

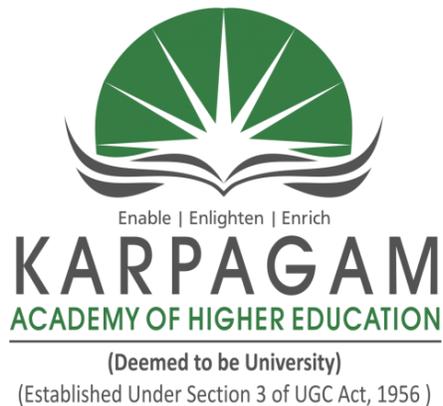
FACULTY OF ENGINEERING

DEGREE OF BACHELOR OF TECHNOLOGY
IN
FOOD TECHNOLOGY

DEPARTMENT OF FOOD TECHNOLOGY

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI
(2025 -2026)



KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act 1956) Coimbatore-641 021, India



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
(B.E/B.Tech.)

IN

FOOD TECHNOLOGY

REGULAR PROGRAMME

REGULATIONS (2025)

CHIOCE BASED CREDIT SYSTEM

Phone: 0422- 6471113 – 5; Fax No: 0422 – 2980022, 2980023

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KARPAGAM ACADEMY OF HIGHER EDUCATION
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Eachanari, Coimbatore-641 021. INDIA

FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY

REGULAR PROGRAMME
REGULATIONS 2025
CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2025 – 2026 and applicable to the candidates admitted to B. E. / B. Tech. programmes. during 2025- 2026 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 SC / ST reserved category) in the above subjects taken together.

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 SC / ST reserved category) in ANY branch of Engineering and Technology are eligible to apply for admission to the third semester of B. E./B. Tech., 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 backgrounds to achieve desired learning outcomes of the programme)

(OR)

B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40%

marks in case of candidates belonging to SC / ST 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.

| S. No. | Programme | Eligibility criteria |
|--------|---|--|
| 1 | B.E Bio Medical Engineering | <p>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.</p> <p style="text-align: center;">OR</p> <p>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 SC / ST reserved category) and passed 10+2 examination with Mathematics as a subject.</p> <p style="text-align: center;">OR</p> <p>Passed D.Voc. Stream in the same or allied sector.</p> <p>(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)</p> |
| 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. Computer Science and Business Systems | |
| 10 | B. Tech. Bio – Technology | |
| 11 | B. Tech. Food Technology | |

1.3 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 5th 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. Programme Equivalence Certificate shall be given by the respective Head of the Department of Karpagam Academy of Higher Education, after verifying the credentials.

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. Computer Science and Business Systems
10. B. Tech. Bio-Technology
11. 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 onwards. 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 and register for the course for every semester within the first week of semester.** Maximum number of students to be registered in each course shall be decided by the HoD in consultation with the Dean. 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.

4.6 Value Added Course (VAC / Skill Development Course (SDC))

Besides core courses and elective courses, VAC / SDC are provided. The blend of different courses is so designed that the interested students would be trained for the holistic development to enhance employment opportunity. Upon completion of 30 Practical Hours / 15 Theory hours and evaluation, a student can claim for 1 additional credit.

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 of 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 74.4% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) shall produce medical certificate and fitness certificate by a Registered Medical Practitioner. 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 in Stamp paper duly signed by the parent and the student.

6.3 Candidates who have not produced / submitted relevant documents for condonation 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. Mentor

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a Faculty of the Department who shall function as Mentor for those students throughout their period of study. Such Mentors 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 Mentor 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 beginning of each semester.

8. CLASS COMMITTEE

8.1. 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.

8.2. 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 all the students, 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.

8.3 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 Executive Council, the same shall be brought to the notice of the Registrar/VC 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 one batch of students shall have a “Course Committee” comprising of all the faculty teaching the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Head of the Department/Dean depending upon whether all the faculty teaching the common course belong to a single department or several departments. The “Course committee” shall meet at least three times and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the course committee may also prepare a common question paper for the assessment test(s). The letter “G” is to be mentioned in the course code for the common course.

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 seminar 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.

c. 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 end semester evaluation of integrated practical component is for 50 Marks and it is scaled down to 15 Marks. Similarly, the end semester evaluation for integrated theory is 100 Marks and it is scaled down to 45 Marks. Hence, the external evaluation of integrated theory and practical elements accounts for 60 marks.

For the integrated course, the ESE mark distribution is as follows:

| Theory | Practical | Total |
|----------|-----------|----------|
| 45 marks | 15 Marks | 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

10.4.1 Project Work

Final year project work will be normally in-house. However, as a special case, if a student is able to get 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.

The evaluation of Project phase I shall be through Continuous Internal assessment mode and Project phase II evaluation shall be through continuous assessments (Three reviews), evaluation of

project thesis report and viva-voce examination. Continuous assessment shall have the weightage of 40%. Evaluation of Project thesis report and viva-voce examination shall have the weightage of 60% each. Break-up of marks is as shown below:

Project Phase I Evaluation:

| Continuous Internal Assessment (100 marks) | | |
|---|------------------|-------------------|
| Review I | Review II | Review III |
| 30 marks | 30 marks | 40 marks |

Project Phase II Evaluation:

| Continuous Internal Assessment (40 marks) | | | ESE (60 marks) | | | |
|--|------------------|-------------------|----------------------------------|-----------------|-----------------------------|-----------------|
| Review I | Review II | Review III | Project Report (30 marks) | | VIVA VOCE (30 marks) | |
| | | | Supervisors | External | Internal | External |
| 5 marks | 15 marks | 20 marks | 15 marks | 15 marks | 15 marks | 15 marks |

10.4.2 Internships

Students must complete Internship for the duration specified in the program's corresponding curriculum. The industry in which the student intends to undergo internship should be aligned in line with the programme of study. The student must submit a report detailing observations, skills learned, usefulness, etc., together with the attendance certificate granted by the relevant industry after completing the internship or industrial training. A committee made up of three faculty members, appointed by the department head, will review this report. One faculty member will be designated as the coordinator. A student can claim one credit if he/she completes one week of training as per curriculum

Weightage for Assessment for Internship

| Report | Presentation | Viva-Voce |
|---------------|---------------------|------------------|
| 30 Marks | 40 Marks | 30 Marks |

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 5.2) 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, it is scaled down to 60 marks.

12.1 ONLINE EXAMINATIONS

The students who are going for Project / Internship / Coursework at National level are permitted to write their CIA test through Online Mode and ESE in Offline/Online mode. When they go for an International Project / Internship / Coursework, both the CIA and ESE shall be conducted through online mode.

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.

13.1.1 The minimum marks to pass for the 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 where he/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). The Evaluation for the CIA reappearance is as follows:

| Test 1 | Test 2 | Assignment | Total |
|---------------|---------------|-------------------|--------------|
| 15 marks | 15 marks | 10 marks | 40 marks |

13.4 CREDIT TRANSFER THROUGH ONLINE PLATFORM / INTERNATIONAL STUDIES

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

Students are encouraged to enroll in courses offered by NPTEL/Swayam/ Swayam Plus 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 & Grade Equivalence Committee comprising the Dean of the Faculty as Chairman, Dean (R&D, Industrial Relations), Head of the Department (HoD) and one faculty member nominated by the Vice Chancellor as members. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council.

