course, students will be able to:

- Discuss the concepts and application of pulsed light and UV radiation technology.
- Discuss the concepts and application of ultrasound and high-pressure processing.
- Interpret the concept, equipment involved and application of food irradiation and cold plasma.
- Illustrate the overall concepts involved in microwave and ohmic heating.
- Summarize the role of food printing in production of designer foods.

UNIT I - PULSE LIGHT AND UV TECHNIQUE **9**

High-intensity pulse technique- Processing systems- design of static chambers - Integration of Multiple Technologies - generation of different voltage waveforms-oscillation magnetic fields for food processing - mechanisms of inactivation of microorganisms in food preservation – UV treatment – principle involved – mechanism of inactivation – Pulsed electric field – principles of microbial inactivation – Generation of PEF – application in food processing, Emerging Applications and Future Trends

UNIT II - ULTRASOUND & HIGH-PRESSURE PROCESSING **9**

Ultra sound – introduction – Ultrasound-Assisted Extraction- types of pressure waves – mechanism of microbial inactivation - Sonochemistry and Sono processing– application in food processing – High-pressure processing – Principles –concepts – basic laws related to HPP - processing of food using HPP - effect on microorganisms – Application in industry.

UNIT III - FOOD IRRADIATION AND COLD PLASMA TECHNOLOGY **9**

Food irradiation – principle of irradiation – radioactive substances – types of irradiations –construction and working of equipment – effect of irradiation on the nutritional and biochemical changes – application in food sectors– cold plasma technology- Microbial Decontamination and Food Preservation- Industrial Applications and Challenges - electron beam radiation - application in food processing.

UNIT IV - MICROWAVE AND OHMIC HEATING **9**

Microwave properties – principle – design aspects of microwave equipment – interaction with food materials, Modeling and Simulation of Microwave Heating-material properties - Microwave-Assisted Drying and Dehydration - application of microwave in food processing – merits and demerits – recent advancement in microwave processing - inactivation of microorganisms and enzymes – electrical resistance heating of food - ohmic heating - Ohmic Heating in Continuous Processing - treatment of products - Elsteril process -influence on microorganisms - food ingredients.

UNIT V - NOVEL FOODS AND BIOSENSORS **9**

Definition-Designer foods and their types -3D and 4D food printing-meat analogues and plant-based products - free from foods and Allergen-Free Products – Biosensors types- application of biosensors to food industry

requirements- Development of Biosensors – e- nose and e- tongue and their applications in sensory evaluation of foods.

TOTAL: 45

SUGGESTED READINGS:

1. Nonthermal Preservation of Foods. Gustavo V. Barbosa-Canovas, Usha R. Pothakamury, Enrique Palou and Barry G. Swanson. Published by Marcel Dekker, Inc., 270, Madison Avenue, New Yorkm 10016, 1998.
2. Biosensors for food analysis, A O Scott, The Tetley Group Limited, UK, Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, CB21 6AH, England, 2008.
3. Trends in Food Engineering, Jorge E. Lozano, Cristina Anon, Efren Parada- Arias, Gustavo V. Barbosa Canovas, Contributor Jorge E. Lozano, Published byCRC Press, 2000.
4. Gould G.W., "New Methods of Food Preservation", Aspen Publishers, Great Britain, ISBN No. 0834213419, 1999.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	2	-	2	2	2
CO2	-	-	-	-	-	-	-	-	-	1	1	1	2	2
CO3	-	-	2	-	3	-	-	-	-	1	2	-	2	2
CO4	1	-	-	2	3	-	-	-	-	1	2	1	2	2
CO5	1	1	-	-	-	-	-	-	-	2	-	-	1	2
Avg.	**1.3**	**1**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**1.4**	**1.6**	**1.3**	**1.8**	**2**

PROFESSIONAL ELECTIVE V

B. Tech. – Food Technology **2024 - 2025**

Semester-VII

24BTFT7E01 **EXTRUSION TECHNOLOGY** **3H-3C**

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To explain the basics principles, types and uses of extrusion cooking.
- To understand the importance of pre-conditioning and de-volatilization of raw materials.
- To discuss the constructional, operational and working of single and twin-screw extruders.
- To summarize the nutritional, functional and sensory properties of extruded food products.
- To discuss the application of extrusion technology in the production and development of new product.

Course outcomes:

Upon completion of this course, students will be able to:

- Identify the principles, types and uses of extrusion cooking.
- Illustrate the importance of pre-conditioning and de-volatilization of raw materials.
- Infer the constructional, operational and working of single and twin-screw extruders.
- Summarize the nutritional, functional and sensory properties of extruded food products.

UNIT I – INTRODUCTION **9**

Extrusion: definition, introduction to extruders and their principles, types of extruders. Extruders in the food industry: Historical evolution and application of extruders in the food industry. Physical and chemical changes during extrusion cooking.

UNIT II – PRECONDITIONING **9**

Pre-conditioning of raw materials used in extrusion process, Pre-conditioning operations and benefits of pre-conditioning and devolatilization. Interpreted-flight expanders - extruders, dry extruders- dry extruders in extrusion – pre-extrusion processes – practical considerations in extrusion processing – addition and subtraction of materials, shaping and forming at the die. properties of Food materials and its significance in equipment design -processing and handling.

UNIT III - SINGLE AND TWIN SCREW EXTRUDER **9**

Single screw extruder: Constructional and operational characteristics, principle of working, net flow, factors affecting extrusion process, co-kneaders. Twin screw extruder: counter rotating and co-rotating twin screw extruder. Process characteristics of the twin-screw extruder: feeding, screw design, screw speed, screw configurations, die design. Barrel temperature and heat transfer, adiabatic operation, heat transfer operations and energy balances. Problems associated with twin screw extruder. Low pressure and high-pressure extrusion.

UNIT IV - CHARACTERISTICS OF EXTRUDED PRODUCTS **9**

Physicochemical, rheological, textural and nutritional properties of extruded products- Sensory characteristics and nutritional value. Chemical and nutritional changes in food during extrusion -. Storage of extruded products- Practical considerations in extrusion processing: pre-extrusion processes, cooker extruder profiling. Addition and subtraction of materials, shaping and forming at the die, post extrusion processes

UNIT V – APPLICATION **9**

Cold extrusion; extrusion cooking, new extrusion technology for confectionery product; Applications in different food commodities- Breakfast cereal products. Breakfast cereals: introduction. Traditional and extrusion methods, classification of breakfast cereals – flaked cereals, oven puffed cereals, gun puffed cereals, shredded products. Texturized vegetable protein: Definition, processing techniques, and foods. Snack food extrusion: Direct expanded (DX) and third generation (3G) Snacks: types, available brands, co- extruded snacks and indirect-expanded products

TOTAL: 45

SUGGESTED READINGS::

1. Richardson P., Thermal Technologies in Food Processing, Wood head Publishers, Cambridge, CRC Press, 2001.

2. Guy R. Extrusion Cooking, Technologies and Applications. Wood head Publishing Limited, Abington, Cambridge, 2001.

3. Fast R.B. and Caldwell E.F. Breakfast Cereals and How they are made. American Association of Cereal Chemists, St. Paul, Minnesota, 2000.
4. Riaz M.N. Extruders in Food Application. CRC Press, 2000.
5. N.D. Frame. Technology of Extrusion Cooking. Springer, 2012.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	1	2	-	-	-	3	3
CO2	-	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	2	-	2	-	1	-	-	-	2	-	-	-	3	3
CO4	-	-	-	-	-	-	-	1	-	2	-	1	3	2
CO5	-	-	-	-	3	-	-	-	1	1	-	-	3	2
Avg	**1.5**	**-**	**2**	**-**	**2**	**-**	**-**	**1**	**1.6**	**1.5**	**-**	**1**	**3**	**4.3**

Semester-VII

24BTFT7E02 **FOOD ALLERGY AND TOXICOLOGY** **3H-3C**

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To summarize hazards, and toxicity associated with food and their implications for health.
- To explain food related toxicological compounds in different foods.
- To understand the protocols of sampling techniques in food toxicology measurements.
- To explain the knowledge on level of processing of food to destroy allergens / toxins.
- To outline an awareness to choose food with highly safe.

Course Outcomes:

Upon completion of this course, students will be able to:

- Summarize the different types of allergens and Natural toxins associated with food.
- Discuss about food toxicology and its hazards.
- Illustrate food sensitivity and allergy.
- Summarize food toxin in food samples.
- Interpret the toxins formed during processing and controlling.

UNIT I – INTRODUCTION **9**

Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humeraland cell media resources. Food Allergens and mechanism of allergic resources.

UNIT II - FOOD ALLERGY AND SENSITIVITY **9**

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, IgE and non-IgE based diseases, lactose intolerance, gluten intolerance, and asthma, primary, secondary and tertiary prevention of allergic disease and the evidence for food desensitization.

UNIT III - PRINCIPLES OF TOXICOLOGY **9**

Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Labelling on processed foods. Biological factors that influence toxicity, toxin absorption in the G.I. track, Industrial microflora, blood, brain barrier, storage and excretion of toxins.

UNIT IV - DETERMINATION OF TOXICANTS IN FOOD SAMPLING **9**

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Pesticidal residues – Permitted limits, Toxicology on public health Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioral effect, immunotoxicity.

UNIT V - TOXICANTS FORMED DURING FOOD PROCESSING **9**

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavor enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens – Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action.