13.4.1 Online Courses / Self Study Courses

Students may be permitted to earn credit through online courses (which are provided with certificate) with the approval of Head of the Department and Dean. The credit may be transferred with the due approval for either programme core, elective or open elective course and complete at any time within the duration of the programme before the last semester.

13.4.2 One credit course

One credit elective course shall be offered by the department in collaboration with the industry/research organizations / higher learning institutions. A student shall be permitted to register for the one-credit courses offered by other departments with approval of both the Heads of the departments. A student shall replace a three credit programme elective / open elective course if he / she registered for three one credit courses and appear for the examination of the courses and get qualified in the examination. Three elective courses of 1 credit shall replace a 3-credit elective course as given in Table.

REPLACEMENTS OF ONE CREDIT COURSES

| Number of credits earned | | Eligible to replace | |
|--------------------------|-----------------------------|---------------------|-----|
| Core electives | Interdisciplinary electives | PEC | OEC |
| 3 | 0 | 1 | - |
| 2 | 1 | 1 | - |
| 1 | 2 | - | 1 |
| 0 | 3 | - | 1 |

Refer the Annexure I for NPTEL Course Durations and credit Equivalence. The Registration / Application form for Credit Transfer of SWAYAM-NPTEL / MOOC Courses shall be submitted as shown in Annexure I.

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+ | 61- 70 | 7 | GOOD |
| B | 56-60 | 6 | AVERAGE |
| C | 50-55 | 5 | PASS |
| RA | Below 50 | - | REAPPEARANCE |
| AAA | - | - | 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.

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

CGPA will be calculated in a similar manner, considering all the courses enrolled from First ~~semster~~ **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 apply for 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 Karpagam Academy 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/lateral entrant is eligible to register for B.E. (Honours)/ B.Tech.(Honours), if he/she has passed all the courses in first attempt from first/third semester onwards and holds / maintains a CGPA of 7.5 in III and IV Semester. Prior approval of the concerned Head of the Department and respective Dean for the enrolment into Honours degree before the commencement of V semester is mandatory. A candidate is eligible for the award of BE(Honours) / B.Tech.(Honours), if he/she earns an additional 18 credits by undergoing additional courses over and above the courses prescribed in the respective curriculum. The opted additional courses shall be Emerging / Multidisciplinary /MOOC /NPTEL courses which are related to the major discipline of study. All these 18 credits need to be completed in III year and IV year only. However, if he/she fails to secure 18 additional credits but maintains a CGPA of 7.5 and above is not eligible for Honours 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.

16.4 All other candidates (not covered in Clauses 17) 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.

These advanced learners can request for an on-demand examination for the courses from IV semester onwards. 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 Executive council of Karpagam Academy of Higher Education.

21. 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 onwards 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 setup a startup (or) to work as part 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, their attendance may be accepted by KAHE for 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 provided by the KIIC's attendance report, 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 of 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.

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

| S. No. | Description/Startup phases | In place of the Subject / Course title | Grades/Credits /Marks |
|--------|--|--|--|
| 1 | Idea stage/Problem Identification | Seminar/Presentation of concept | 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 | |

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 university curriculum.

PROGRAM OUTCOMES (POS)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for

i) independent and life-long learning

ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

KNOWLEDGE AND ATTITUDE PROFILE (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

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.

PROGRAMME SPECIFIC OUTCOMES (PSO)

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

1. **PSO1:** Demonstrate the knowledge in fundamental sciences and engineering that are essential to understand food processing and preservation technology.
2. **PSO2:** Demonstrate a working knowledge to apply for advanced food sciences and technologies.

Annexure I

Credit Transfer of Online Courses (SWAYAM / NPTEL)

1. The credit transfer shall be applicable to the students of UG programme from 2022 Batch onwards

The proposed conversion from percentage marks given by (SWAYAM NPTEL) to the corresponding grades shall be as follows: -

| NPTEL Course Durations and credit Equivalence | | |
|--|------------------------|---|
| S. NO | Course Duration | Credit Equivalence for Transfer of Credits |
| 1 | 4 Weeks | 1 Credit |
| 2 | 8 Weeks | 2 Credit |
| 3 | 12 Weeks | 3 Credit |
| 4 | 16 Weeks | 4 Credit |

| Type of NPTEL certificate | NPTEL Score | Equivalent Grade (KAHE) | KAHE Score |
|----------------------------------|--------------------|--------------------------------|-------------------|
| Elite + Gold | ≥ 90 | O | 91-100 |
| Elite + Silver | 75-89 | A+ | 81-90 |
| Elite | 60-74 | A | 71-80 |
| Successfully completed | 40-59 | B+ | 66-70 |
| No certificate | < 40 | - | - |

**Registration / Application form for Credit Transfer of
SWAYAM-NPTEL / MOOC Courses (Academic Year 2025-2026)**

1. Name of Student: _____
2. Register No : _____
3. Faculty :

| | | | | | | | |
|--|-----|--|-------|--|-----|--|------|
| | FOE | | FASCM | | FOP | | FADP |
|--|-----|--|-------|--|-----|--|------|
4. Department/Centre _____
5. Name of the programme : _____ 5. Year/Semester: _____

6. Details of SWAYAM-NPTEL / MOOC Courses:

| S. No. | NPTEL Course Title | Duration (In Weeks) | NPTEL Roll No | Month & Year of Exam | Registered Against | | | PE/OE (KAHE Course Code) |
|--------|--------------------|---------------------|---------------|----------------------|--------------------|----|----|--------------------------|
| | | | | | PE | OE | EX | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

PE: Professional Elective, OE: Open Elective, EX: Extra / add- on Course

Declaration by the Student:

I hereby declare that all the information given by me in this application are true and correct to the best of my knowledge and belief. I will comply with the all rules and regulations of SWAYAM NPTEL/MOOC's courses notified by the Course. I also undertake that after completion of the registered course/s, it's my duty to submit the course completion certificate to HOD otherwise my Marks / Grades shall not be incorporated in Grade Statement of the respective Semester.

Date: _____

Signature of candidate

For Dean / HoD Office:

As per the student application and provision in Academic Regulations, the courses of the above student is /are approved for Registration / Transfer of credits:

| Sl. No | Course Title | Registered Apporved | | | Semester (I / II / III /IV / V / VI / VII / VIII) | Course Code Assigned | Name of Course Coordinator (If applicable) |
|--------|--------------|---------------------|----|----|---|----------------------|--|
| | | PE | OE | EX | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

NPTEL Certificate verified by: **Name:** _____

Signature: _____

Approved by:

Coordinator

HoD

Dean

For Controller of Examinations Office:

| NPTEL Course Durations and credit Equivalence (As per Regulation) | | |
|--|-----------------|--|
| S. No | Course Duration | Credit Equivalence for Transfer of Credits |
| 1 | 4 Weeks | 1 Credit |
| 2 | 8 Weeks | 2 Credit |
| 3 | 12 Weeks | 3 Credit |
| 4 | 16 Weeks | 4 Credit |

| Type of NPTEL certificate | NPTEL Score | Equivalent Grade (KAHE) | KAHE Score |
|---------------------------|-------------|-------------------------|------------|
| Elite + Gold | >=90 | O | 91-100 |
| Elite +Silver | 75-89 | A+ | 81-90 |
| Elite | 60-74 | A | 71-80 |
| Successfully completed | 40-59 | B+ | 66-70 |
| No certificate | < 40 | - | - |

| S. No | Course Code (KAHE) | Course Title (KAHE) | NPTEL Certificate /Roll No | Duration | Credits | Marks | Grade Awarded |
|-------|--------------------|---------------------|----------------------------|----------|---------|-------|---------------|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Grades to be incorporated in the Semester:

| | | | | | | | |
|---|----|-----|----|---|----|-----|------|
| I | II | III | IV | V | VI | VII | VIII |
|---|----|-----|----|---|----|-----|------|