TOTAL: 45

SUGGESTED READINGS:

1. Helferich, William and Carl K.Winter, Food Toxicology, CRC Press, 2001.
2. Alluwalia and Vikas, Food Hygiene and Toxicology, Paragon International Publishers, 2007.
3. Shibamoto, Taka yuki and Leonard F.Bjeldanzes, Introduction to Food Toxicology, 2nd Edition, Academic Press, 2009.
4. Maleki, Soheila J. A.Wesley Burks, and Ricki M.Helm, Food Allergy, ASM Press, 2006.
5. Cliver, Dean O. and Hans P.Riemann, Food Borne Diseases, 2nd Edition, Academic Press/Elsevier, 2002.
6. Riemann, Hans P. and Dean O. Cliver, Food Borne Infections and Intoxications, 3rd Edition, Academic Press/Elsevier, 2006.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	2	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO5	-	-	-	-	-	-	-	-	-	-	-	-	2	2
Avg	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

24BTFT7E03 TOTAL QUALITY MANAGEMENT 3H-3C

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To understand total quality management and appreciate its importance in today's business environment.
- To summarize required diagnostic skills and use various quality tools.
- To relate the concepts of Quality Management System in the industries.
- To understand the various principles, practices of TQM to achieve quality.
- To understand the TQM tools for continuous process improvement.

Course Outcomes:

Upon completion of this course, students will be able to:

- Apply the TQM concepts for improving the quality of products and services.
- Use tools and techniques of TQM for continuous improvement in quality.
- Summarize Quality Management System.
- Infer the principles, practices and statistical techniques.

UNIT I – INTRODUCTION **9**

Introduction - Need for quality - Vision, mission and policy statements of quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II - TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, 8D methodology - Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III - TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Requirements of reliability, Failure rate, Stages, Types, Process and Documentation.

UNIT IV - TQM TOOLS & TECHNIQUES II **9**

Quality circles – House of quality – Building of HOQ- Quality Function Deployment (QFD) – Taguchi quality loss function – TPM - Concepts, improvement needs – Performance measures - BPR.

UNIT V - QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, guideline for performance improvement - Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL: 45

SUGGESTED READINGS:

1. Besterfiled, Dale H. et al., "Total Quality Management", 4thEdition, Pearson Education Asia, 2006.
2. Evans, James R. and William M. Lindsay, "The Management and Control of Quality". 6th Edition South-Western (Thomson Learning), 2005.
4. Suganthi, L and Anand Samuel, "Total Quality Management", PHI, 2006.
5. Janakiraman, B and Gopal, R.K, "Total Quality Management – Text and Cases". PHI, 2006.
6. Poornima M. Charantimath., Total quality management, Pearson Education, 2ND Edition, 2011.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	-	3	-	2	-	-	-	-	3	-	-	-	3	3
CO2	-	-	-	-	-	3	-	-	3	2	3	-	3	3
CO3	3	3	-	3	-	2	-	-	-	-	-	-	3	3
CO4	-	3	-	3	-	-	-	2	-	2	-	3	3	3
CO5	3	3	-	3	-	3	-	1	3	3	3	-	3	3
Avg.	**3**	**3**	**-**	**2.75**	**-**	**2.6**	**-**	**1.5**	**3**	**2.3**	**2**	**3**	**3**	**3**

Semester-VII

24BTFT7E04 **CRYOGENIC ENGINEERING** **3H-3C**

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To apply the concept of cryogenics and its applications.
- To understand various cycles of cryogenics.
- To illustrate the applications of cryogenic refrigerators in different food sectors.
- To demonstrate the handling and instrumentation of cryogenic fluids.
- To explain the measuring devices involved in different cryogenic temperatures.

Course Outcomes:

Upon completion of this course, students will be able to:

- Explain cryogenics, their applications and the production of low temperatures.
- Describe various cryogenic liquefaction processes and cryogenic gas purification processes.
- Illustrate thermophysical, transport properties and medical application of cryogenic fluids.
- Discuss cold exchange in cryogenic fluids and design concepts of cryogenic propulsions.
- Discover the measurement devices and material properties at cryogenic temperatures.

UNIT I- CRYOGENICS **9**

Cryogenics – Introduction and history. Applications – space and aerospace industry, cryobiology and superconductivity. Thermodynamic analysis of low temperature processes refrigeration and production of low temperatures.

UNIT II- LIQUEFACTION PROCESSES **9**

Cryogenic liquefaction processes – Liquefaction process of Nitrogen, Oxygen, Argon, Methane, Natural gas, Neon, Hydrogen and Helium. Separation processes for cryogens (Air, Hydrogen and Helium). Non- Cryogenic separation processes for Air and Helium. Cryogenic gas purification processes.

UNIT III- PROPERTIES OF CRYOGENIC FLUIDS **9**

Thermophysical properties of cryogenic fluids – VLE data on mixtures of cryogenic liquids. Prediction of thermodynamic properties – Transport properties of cryogenic fluids- Unique properties of noble gases and Hydrogen isotopes – selection of proper cryogenic fluid for freezing of foods and medical application.

UNIT IV- COLD AND HEAT EXCHANGE IN CRYOGENIC FLUIDS **9**

Cold exchange in cryogenic fluids – Introduction, heat exchanger configurations, Heat exchanger design analysis, cryogenic regeneration, thermal insulations for cryogenic systems. Cryogenic propellants for rocket propulsion – Introduction, challenge, performance analysis, selection of propellants and design concepts of cryogenic propulsions.

UNIT V- MEASUREMENT AND STORAGE DEVICES **9**

Measurement devices at cryogenic temperatures – Temperature, sub-atmospheric pressure and vacuum, flow rates and liquid level. Storage and transportation of cryogenic fluids. Material properties at cryogenic temperatures.