For Scrutiny and Tabulation Section:

Grades Incorporated in the Semester: _____

Grade Awarded: _____

CONTROLLER OF EXAMINATION

B. TECH. – FOOD TECHNOLOGY
COLLEGE OF STUDY AND SCHEME OF EXAMINATION
(2025 BATCH ONWARDS)

| Semester - I | | | | | | | | | | | | |
|--------------|----------------------------|----------|----------------|-----|------------------------|----------|----------|-----------|---------------|------------|------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTHS101G | Technical English I | HS | 5,7,8,9,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 1 |
| 25BTHS103G | Matrices and Calculus | BS | 1,2,3,11 | 1 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | 4 |
| 25BTHS106G | Physics for Life Sciences | BS | 1,2,3,6,8,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 6 |
| 25BTHS145G | Engineering Chemistry | BS | 1,2,3,6,7,8,11 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 8 |
| 25BTAD141G | Python Programming | ES | 1,2,3,4,8,9,11 | 2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 11 |
| 25BTMC151G | Women Safety and Security* | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 14 |
| 25BTMC152G | தமிழர் மரபும் பண்பாடும்* | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 15 |
| | TOTAL | | | | 17 | 1 | 4 | 18 | 400 | 300 | 700 | |

| Semester - II | | | | | | | | | | | | |
|---------------|--|----------|------------------|-----|------------------------|----------|-----------|-----------|---------------|------------|-------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTTHS201G | Technical English II | HS | 5,7,8,9,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 17 |
| 25BTTHS202CG | Transforms and its Applications | BS | 1,2,3,11 | 1,2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | 19 |
| 25BTTHS208G | Environmental Studies | BS | 1,2,6,7,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 21 |
| 25BTTHS207 | Physics for Food Technology | BS | 1,2,3,4,6,7,8,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 24 |
| 25BTFT205 | Fundamentals of Food Science and Technology | ES | 1,2,6,7,9,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 26 |
| 25BEEE242G | Basic Electrical and Electronics Engineering | ES | 1,2,3,8,9,11 | - | 4 | 0 | 2 | 4 | 40 | 60 | 100 | 28 |
| 25BTTHS211G | Communication Skills Laboratory | HS | 5,7,8,9,11 | 1 | 0 | 0 | 2 | 1 | 40 | 60 | 100 | 30 |
| 25BTTHS213G | Physical Sciences Laboratory | BS | 1,2,3,8,9,11 | 1,2 | 0 | 0 | 2 | 1 | 40 | 60 | 100 | 32 |
| 25BTTHS246G | Yoga* | SD | 6,11 | - | 0 | 0 | 4 | 2 | 100 | - | 100 | 33 |
| 25BTMC251G | Vedic Mathematics* | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 35 |
| TOTAL | | | | | 20 | 1 | 10 | 24 | 520 | 480 | 1000 | |

| Semester – III | | | | | | | | | | | | |
|---------------------------|---|----------|--------------|-----|------------------------|----------|----------|-----------|---------------|------------|------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTHS302BG | Numerical Methods | HS | 1,2,3, 11 | 1,2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | 36 |
| 25BTFT302 | Post-Harvest Technology | PC | 1,2,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 39 |
| 25BTFT303 | Food Process Calculations | PC | 1,2 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 41 |
| 25BTFT304 | Fluid Mechanics | ES | 1,2, 3,9 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 43 |
| 25BTFT341 | Food Microbiology | PC | 1,2,9, 11 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 45 |
| 25BTFT342 | Food Chemistry | PC | 1,2,8, 10 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 48 |
| 25BTMC351G | Aptitude and Reasoning* | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 51 |
| 25BTMC352A /25BTMC352B | Foreign Language German/Foreign Language French | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 53 |
| 25BTFT391 | Field Project/ Internship* | PW | - | - | 0 | 0 | 0 | 1 | 100 | - | 100 | 55 |
| SEMESTER TOTAL | | | | | 20 | 1 | 4 | 22 | 540 | 360 | 900 | |

| Semester – IV | | | | | | | | | | | | |
|-----------------------|---|----------|-----------------|-----|------------------------|----------|----------|-----------|---------------|------------|------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTHS402BG | Probability and Statistics | HS | 1,2,3,11 | 1 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | 56 |
| 25BTFT402 | Thermodynamics | ES | 1,2,3 | 1,2 | 3 | 1 | 0 | 4 | 40 | 60 | 100 | 59 |
| 25BTFT403 | Plantation Products and Spice Processing Technology | PC | 1,2,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 61 |
| 25BTFT404 | Heat and Mass Transfer in Food Processing | PC | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 63 |
| 25BTFT441 | Unit Operations in Food Processing | PC | 1,2,8 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 65 |
| 25BTFT442 | Food Biochemistry and Nutrition | PC | 1,2,4,6,8,10,11 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 68 |
| 25BTFT411 | Community Engagement and Social Responsibility | ES | 6,8,9,11 | - | 1 | 0 | 2 | 2 | 100 | - | 100 | 71 |
| 25BTMC451G | Foundation of Entrepreneurship* | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 73 |
| 25BTMC452G | Essence of Traditional Indian Knowledge and Heritage* | MC | - | - | 1 | 0 | 0 | 0 | 100 | - | 100 | 75 |
| SEMESTER TOTAL | | | | | 21 | 2 | 6 | 24 | 540 | 360 | 900 | |

| Semester – V | | | | | | | | | | | | |
|-----------------------|---|----------|---------------|-----|------------------------|----------|----------|-----------|---------------|------------|------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT501 | Refrigeration and Cold Chain Management | PC | 1,2,8, 10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 76 |
| 25BTFT502 | Dairy Technology | PC | 1,2 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 78 |
| 25BTFT5EXX | Professional Elective - I | PE | - | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | - |
| 25BTFT5EXX | Professional Elective - II | PE | - | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | - |
| 25BTFT541 | Food Analysis | PC | 1,2 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 80 |
| 25BTFT542 | Fruits and Vegetables Processing Technology | PC | 1,2,10 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 83 |
| 25BTMC551G | Cyber security* | MC | 1,2,7,8,10,11 | 1,2 | 1 | 0 | 0 | 0 | 100 | - | 100 | 86 |
| 25BTFT511 | Skill Development I (New Product Development) * | SD | 1,2,7,8,10,11 | 1,2 | 0 | 0 | 2 | 1 | 100 | - | 100 | 88 |
| 25BTFT591 | Field Project/ Internship* | PW | - | - | 0 | 0 | 0 | 1 | 100 | - | 100 | 90 |
| SEMESTER TOTAL | | | | | 19 | 0 | 6 | 22 | 540 | 360 | 900 | |

| Semester – VI | | | | | | | | | | | | |
|-----------------------|--|----------|-------------|-----|------------------------|----------|----------|-----------|---------------|------------|------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTHS601G | Universal Human Values* | HS | 7,8,11 | - | 2 | 0 | 0 | 2 | 100 | - | 100 | 91 |
| 25BTFT641 | Food Additives | PC | 1,2 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 94 |
| 25BTFT642 | Bakery and Confectionary Technology | PC | 1,2,3 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 97 |
| 25BTFT601 | Food Safety Regulations | PC | 1,2,3 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 100 |
| 25BTFT611 | Skill Development II (Food Quality Detection and Analysis) * | SD | 1,2,7,10,11 | 1,2 | 0 | 0 | 2 | 1 | 100 | - | 100 | 102 |
| 25BTFT6EXX | Professional Elective – III | PE | - | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | - |
| 25BTFT6EXX | Professional Elective – IV | PE | - | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | - |
| 25BTFT691 | Mini Project* | PW | - | - | 0 | 0 | 2 | 2 | 100 | - | 100 | 104 |
| SEMESTER TOTAL | | | | | 17 | 0 | 8 | 22 | 500 | 300 | 800 | |

| Semester – VII | | | | | | | | | | | | |
|-----------------------|---|----------|---------------------|-----|------------------------|----------|-----------|-----------|---------------|------------|------------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT701 | Professional Ethics and IPR | HS | 1,6,7,11 | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 105 |
| 25BTFT702 | Process Economics and Plant-Layout Design | PC | 1,2,3,6,7,8,9,10,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 107 |
| 25BTFT741 | Food Packaging Technology | PC | 1,2,6,8,9,10,11 | 1,2 | 3 | 0 | 2 | 4 | 40 | 60 | 100 | 109 |
| 25BTFT7XX | Professional Elective - V | PE | - | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | - |
| 25BTFT7XX | Professional Elective - VI | PE | - | - | 3 | 0 | 0 | 3 | 40 | 60 | 100 | - |
| 25BTFT791 | Project Work Phase I | PW | - | - | 0 | 0 | 8 | 4 | 100 | 0 | 100 | 112 |
| SEMESTER TOTAL | | | | | 15 | 0 | 10 | 20 | 300 | 300 | 600 | |

| Semester – VIII | | | | | | | | | | | | |
|-----------------------|-------------------------|----------|----------|-----|------------------------|----------|-----------|----------|---------------|-----|-------|----------|
| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 160 | 240 | 400 | |
| 25BTFT891 | Project Work Phase – II | PW | - | - | 0 | 0 | 16 | 8 | 160 | 240 | 400 | 113 |
| SEMESTER TOTAL | | | | | 0 | 0 | 16 | 8 | 160 | 240 | 400 | |

Open Elective

| Course Details | Platform | Category | | | | Credits | Online Exam | Total | | | | |
|----------------------|----------------|----------|--|--|------------|----------|-------------|------------|--------------|--------------|--------------|--|
| Open Elective-I** | NPTEL - Swayam | OE | | | | 3 | 100 | 100 | - | | | |
| Open Elective-II** | NPTEL - Swayam | OE | | | | 3 | 100 | 100 | - | | | |
| Total | | | | | | 6 | 200 | 200 | | | | |
| PROGRAM TOTAL | | | | | 129 | 5 | 64 | 166 | 3,500 | 2,900 | 6,400 | |

***Internal Evaluation Only**

**** Refer clause 13.4 in regulation**

Professional Elective – I

| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
|-------------|------------------------------------|----------|----------|-----|------------------------|---|---|---------|---------------|-----|-------|----------|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT5E01 | Lipid Processing Technology | PE | 1,2,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 114 |
| 25BTFT5E02 | Food processing and preservation | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 116 |
| 25BTFT5E03 | Cereals and Pulses Technology | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 118 |
| 25BTFT5E04 | Milling Technology | PE | 1,2,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 120 |
| 25BTFT5E05 | Technology of Oil seeds Processing | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 122 |

Professional Elective – II

| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
|-------------|--------------------------------------|----------|----------|-----|------------------------|---|---|---------|---------------|-----|-------|----------|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT5E06 | Design and Formulation of Foods | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 124 |
| 25BTFT5E07 | Functional Foods and Nutraceuticals | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 126 |
| 25BTFT5E08 | Snack Food Technology | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 128 |
| 25BTFT5E09 | Analytical Methods for Food Products | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 130 |
| 25BTFT5E10 | Beverage Processing Technology | PE | 1,2,3,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 132 |

Professional Elective – III

| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
|-------------|--|----------|----------|-----|------------------------|---|---|---------|---------------|-----|-------|----------|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT6E01 | New Product Development and Sensory Science | PE | 1,2,3,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 134 |
| 25BTFT6E02 | Marketing Management and International Trade | PE | 1,2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 136 |
| 25BTFT6E03 | Food Process Automation | PE | 1,2,3 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 138 |
| 25BTFT6E04 | Energy Conservation in Food Design | PE | 1,2,3,7 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 140 |
| 25BTFT6E05 | Process Control for Food Engineers | PE | 1,2,3 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 142 |

Professional Elective – IV

| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
|-------------|---|----------|--------------------|-----|------------------------|---|---|---------|---------------|-----|-------|----------|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT6E06 | Waste Management in Food Industries | PE | 1,2,3 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 144 |
| 25BTFT6E07 | Food Colorants and Flavorants | PE | 1,2,3 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 146 |
| 25BTFT6E08 | Biologically Active Phytochemicals in Foods | PE | 1,2,3 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 148 |
| 25BTFT6E09 | Livestock and Marine Technology | PE | 1,2 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 150 |
| 25BTFT6E10 | Novel Food Processing Technologies | PE | 1,2,3,4,5,10,11,12 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 152 |

Professional Elective – V

| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
|-------------|--|----------|---------------------------------|-----|------------------------|---|---|---------|---------------|-----|-------|----------|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT7E01 | Extrusion Technology | PE | 1,3,5, 7,8,9, 11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 154 |
| 25BTFT7E02 | Food Allergy and Toxicology | PE | 2,8 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 156 |
| 25BTFT7E03 | Total Quality Management | PE | 1,2,4, 6,7,8, 9,10, 11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 158 |
| 25BTFT7E04 | Cryogenic Engineering | PE | 1,2,3, 4,8,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 160 |
| 25BTFT7E05 | Process Instrumentation and Control in Food Processing | PE | 1,2,3, 8, 9,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 162 |

Professional Elective – VI

| Course Code | Course Title | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No. |
|-------------|--|----------|----------------------|-----|------------------------|---|---|---------|---------------|-----|-------|----------|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| 25BTFT7E06 | Food Biotechnology | PE | 1,4,7,8,11 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 164 |
| 25BTFT7E07 | Supply Chain Management | PE | 1,2,3,4,7,8,9,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 166 |
| 25BTFT7E08 | Drying Technology for Foods | PE | 1,2,3,4,7,8,9,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 168 |
| 25BTFT7E09 | Food Fermentation Technology | PE | 1,2,3,4,7,8,9,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 170 |
| 25BTFT7E10 | Rheology and Texture Analysis of Foods | PE | 1,2,3,4,7,8,9,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 172 |
| 25BTFT7E11 | Sea Food Processing Technology | PE | 1,2,3,4,5,6,7,8,9,10 | 1,2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 174 |