TOTAL: 45

SUGGESTED READINGS:

1. Harold Weinstock, 1970. “Cryogenic Technology”, Boston Technical Publications.
2. Boris V.Kuznetsov, 1981. “Theory and design of Cryogenic system”. MIR Publishers, 1981.
3. C.Rose Innes, 1964. “Low Temperature Techniques” , English University Press.
4. Mamata Mukhopathay. “Fundamentals of Cryogenic Engineering”.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	-	-	-	2	2
CO2	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO3	1	-	-	2	-	-	-	-	-	-	1	-	2	2
CO4	2	-	2	-	-	-	-	-	2	-	-	-	2	2
CO5	-	2	-	2	-	-	-	-	-	-	3	-	2	2
Avg.	**1.3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**2**	**2**

Semester-VII

24BTFT7E05 PROCESS INSTRUMENTATION AND CONTROL IN FOOD PROCESSING 3H-3C

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To discuss in deatil the concepts of process instrumentation.
- To compare the knowledge of different process instruments.
- To explain several measurement techniques used in food processing.
- To summarize the types of controllers and indicators used in food processing.
- To interpret computer-based monitoring and control in food processing.

Course Outcomes:

Upon completion of this course, students will be able to:

- Explain the process instrumentation and control in food processing industries.
- Compare various measuring and controlling devices in food processing.
- Illustrate several measurements in food processing.
- Interpret various controllers and indicators used in food processing.
- Discuss about computer-based monitoring and control in food processing.

UNIT I- INTRODUCTION 9

Introduction to food processing industries- canned and bottled fruits and vegetables, beer, ciders, soft drinks, sugar, jams, jellies and beverages. Introduction process instrumentation and control- Industrial processes, process parameters, batch and continuous processes, instrumentation and control and selection of controllers.

UNIT II- MEASURING AND CONTROLLING DEVICES 9

Measuring and controlling devices in food processing- role. Classification and types of transducers. Selection of transducers- Actuating and controlling devices.

UNIT III- MEASUREMENTS IN FOOD PROCESSING 9

Measurements in food processing- moisture, humidity, turbidity, colour, flow metering, viscosity, brix, pH, food enzymes, flavour measurement, texture, particle size and food constituents' analysis.

UNIT IV- CONTROLLERS AND INDICATORS 9

Temperature control in food dehydration and drying- Electronic controllers- flow ratio control, atmosphere control- timers and indicators- Food sorting and grading control- Discrete, Adaptive and Intelligent controllers.

UNIT V- COMPUTER BASED MONITORING 9

Computer – Based Monitoring and Control – Introduction and Importance of monitoring and control – Hardware features of a data acquisition and control – Remote data acquisition – signal interfacing – Examples of computer-based measurement and control in food processing.

TOTAL: 45

SUGGESTED READINGS::

1. Manabendra Bhuyan. 2007. "Measurements and Control in Food Processing" CRC, Taylor and Francis.
2. E Kress-Rogers and C J B Brimelow. 2001. "Instrumentation and Sensors for the Food Industry" 2nd Edition Woodhead Publishing.
3. William C. Dunn. 2006. "Introduction to Instrumentation, Sensors and Process Control", Artech House Inc.
4. Eckman.D.P, 1984. "Industrial Instrumentation", Wiley Eastern Ltd.
5. James E. Bailey and David F. Ollis, 1986. "Biochemical Engineering Fundamentals", McGraw-Hill Book Company, 2nd ed.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	2	-	-	2	2
CO2	2	-	1	-	-	-	-	-	2	2	-	-	2	2
CO3	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	2	-	-	-	-	-	-	-	-	2	-	2	2
CO5	1	2	-	-	-	-	-	-	-	2	-	-	2	2
Avg.	**1.6**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**-**	**2**	**2**

PROFESSIONAL ELECTIVE VI
SEMESTER VII

B. Tech. – Food Technology **2024 - 2025**

Semester-VII

24BTFT7E06 **FOOD BIOTECHNOLOGY** **3H-3C**

Instruction Hours/week: L:3T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

The goal of this course is for students:

- To understand the role of biotechnology in various food processing applications.
- To explain production of flavors, colors, protein rich foods and preservatives using biotechnological methodologies.
- To discuss the various downstream processing techniques.
- To explain the molecular diagnostic tools and methods applied to detect pathogens, pesticides in the raw materials and food.
- To summarize the classification of biosensors and discuss the social, ethical and safety aspects of GM foods.

Course Outcomes:

Upon completion of this course, students will be able to:

- Identify the biotechnological applications in the various food processing sectors.
- Illustrate the production of various biotechnologically derived food products.
- Demonstrate the importance of downstream processing techniques in biotechnology and food processing.
- Infer the different types of molecular diagnostic tools, assays and methods in the detection of pathogens, pesticides and toxins in the raw materials and food.
- Summarize the classification and applications of biosensors and discuss the ethical, social, and safety aspects of production and consumption of GM foods.