Credit Distribution:

| S.No | Course Category | Credit Distribution | Percentage |
|--------------|------------------------|---------------------|------------|
| 1. | Basic Science | 22 | 13.25 |
| 2. | Engineering Science | 20 | 12.04 |
| 3. | Humanities and Science | 20 | 12.04 |
| 4. | Professional Core | 60 | 36.14 |
| 5. | Professional Elective | 18 | 10.84 |
| 6. | Open Elective | 06 | 3.61 |
| 7. | Skill Development | 04 | 2.40 |
| 8. | Project Work | 16 | 9.63 |
| 9. | Mandatory Course | 0 | 0 |
| Total | | 166 | 100 |

SEMESTER I

B. Tech. Food Technology

2025-2026

25BTHS101G

TECHNICAL ENGLISH – I
(THEORY)

SEMESTER-I
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:

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

COURSE OUTCOMES

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

- Replicate grammar usage in reading, speaking, and writing skills. **P2**
- Describe precise transitions while reading, writing, and speaking to enhance communication coherence and clarity. **A2**
- Report the interpretation of linguistic parameters in day-to-day reading, listening, and speaking interactions. **A2**
- Point out errors to restructure paragraphs, compose, compile, and synthesize documents for presentations. **P2**
- Demonstrate proficiency in reading, writing, and critical listening and the ability to interpret and articulate complex ideas persuasively in written and oral forms. **A3**

***P- Psychomotor skills, A-Affective Domain Skills**

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 question.

| | | |
|------------------|---|----------|
| 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 HOURS: 45

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

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|-----|-----|-----|-----|----------|-----|----------|----------|------------|------|----------|----------|----------|
| C101.1 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C101.2 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C101.3 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C101.4 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C101.5 | - | - | - | - | 2 | - | 2 | 2 | 2 | - | 2 | 1 | 1 |
| C101 | - | - | - | - | 2 | - | 2 | 2 | 2.8 | - | 2 | 1 | 1 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 **(K3)**
- Utilize differential calculus of multivariable to optimization problems **(K3)**
- Apply multiple integrals for finding area and volume **(K3)**
- Solve the n^{th} order Ordinary Differential Equations and Homogeneous equation of Euler's type **(K3)**
- Solve the n^{th} order Partial Differential Equations **(K3)**

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 HOURS: 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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 | - |
| C102 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

Instruction Hours/week: L:3 T:0 P:0
Total:100

Marks: Internal:40 External:60

End Semester Exam: 3 Hours

COURSE OBJECTIVES

The goal of this course is to

- Introduce the concepts of quantum mechanics and crystal for diverse applications.
- Understand the basics of laser and optical fiber with appropriate applications.
- 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 (**K2**)
- Choose the performance of light and laser (**K3**)
- Identify the numerical aperture and acceptance angle of an optical fibre (**K3**)
- Relate the quantum concepts in electron microscope (**K2**)
- Apply the elastic properties of the materials to understand the modulus of the material (**K3**)

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 losses 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.

Elasticity – stress – strain – Hooke’s 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 Hours: 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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|------------|-----|-----|------------|-----|------------|-----|------|------------|------------|------------|
| C103.1 | 2 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | - | - |
| C103.2 | 3 | 2 | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| C103.3 | 3 | 2 | 1 | - | - | 1 | - | 1 | - | - | 1 | - | - |
| C103.4 | 2 | 1 | - | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| C103.5 | 3 | 2 | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| CO103 | 2.6 | 1.6 | 1.0 | - | - | 1.0 | - | 1.0 | - | - | 1.0 | 1.0 | 1.0 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

(i)Theory**COURSE OBJECTIVES:**

The goal of this course is to:

- Summarize water treatment process and engineering materials.
- Acquire knowledge on fuels, lubricants and principles of corrosion.
- 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 (**K3**)
- Interpret the basics of engineering materials and its applications (**K2**)
- Outline the methods to enhance the quantity & quality of fuels and Lubricants (**K2**)
- Illustrate the types of corrosion and its prevention techniques (**K2**)
- Demonstrate the principle and working of analytical techniques (**K3**)

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 corrosions - 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 SUMare, “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

(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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|----------|----------|
| C104.1 | 3 | 2 | 1 | - | - | 2 | 1 | 1 | - | - | 1 | 1 | 1 |
| C104.2 | 2 | 1 | - | - | - | 2 | 1 | 1 | - | - | 1 | - | - |
| C104.3 | 2 | 1 | - | - | - | 2 | 1 | 1 | - | - | 1 | - | - |
| C104.4 | 2 | 1 | - | - | - | 2 | 1 | 1 | - | - | 1 | 1 | 1 |
| C104.5 | 3 | 2 | - | - | - | 2 | 1 | 1 | - | - | 1 | 1 | 1 |
| C104 | 2.4 | 1.4 | 1 | - | - | 2 | 1 | 1 | - | - | 1 | 1 | 1 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25BTAD141G

**PYTHON PROGRAMMING
(THEORY & LABORATORY)**

SEMESTER-I

5H-4C

Instruction Hours/week: L:3 T:0 P:2

Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

PRE-REQUISITES: Nil**i) THEORY****COURSE OBJECTIVES:**

The goal of this course is for students to

- Learn about basic python syntax and semantics like control structures and functions.
- Develop logical thinking abilities and to propose novel solutions for real world problems through object-oriented programming concepts.
- Model the empirical knowledge on applying programming on business domains.

COURSE OUTCOMES:

Upon completion of this course students will be able to

- Interpret the basic representation of the data structures and sequential programming (K2)
- Solve the problems using list, dictionaries, tuples, and sets core data structures (K3)
- Build applications using functions, modules and packages (K3)
- Examine the error-handling constructs for unanticipated states/inputs. (K4)
- Analyze the applications on real-world problems using object-oriented concepts (K4)

UNIT I INTRODUCTION TO PYTHON BASICS**9**

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, LCM, Sum an array of numbers, Linear search, Binary search.

UNIT II PYTHON DATA STRUCTURES**9**

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 - Set - Set operations - Illustrative programs: Simple sorting, pattern matching, Fibonacci, Factorial, Prime numbers.

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 - Python libraries NumPy, pandas, Matplotlib - Flask/Django

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 ERROR HANDLING, TESTING

9

Exception handling with try, except, finally - Exception handling: Errors vs exceptions - Handling exceptions - Raising exception - Creating user defined exception - Debugging techniques- Unit testing with unit test - Writing test cases - web scraping - Data analysis project - Automation script

Total Hours: 45

ii) LABORATORY

LIST OF EXPERIMENTS:

1. Write conditional and looping statements in Python.
2. Create and manipulate strings using indexing, slicing, and various string functions.
3. Create and manipulate lists using operations, slices, methods, list comprehension, and looping.
4. Create and manipulate tuples, dictionaries, and sets, and understand the differences between mutable and immutable types.
5. Implement user-defined functions and understand the different types of function arguments, such as positional, keyword, and default arguments.
6. Implement inheritance and understand the different types of inheritance.
7. Implement polymorphism through method overloading, overriding, and operator overloading.

Total Hours: 30

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”,2ndEdition ,Dorling Kindersley India Pvt. Ltd, 2019.

WEBSITES:

1. <https://realpython.com/>
2. www.programiz.com/python-programming
3. <https://www.geeksforgeeks.org/python-programming-language/>
4. <https://www.pythonspot.com/>

CO, PO and PSO Mapping

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|------------|----------|-----|-----|-----|----------|----------|------|----------|------|----------|
| C105.1 | 2 | 1 | - | - | - | - | - | 2 | 2 | - | 3 | - | 3 |
| C105.2 | 3 | 2 | 1 | - | - | - | - | 2 | 2 | - | 3 | - | 3 |
| C105.3 | 3 | 2 | 1 | - | - | - | - | 2 | 2 | - | 3 | - | 3 |
| C105.4 | 3 | 3 | 2 | 1 | - | - | - | 2 | 2 | - | 3 | - | 3 |
| C105.5 | 3 | 3 | 2 | 1 | - | - | - | 2 | 2 | - | 3 | - | 3 |
| C105 | 2.8 | 2.4 | 1.4 | 1 | - | - | - | 2 | 2 | - | 3 | - | 3 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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

- Make aware about the practical issues concerning gender and politics.
- Acquaint knowledge about the national policies and programmes and the gendered structures of governance and polity
- Observe the liability of women and women's work in the context of globalization.

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 5

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 5

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 5

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

Total Hours:15**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 Jaipur.

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
- தமிழ்மொழியின் பழைமையும், திராவிடமொழிகளில் தமிழ் மொழியின் தனிச்சிறப்பையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்.
- தமிழர்களின் வாழ்வியல், தமிழர்கலைகள், ஆற்றங்கரைப் பண்பாடுகள் குறித்து மாணவர்கள் அறியச்செய்தல்.
- இந்தியக் குடியரிமைப்பணி முதலான போட்டித்தேர்வுகளில் விருப்பப்பாடமாக இடம்பெறுகின்ற தமிழ் நாகரிகமும் பண்பாடும் குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்

பாடத் திட்டப் பொது நோக்கம்:

1. இந்தியக் குடியரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வு மனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்'; 'இணையதமிழ்' குறித்த பன்னோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனைமேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி. மொழிபெயர்ப்புத் துறைசார்ந்த வேலைவாய்ப்புத்திறன் பெற்றிருத்தல்.

அலகு:1 தமிழர்மரபு

மரபு- விளக்கம்- சங்ககால தமிழர் மரபு – திணைப் பகுப்பும் தமிழர் மரபும்-உலகப்பொதுமை – அகத்திணைமரபு – புறத்திணைமரபு- இடைக்காலத்தமிழர்மரபு – பிற்காலமரபும்மாற்றமும் – தற்காலத்தமிழர்மரபு - வளர்ச்சி.

அலகு: 2 தமிழர் பண்பாடு

பண்பாடு – விளக்கம் – பழந்தமிழர் பண்பாடு – இயற்கை சார்ந்த வாழ்வியல் – தமிழர் சமயம் – அரசியல் நிலை-சமூகப்பழக்க வழக்கங்கள் – நம்பிக்கைகள் – வாழ்வியல் அறங்கள் – வணிகம்போன்றவை

அலகு:3 தமிழர்கலைகள்

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

அலகு: 4 தமிழர் சமயம்

பழந்தமிழரின் சமயம் – சங்ககாலசமயம் – தொல்காப்பியத்தில் சமயம் – சைவசமயம் – வைணவம் – தமிழ்ப்பண்பாட்டில் பௌத்தம் – தமிழ்ப்பண்பாட்டில் சமணத்தின்தாக்கம்-தமிழ்ப்பண்பாட்டில் இசுலாம்மற்றும் 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 பண்பாட்டுப்பதிவுகள்

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

பார்வைநூல்கள்:

1. தமிழ் இலக்கியவரலாறு – தமிழண்ணல், மீனாட்சி புத்தகநிலையம்- மதுரை-இரண்டாம்பதிப்பு- ஜூலை – 2000.
2. தமிழர் நாகரிகமும் பண்பாடும், அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், சென்னை, திருத்தியபதிப்பு – 2022.
3. தமிழர்வரலாறும் பண்பாடும், நா. வானமாமலை, நியூசெஞ்சரிபுக்ஹவுஸ், சென்னை, ஆறாம்பதிப்பு - 2007 .
4. தமிழக வரலாறு மக்களும் பண்பாடும், கே.கே. பிள்ளை, உலகத் தமிழராய்ச்சி நிறுவனம், சென்னை.

SEMESTER II

B.TECH. - Food Technology

2025 -2026

25BTHS201G

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 hours: 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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|-----|-----|-----|-----|----------|-----|----------|----------|------------|------|----------|----------|----------|
| C106.1 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C106.2 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C106.3 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C106.4 | - | - | - | - | 2 | - | 2 | 2 | 3 | - | 2 | 1 | 1 |
| C106.5 | - | - | - | - | 2 | - | 2 | 2 | 2 | - | 2 | 1 | 1 |
| C106 | - | - | - | - | 2 | - | 2 | 2 | 2.8 | - | 2 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

25BTHS202CG

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

Instruction Hours/week: L:3 T:1 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

Pre-Requisites: Matrices and Calculus**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 (**K2**)
- Apply Fourier series in one dimensional heat flow and wave equation (**K3**)
- Make use of Fourier transform for converting elementary functions into frequency domain (**K3**)
- Utilize Laplace Transform to convert time-domain systems into frequency-domain systems (**K3**)
- Apply Inverse Laplace Transform in linear differential equations (**K3**)

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”, 44th Edition, Khanna Publishers, New Delhi, 2018.

WEBSITES:

1. [www.infocobuild.com/education/audio-video-courses/mathematics/Transform Techniques For Engineers-IIT-Madras/lecture-01.html](http://www.infocobuild.com/education/audio-video-courses/mathematics/Transform%20Techniques%20For%20Engineers-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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|----------|-----|-----|-----|-----|-----|-----|------|----------|----------|----------|
| C107.1 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - |
| C107.2 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | 1 |
| C107.3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C107.4 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C107.5 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C107 | 2.8 | 1.8 | 1 | - | - | - | - | - | - | - | 1 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

Instruction Hours/week: L:3 T:0 P:0
Total:100

Marks: Internal:40 External:60

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students to:

- Create a basic understanding about ecosystem and natural resources.
- Acquire knowledge on biodiversity conservation and pollution eradication.
- 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 (**K2**)
- Infer the importance of environment and impact of human activities on natural resources (**K2**)
- Demonstrate the levels and values of biodiversity and its conservation (**K2**)
- Summarize the problems of environmental pollution and its control measures (**K2**)
- Interpret the remediation methods for social issues and degraded environment (**K2**)

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/In/environment/>

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|----------|-----|-----|-----|----------|----------|-----|-----|------|----------|----------|----------|
| C108.1 | 2 | 1 | - | - | - | 3 | 3 | - | - | - | 2 | 1 | - |
| C108.2 | 2 | 1 | - | - | - | 3 | 3 | - | - | - | 2 | - | 1 |
| C108.3 | 2 | 1 | - | - | - | 3 | 3 | - | - | - | 2 | - | - |
| C108.4 | 2 | 1 | - | - | - | 3 | 3 | - | - | - | 2 | - | - |
| C108.5 | 2 | 1 | - | - | - | 3 | 3 | - | - | - | 2 | 1 | 1 |
| C108 | 2 | 1 | - | - | - | 3 | 3 | - | - | - | 2 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

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 basics of nano materials and its synthesis.
- To introduce the physics of semiconducting and superconducting materials and its applications in diverse fields.
- To familiarize the applications of magnetic, advanced materials and dielectric materials.