UNIT I - INTRODUCTION TO BIOTECHNOLOGY **9**

Introduction - Fundamental Principles of Biotechnology. Biotechnology relating to the food industry – Applications of Biotechnology in Crop Improvement -application of genetics to food production – Genetic Engineering Techniques- Recombinant DNA Techniques and Cloning Strategies - Genetically modified organisms. Regulatory and Social aspects of biotechnology of foods. Biotechnological approaches to improve nutritional qualities and shelf life of fruits and vegetables, livestock, poultry and fish products.

UNIT II - PRODUCTION OF PRIMARY AND SECONDARY METABOLITES **9**

Fermentation Processes - Enzymatic Conversion Processes - Production of commercially important metabolites – citric acid, lactic acid, acidic acid, gluconic acid, amino acids, Flavoring agents, coloring agents and vitamins. Biotechnological Tools for Metabolic Engineering - Stages in industrial production of microbial metabolites - New protein foods - SCP; mushroom; algal proteins.

UNIT III – FOOD BIOTECHNOLOGY **9**

Principle of Downstream Processing – stages in downstream processing – solid-liquid separation – flotation – flocculation – filtration – types – centrifugation- cell disruption – concentration – evaporation liquid-liquid extraction – Clarification and Purification Processes membrane filtration precipitation – adsorption – purification by chromatography - Biopreservation Methods - Solid-Liquid Separation in Biorefinery Processes.

UNIT IV - MOLECULAR DIAGNOSTIC TOOLS **9**

Rapid detection techniques for food borne pathogens and their toxins; In-vitro evaluation of bacterial toxins by immunological techniques like slide agglutination, tube agglutination, gel diffusion assay - Polymerase Chain Reaction (PCR). The development of novel molecular diagnostic methods for different diseases, including nanotechnology-based diagnostics, and their application in medical clinics. Micro array diagnostic methods. Next-Generation Sequencing (NGS) Technologies, Biosensor Technologies.

UNIT V - BIOSENSORS AND GM FOODS – SOCIAL AND ETHICAL ISSUES **9**

Biosensors: Introduction, classification and application in food industries Potential Impact of Biotechnology on Food Industries, GM foods - Food Security and Equity– legal framework for the production of raw materials or food from genetically modified organisms - Safety aspects and social acceptance - Consumer Choice and Transparency - Ethical issues. GMOs- current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects; Privacy and Data Security.

TOTAL: 45

SUGGESTED READINGS:

1. Bielecki S., Ed., Polak J., J. and Bielecki, Tramper S., Food Biotechnology, Elsevier Science Publishing Company, New Delhi, 2000.
2. Gutierre, Gustavo F., Food Science and Food Biotechnology, CRC Press, New York, 2003.
3. Rita Singh, Food Biotechnology, Global vision publication house, Delhi, 2004.
4. B.D. Singh. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
5. Meenakshi Paul. 2007. Biotechnology and Food Processing Mechanics. Gene- Tech Books, New Delhi.

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	1	-	-	-	-	-	-	1	-	2	2
CO2	-	-	-	2	-	-	-	-	-	-	1	-	2	2
CO3	2	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	-	-	-	-	-	2	-	-	-	-	2	-	2	2
CO5	-	-	-	-	-	2	-	2	-	-	-	-	2	2
Avg.	**2**	**-**	**-**	**1.5**	**-**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**2**	**2**

Semester-VII

24BTFT7E07 SUPPLY CHAIN MANAGEMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives:

The goal of this course is for students:

- To understand the various concepts of food marketing system.
- To explain the different constraints involved in the marketing research.
- To discuss the innovations in food chains, quality and safety standards in the retail management.
- To explain the important key areas relating to supply chain management in food processing industries.
- To understand the overall concepts of globalization and logistics.

Course outcomes:

Upon completion of this course, students will be able to:

- Outline the important concepts and approaches of food marketing system.
- Illustrate the multivariate techniques involved in market research.
- Illustrate the innovations in food chains, quality and safety standards in then retail management.
- Discuss the multiple strategies of supply chain management system in food industries.
- Infer the important concepts of globalization and logistics.

UNIT I - INTRODUCTION **9**

Supply chain, logistics, Evolution of logistics concept, Logistical mission and strategic Issues, Logistics in India, Importance of logistics management, Strategic logistics planning process, Operational objectives, Components of logistics management, Functions of logistics management, Integrated logistics system, Agribusiness Environment & Policy – Agricultural Production Management - Business Ethics & Global Business Environment Sources of cereals and legumes, fruits and vegetables,

milk and milk products, meat and meat products, marine products in India, its importance in national economy. Supply chain business opportunities, Market, Assessment, Technical Analysis, and Financial Analysis, Forecasting, Facilities and Aggregate Planning.