COURSE OUTCOMES:

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

- Explain the significance of phase diagram in the material preparation and synthesis methods of nanomaterials. **(K2)**
- Utilize the electron theory to understand conductivity and the properties and applications of superconductors. **(K3)**
- Identify the types of semiconductors and its carrier concentration using Hall effect. **(K3)**
- Apply the concepts of dielectric and magnetic materials in technological applications. **(K3)**
- Choose the types of ceramics, composites and advanced materials for specific engineering applications. **(K3)**

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 PROPERTIES OF MATERIALS 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.

TEXTBOOKS:

- W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.
- V.Raghavan.Materials Science and Engineering: A FirstCourse.PHILearning,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 MaterialsScienceforEngineers.Pearson,2015.
2. D.R.AskelandandW.J.Wright.EssentialsofMaterialsScienceandEngineering, Cengage Learning, 2013.
3. Charles Kittel, Introduction to Solid State Physics, Wiley IndiaEdition,2019.
4. JeanP. Mercier,G.ZambelliandW.Kurz,IntroductiontoMaterialsScience,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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C109.1 | 3 | 2 | 1 | 1 | - | 1 | 1 | 1 | - | - | 1 | 1 | 1 |
| C109.2 | 2 | 2 | 1 | 1 | - | 1 | 1 | 1 | - | - | 1 | - | - |
| C109.3 | 2 | 2 | 1 | 1 | - | 1 | 1 | 1 | - | - | 1 | - | - |
| C109.4 | 2 | 1 | - | - | - | 1 | 1 | - | - | - | 1 | 1 | 1 |
| C109.5 | 2 | 1 | - | - | - | 1 | 1 | - | - | - | 1 | 1 | 1 |
| C109 | 2.2 | 1.6 | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.0 | - | - | 1.0 | 1.0 | 1.0 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

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- FOOD PRESERVATION**9**

Preservation of food by salt, sugar, high temperature, Preservation by use of low temperature- Chilling, freezing and cold storage-Principle, methods and equipment-Preservation by drying, dehydration and concentration-Principle, methods and equipment. Irradiation and fermentation.

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. ManayN.S and Shadakshara swamy, 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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|-----|-----|-----|----------|----------|-----|----------|------|----------|------------|------------|
| C110.1 | 2 | 1 | - | - | - | - | 1 | - | 1 | - | 2 | 3 | 2 |
| C110.2 | 2 | 1 | - | - | - | - | - | - | 1 | - | 2 | 2 | 2 |
| C110.3 | 2 | 1 | - | - | - | - | - | - | 1 | - | 2 | 3 | 3 |
| C110.4 | 3 | 2 | - | - | - | 1 | 1 | - | 1 | - | 2 | 3 | 3 |
| C110.5 | 3 | 2 | - | - | - | - | - | - | 1 | - | 2 | 3 | 2 |
| C110 | 2.4 | 1.4 | - | - | - | 1 | 1 | - | 1 | - | 2 | 2.8 | 2.4 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

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.
3. A. Sudhaka and Shyammohan S Palli, “Circuits and Networks”, McGraw Hill, 2013.
4. R. Muthusubramanian and S. Salivahanan, “Basic Electrical and Electronics Engineering”, TMH, 2014.

Web Links:

- <https://nptel.ac.in/courses/108108076>
- encyclopedia-magnetica.com/doku.php/co energy.
- [https://en.wikibooks.org/wiki/electronics/measuring instruments](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 Hours: 30

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C111.1 | 3 | 2 | 1 | - | - | - | - | 2 | 2 | - | 1 | - | - |
| C111.2 | 3 | 2 | 1 | - | - | - | - | 2 | 2 | - | 1 | - | - |
| C111.3 | 2 | 1 | - | - | - | - | - | 2 | 2 | - | 2 | - | - |
| C111.4 | 2 | 1 | - | - | - | - | - | 2 | 2 | - | 2 | - | - |
| C111.5 | 2 | 1 | - | - | - | - | - | - | 1 | - | 2 | | |
| C111 | 2.4 | 1.4 | 1 | - | - | - | - | 2 | 1.8 | - | 1.6 | - | - |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

COMMUNICATION SKILLS LABORATORY
(LABORATORY)Instruction Hours/week: L:0 T:0 P:2
Total:100

Internal: 40 External:60

End Semester Exam: 3 Hours

OBJECTIVES:

The goal of this course is;

- To acquire different listening techniques for understanding different kinds of audio content, including lectures, conversations, videos, etc. and to effectively communicate their ideas using a variety of media
- To understand the “English language skills” by engaging them in listening and reading activities that are relevant to authentic contexts and to help learners use language effectively in academic /work contexts
- To apply the communicative competence of learners in listening, speaking, reading and writing

OUTCOMES:

Learners will be able to,

- Organize the context, topic, and pieces of specific information of English through all four skills. **P1**
- Identify the purpose and clarity of facts and reflect their thoughts, opinions, and knowledge through all the language skills. **A1**
- Put together skimming, scanning, and listening techniques effectively to acquire the gist from the context. **P2**
- Demonstrate in communication more effectively with their peers, instructors, and colleagues. **A2**
- Master public speaking techniques, business writing, and listening with professional speaking techniques. **P3**

P-Psychomotor Skills, A- Affective Domain Skills*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 Hours: 30

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| C112.1 | - | - | - | - | 2 | - | 2 | 3 | 3 | - | 2 | 1 | - |
| C112.2 | - | - | - | - | 2 | - | 2 | 3 | 3 | - | 2 | 1 | - |
| C112.3 | - | - | - | - | 1 | - | 2 | 3 | 3 | - | 2 | 1 | - |
| C112.4 | - | - | - | - | 1 | - | 1 | 2 | 3 | - | 2 | 1 | - |
| C112.5 | - | - | - | - | 1 | - | 1 | 2 | 3 | - | 2 | 1 | - |
| C112 | - | - | - | - | 1.4 | - | 1.6 | 2.6 | 3 | - | 2 | 1 | - |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

PHYSICAL SCIENCES LABORATORY
(LABORATORY)Instruction Hours/week: L:0 T:0 P:2
Total:100

Marks: Internal:40 External:60

End Semester Exam: 3 Hours

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.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C113.1 | 2 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| C113.2 | 2 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| C113.3 | 3 | 2 | 1 | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| C113.4 | 2 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| C113.5 | 2 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| C113 | 2.2 | 1.2 | 1.0 | - | - | - | - | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.0 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

Instruction Hours/week: L:0 T:0 P:4

Marks: Internal:100 Total:100

PRE-REQUISITE: NIL

COURSE OBJECTIVES:

The goal of this course for students is to

- Understand the concepts of Yoga and Physical Health
- Provide value education to improve the students character, understanding greatness of life force and
- Mind.
- Learning introspection practices like analysis of Thought, Moralization of Desires, Neutralization of Anger and Eradication of Worries

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

15

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 AND PHYSIOLOGY IN SPORTS & YOGA

15

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

15

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

Total Hours: 45

SUGGESTED READINGS

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 Delhi ISBN: 8172235011
3. V.K.Sharma, Health and Physical Education, NCERT Books; Class 11,12 Saraswati House Publication, New Delhi

4. Acharya Yatendra, Yoga and Stress Management, Fingerprint Publishing ISBN: 938905303X
5. Swami Vivekanand, Patanjali Yoga Sutras, Fingerprint Publishing ISBN 9389567351.
6. Ramdev, Pranayam Rahasya, Patanjali-Divya Prakashan, Haridwar ISBN: 9788189235017
7. Ramdev, Yoga its Philosophy & Practice, Divya Prakashan, Haridwar.