UNIT II - LOGISTICS, SUPPLY AND DISTRIBUTION **9**

Principles of Logistics Production and sale of food products at global level, and the life cycle of the product is short. The right and wrong of logistics are influencing the success or failure of corporate management. Learning CSF (critical success factor) of Logistics through the study of successful food industry. Quantitative Management Analysis Business logistics - The supply chain Importance of Logistics/Supply Chain (SC) Costs analysis Logistics customer service Supply and distribution lines lengthening with greater complexity Quick customized response Logistics, Food supply chain management from farm to fork, Elements of the supply chain, Transport and storage, Social and environmental concerns associated with the food supply chain.

UNIT III - MANAGEMENT CHALLENGES IN COLD CHAIN **9**

Post-Harvest Food Management - Supply Chain Management, The major cold chain technologies Dry ice, Gel packs, Eutectic plates, Liquid nitrogen, Quilts, Reefers Refrigerated Containers, Managerial Economics - Fresh Food and Supply Chain Management Challenges, Life Cycle Assessment Studies of Food Product, Retail logistics changes and challenges Retail Logistics and supply chain Transformation The Cold Chain and its Logistics, From a geographical perspective, the cold chain has the following impacts The major cold chain technologies, Value Chain, Global Value Chain.

UNIT IV - FOOD SAFETY MANAGEMENT **9**

Food safety - The risk management, internationally agreed definition, framework and process of risk management. Risk analysis, risk assessment, risk management and risk communication. Food Safety and Standards - Agricultural Marketing - Production and Operations Management Commodity Markets and Futures Trading – Retail Management - Management Concepts - Business Communication, Traceability system in order to nurture a diverse viewpoint capable of understanding and analyzing traceability, Recalls.

UNIT V - QUALITY CONTROL AND MANAGEMENT REGULATION **9**

Organizational Behavior - Human Resource Management - Financial Management of Agribusiness Managerial Accounting and Control, Quality Management in Agribusiness - Agribusiness and Society International food Legislation & Standards Concepts and trends in food legislation. International and federal standards Codex Alimentarius, ISO series, food safety in USA. Legislation in Europe EU, Enforcers of Food Laws Approval Process for Food Additives Nutritional Labeling. Distribution - Purpose of Quality Control Raw Material Safety,

Product Value, Accident Prevention QC Issues in Food System Raw Material Sourcing, Manufacturer, Distributer, Retailer. Safety/Quality/Price required by consumers, Consumer Needs The practices of QC in wholesalers the practices of QC in retailers.

TOTAL: 45

SUGGESTED READINGS:

1. Supply Chain Management Theories & Practices, R. P. Mohanty, S. G. Deshmukh, Dream tech Press, 2005.
2. Total Supply Chain Management by Ron Basu, J. Nevan Wright, 1st edition 2008, Elsevier.
3. Supply Chain Management, Chopra and peter, Pearson, 5th edition, 2013.
4. Logistics Engineering and Management, Blanchard, pearson, 6th edition 2004.

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO2	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO3	1	2	1	3	-	-	-	2	-	-	-	-	2	2
CO4	1	2	1	3	-	-	-	2	-	-	2	-	2	2
CO5	1	2	1	3	-	-	-	2	-	2	-	-	2	2
Avg.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**2**		**2**	**2**

Semester-VII

24BTFT7E08 DRYING TECHNOLOGY FOR FOODS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives:

The goal of this course is for students:

- To understand the basic theory of drying and its significance in food systems.
- To summarize the importance of drying as a method of food processing.
- To compare drying mechanism of food products.
- To interpret moisture content measurement and thermal properties related to drying judge quality of dried product.
- To infer the relative advantages / disadvantages of each method of drying.

Course outcomes:

Upon completion of this course, students will be able to:

- Outline the novel and hybrid drying technology.
- Illustrate the suitable dryer meeting requirements.
- Demonstrate functional design of dryers.
- Discuss the importance of drying as a method of food processing.
- Infer the principle and working of various types of dryers.

UNIT I – PRINCIPLES OF DRYING 9

Principles of drying – Fundamentals of air-water mixtures – Theories of drying – Factors affecting drying - Psychometric chart – Problems based on psychometry – Drying curves – constant and falling rate period - Heat and mass transfer in dryers– Dryers in food processing industry – Advancement in drying technology.

UNIT II – TYPES OF DRYES 9

Drum driers - Types of Drum Dryers - Principles of Operation of the Drum Dryer – Steam Consumption – Types of Feeding. Foam Mat Drying- Principles- Equipments- Factors affecting Foam mat drying. Rotary Dryer. Osmotic dehydration – Principles – Osmotic agents - Factors affecting osmosis- Equipment used.

UNIT III - SPRAY DRYING OF FOODS 9

Fundamentals –Nozzles, Rotary atomizers and two fluid feeds- Interaction of droplets with air- Drying of droplets with soluble and insoluble solids – factors affecting spray drying- glass transition temperature - Microstructure of spray dried products – properties of spray dried powders – Packing and storage of spray dried powder - Reconstitution – Foam spray drying – Applications in the Food industry.

UNIT IV – FLUIDIZED BED, PNEUMATIC AND FREEZE DRYING 9

Fluidized bed drying – Introduction – Effect of operating parameters – conventional and modified fluidized bed dryer – Effects of processing parameters in fluidized bed dryer - Fundamentals of freeze drying – Freezing – Primary drying stage – secondary drying stage -Changes during freeze drying – Condensation, defrosting – Industrial freeze driers. Pneumatic / Flash dryers - Basic Operation Principle and Applications of Flash Dryers - Design of Flash Dryers - Materials Dried in Flash Dryers.

UNIT V - NOVEL DRYING METHODS 9

Special drying techniques - contact-sorption drying - drying on inert particles –pulse combustion drying - drying with induction heating - novel dryers - Airless drying, drying in mobilized beds, vacuum jet drying, Refractance window drying. Dryer performance indices. Pulsed fluid bed drying: Principle and layout - dehydration of foods using cyclic pressure.

TOTAL: 45

SUGGESTED READINGS:

1. Paul Singh, R and Dennis R. Heldman. Introduction to Food Engineering Academic Press, 2001
2. Loasecke H.W.V., Drying and dehydration of Foods, Agrobios, Jodhpur, 2001
3. Kudra, T and Majumdar, A.S., Advanced Drying Technologies, Marcel Dekker Inc., New York, 2002.
4. Loeseck ,H. W. V, “Drying & Dehydration of Foods”, Published by Agrobios, 2005.
5. Arun S. Mujumdar, “Handbook of Industrial Drying”, CHIPS, 3rd Edition, 2006.
6. Hui Y. H,:”Food Drying Science and Technology, Microbiology, Chemistry, Application”, CHIPS, 2008

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO2	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO3	1	2	1	3	-	-	-	2	-	-	-	-	2	2
CO4	1	2	1	3	-	-	-	2	-	-	2	-	2	2
CO5	1	2	1	3	-	-	-	2	-	2	-	-	2	2
Avg.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**2**		**2**	**2**

24BTFT7E09 FOOD FERMENTATION TECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course objectives:

The goal of this course is for students:

- To understand the benefits, nutritive value, and microorganisms associated with the fermentation processes.
- To demonstrate the preparation and culture maintenance of bacteria, yeast and mold.
- To explain the production of different types of fermented products.
- To discuss the production processes of fermented drinks and fermented vegetables.
- To understand the production of yeast, enzymes, proteins, fats and HFCS.

Course outcomes:

Upon completion of this course, students will be able to:

- Explain the overall benefits, nutritive value, and microorganisms involved in the fermentation processes.
- Describe the preparation of the cultures of bacteria, yeast and mold for fermentation processes.
- Infer the processes involved in the production of fermented drinks.
- Illustrate the overall steps employed in the production of fermented vegetables.
- Outline the different set of processes followed in the production of yeast, enzymes, proteins, fats and HFCS.

UNIT I - INTRODUCTION TO FERMENTATION **9**

Definition - benefit of fermentation - design of fermenters - nutritive value of fermented foods - microbial changes in fermented foods – selection and importance of microorganism - proteolytic, liploytic and fermentative bacteria.

UNIT II - CULTURE MAINTENANCE **9**

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Probiotics - Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

UNIT III - FERMENTED PRODUCTS **9**

Fermented Vegetables (Pickles) Fermented meat and fish products, Oriental fermented foods - Fermented Dairy Products: Cheeses, Curd and Yoghurt. Spoilages and defects of fermented products and their control.

UNIT IV - FERMENTED DRINKS **9**

Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg. Rum, gin, whisky), Fermented Dairy drinks: Butter milk and the fermented milks.

UNIT V - MICROBIAL PROTEINS **9**

Microbial proteins, Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases, protease, lipases, pectinases, rennin) - production and their applications in food fermentation. HFCS (High Fructose Corn Syrup). Health benefits of microbial protein.

TOTAL: 45

SUGGESTED READINGS:

1. K.H. Steinkrus, Handbook of Indigenous Fermented Foods, Marcel Dekker publisher,1983.
2. Sukumar De, Outlines of Dairy Technology, Oxford University Press N Delhi , 1991.
3. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009
4. L.E.Casida, Industrial Microbiology, New Age International(p) Ltd N Delhi, 2007
5. W.C.frazier and D.C.Westhoff, Food Microbiology, Tata McGraw Hill publisher, 3rd edition, 2008

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO2	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO3	1	2	1	3	-	-	-	2	-	-	-	-	2	2
CO4	1	2	1	3	-	-	-	2	-	-	2	-	2	2
CO5	1	2	1	3	-	-	-	2	-	2	-	-	2	2
Avg.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**2**	**2**

Semester-VII

24BTFT7E10 RHEOLOGY AND TEXTURE ANALYSIS OF FOODS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives:

The goal of this course is for students:

- To illustrate the importance of rheology in the food industry.
- To explain the mechanical and sensory characteristics of foods.
- To understand the significance of food texture.
- To summarize the instrumental measurement of rheology.
- To understand the significance of emulsifiers in foods.

Course outcomes:

Upon completion of this course, students will be able to:

- Illustrate the importance of rheology in the food industry.
- Explain the mechanical and sensory characteristics of foods.
- Discuss the significance of food texture.
- Summarize the instrumental measurement on rheology.
- Infer the significance of emulsifiers in foods.

UNIT I – PROPERTIES OF FOOD **9**

Properties of foods. Models to visualize behavior of foods. Basic and applied rheological considerations and their application to foods.

UNIT II- STRUCTURE AND SENSORY ANALYSIS **9**

Food Microstructure. Scanning and Transmission Electron microscopy. Determining mechanical and sensory characteristics of foods.

UNIT III – FOOD TEXTURE **9**

Requirement of test systems for measuring food texture. Types of texture Instrument and their operating mechanisms, Calibration, Performance of test and measurements of test Parameters. Interpretation of test results.

UNIT IV – INSTRUMENTAL ANALYSIS **9**

Dough, Pasta, Baked products and fat products; and their instrumental Measurements.

UNIT V – FOOD EMULSIONS **9**

Textural characteristics of food emulsions, Functions of emulsifiers in relation to food texture, Sensory measurement of food texture.

TOTAL: 45

SUGGESTED READINGS:

1. J.M. de Man Rheology and Texture in Food quality
2. Berk, Zeki. “Food Process Engineering and Technology”. Elsevier, 2009.

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO2	1	2	1	3	-	-	-	2	2	2	-	-	2	2
CO3	1	2	1	3	-	-	-	2	-	-	-	-	2	2
CO4	1	2	1	3	-	-	-	2	-	-	2	-	2	2
CO5	1	2	1	3	-	-	-	2	-	2	-	-	2	2
Avg.	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**2**	**2**

24BTFT7E11 SEA FOOD PROCESSING TECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course objectives:
The goal of this course is for students:

- To understand the benefits, nutritive value, and microorganisms associated with sea food processing.
- To demonstrate the drying and irradiation of sea foods.
- To explain the freezing and cold storage of sea foods.
- To discuss the various packaging techniques in sea food processing.
- To understand the utilization of fishery by products.

Course outcomes:
Upon completion of this course, students will be able to:

- Explain the overall benefits, nutritive value, and microorganisms involved in the fermentation processes.
- Infer the details in preparation and maintenance of the cultures of bacteria, yeast and mold for fermentation processes.
- Demonstrate the processes involved in the production of fermented drinks.
- Illustrate the overall steps employed in the production of fermented vegetables.
- Outline the different set of processes followed in the production of yeast, enzymes, proteins, fats and HFCS.

UNIT I – PRESERVATION AND PROCESSING **9**

Importance of preservation and processing of sea foods criteria for assessing freshness handling of fresh materials – on board handling, chilling methods, phenomena of rigor mortis, spoilage changes – causative factors (other than microbial).

UNIT II – DRYING AND IRRADIATION **9**

Drying and dehydration – conventional and modern methods, relative merits and demerits. Quality changes during drying and storage – functional properties, sensory quality, nutritional value, quality indices, storage life. Salt curing, picking and smoking – methods, merits and demerits – quality changes during processing and storage life – quality standards. Irradiation – source of radiation, methods, merits and demerits, quality changes during processing and storage - quality standards, minimal processing technologies.

UNIT III – FREEZING **9**

Freezing and cold storage – process of freezing, types, quality changes during processing and storage. Canning – procedures, quality changes during processing and storage – quality standards. Role of preservatives in processing.

UNIT IV – PACKING **9**

Packing – a function of packaging, special needs in food packaging, packaging materials, types -1 handling fresh fish, retail packing, wholesale packaging, block frozen packs, IQF, layered and shatter packs, modified atmospheric packaging, vacuum packaging, boil and bag type, cans and containers, air freight packaging, packaging standards for wet shipment and irradiated foods. Food contact substances – limits. Labeling – information to be included, labeling regulation.

UNIT V – FISHERY BY – PRODUCTS **9**

Fishery by – products of commerce – surimi, fish protein concentrate, meal and oil production, hydrolysis of fish protein. Cannery waste processing of fish stick water. Animal feeds, fish silage, fish liver preservation, fish gelatin, fish glue, leather from fish skin, chitin and chitosan, pearl essence, use of shells, fertilizer from fishery by products.

SUGGESTED READINGS::

1. Kreuzer R., 1974. Fishery Products, FAO Fishing News (Books) Ltd., England.
2. Anon, 1979. Handling, Processing and Marketing of Tropical fish, Tropical Products Institute, London.
3. Miller, M.D., 1990. Ciguatera Seafood Toxins, CRC Press.
4. Sikorski, Z.E., 1990. Seafood: Resource, Nutritional Composition, Preservation, CRC Press.

CO PO Mapping

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	1	1	1	2	2	2	-	-	2	2
CO2	1	2	1	3	1	1	1	2	2	2	-	-	2	2
CO3	1	2	1	3	1	1	1	2	-	-	-	-	2	2
CO4	1	2	1	3	1	1	1	2	-	-	2	-	2	2
CO5	1	2	1	3	1	1	1	2	-	2	-	-	2	2
Avg.	**1**	**2**	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**-**	**2**	**2**