CO-PO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C114.1 | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| C114.2 | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| C114.3 | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| C114.4 | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| C114.5 | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| C114 | - | - | - | - | - | 1 | - | - | - | - | 2 | - | - |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

Instruction Hours/week: L:1 T:0 P:0

Marks: Internal:100 Total:100

EndSemesterExam:3Hours

COURSE OBJECTIVES:

The goal of this course is;

- To overcome the fear of maths, acquire knowledge in Logical thinking, increase concentration and improve critical thinking.
- To build the skill to perform basic math fast and accurately with confidence.
- To enhance computation skills through Vedic Mathematics

COURSE OUTCOMES:

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

- Apply Vedic sutras for arithmetic computation. **(K3)**
- Utilize Urdhva Tiryagbhyam for solving complex multiplication problems. **(K3)**
- Make use of Vedic division method for basic word problems. **(K3)**

UNIT I

5

Application of vedic sutras, Arithmetic computation, Shudh method for a list of number, Rapid Addition- Single to Double-Digit, Subtraction using Nikliam 3 Digit

UNIT II

5

Multiplication by Thumb Rule, Multiplication Vertically and cross wise, Urdhvatiryagbhyam, Anurupyena.

UNIT III

5

Squaring numbers, Traditonal Division, Straight Division, Facts of Division, Basic Word Problems.

Total Hours: 15**REFERENCES:**

1. Jagadguru swami sri Bharathi krsnatirthajimaharaja, "Vedic Mathematics", International Best seller, New Revised Edition.
2. Sri Bharati Krsna Tirthaji, "Vedic Mathematics", published by Motilal Banarsidass, 1965.
3. Williams K.R. "Discover Vedic Mathematics." Vedic Mathematics Research Group, 1984.
4. Rajesh Kumar Thakur, "Advanced Vedic Mathematics", Rupa Publications India Pvt. Ltd 2019.

WEBSITES:

1. www.nptel.ac.in/courses/111101080
2. www.https://vedicmathworld.com/

SEMESTER- III

B. Tech. Food Technology

2025-2026

25BTHS302BG

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

Pre-Requisites: Transforms and Its Applications

COURSE OBJECTIVES:

The goal of this course is for students:

- To inculcate the basic concepts of solving algebraic and transcendental equations.
- To understand the numerical techniques of interpolation in various intervals
- To develop proficiency on numerical differentiation and integration
- To provide the knowledge of solving ordinary differential equations and partial differential equations numerically

COURSE OUTCOMES:

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

- Solve the systems of linear and nonlinear equations by iterative methods **(K3)**
- Make use of interpolation methods for finding the missing terms **(K3)**
- Apply numerical methods for finding differentiation and integration of a given function **(K3)**
- Solve ordinary differential equations using Euler's, Taylor's, Runge Kutta and Milne Thomson's method **(K3)**
- Utilize implicit and explicit methods in heat and wave equations **(K3)**

UNITI SOLUTION OF EQUATIONS

12

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

UNIT II INTERPOLATION **12**

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 **12**

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 SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

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 **12**

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

Total hours:45+15

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale, Numerical Methods for Engineers,8thEdition , Tata McGraw Hill Education,2021.
2. Curtis F. Gerald and Patrick O. Wheatley,Applied Numerical Analysis,Addison Wesley, Thirteenth Edition,2004.

REFERENCE BOOKS:

1. Richard L. Burden and J. Douglas Faires, Numerical Methods, 4th Edition, Brooks/Cole 2012.
2. Boyce, Di Prima and Meade, "Elementary Differential Equations and Boundary value problem", 12th Edition, John Wiley & Sons, 2021.
3. Steven Chapra, "Applied Numerical Methods with MATLAB", 5th Edition, Mcgraw-Hill Education, 2022.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, Tenth Edition, 2011.

WEBSITES:

1. www.classcentral.com/course/numerical-methods-engineers-32822
2. <http://www.infocobuild.com/education/audio-video-courses/mathematics/numerical-analysis-iit-madras.html>
3. <http://www.infocobuild.com/education/audio-video-courses/mathematics/NumericalMethods-FiniteDifference-IIT-Roorkee/lecture-6.html>

CO-PO Mapping:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C201.1 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C201.2 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C201.3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C201.4 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | - |
| C201.5 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | 1 |
| C201 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | 1 |

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 the 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, the student will be 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**

Overview of agricultural crops, their cropping pattern, production, harvesting and post-harvest losses-physiological processes and biochemical changes affecting the quality of fruits and vegetables. Ethylene effect, Temperature effects- heat, chilling and freezing injury, Post- Harvest Handling operations.

UNIT – II CLEANING SORTING AND GRADING**9**

Cleaning operations, types of cleaners, screens, types of screens, equipment design, cleaning efficiency care and maintenance; Peeling, Sorting, grading, methods of grading; 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 construction details, operating parameters, maintenance. of various decorticators/dehullers/shellers.

UNIT – IV MILLING AND MATERIALS HANDLING**9**

Milling operations, milling equipment, flour milling machines, pulse milling machines, Introduction to different conveying equipment used for handling of grains, fruits and vegetables; Post harvest treatment to increase shelf life i.e. refrigeration, freezing, thermal processing, pulsed electric field, high hydrostatic pressure, cold plasma, electronic noses and near-infrared spectroscopy. Scope and importance of material handling devices.

9

UNIT – V MATERIAL HANDLING SYSTEMS

Introduction to different conveying equipment used for handling of grains, fruits and vegetables, principles of operation, conveyor system selection/design, classification: Belt conveyor, chain conveyor and screw conveyor, bucket elevator. Pneumatic conveying system: types, air/product separators; Gravity conveyor design considerations, capacity and power requirement.

Total Hours: 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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C202.1 | 1 | 3 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C202.2 | 1 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C202.3 | 2 | - | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C202.4 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C202.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C202 | 1.6 | 1.7 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

25BTFT303

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 Hours: 45**SUGGESTED READINGS:****TEXT BOOKS:**

1. Singh, R. Paul and Heldman, Dennis R., "Introduction to Food Engineering", Fifth Edition, Academic Press, London, 2013.
2. Venkata ramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India, New Delhi, 2011.
3. Toledo, Romeo T., "Fundamentals of Food Process Engineering", Third Edition, Springer, New York, 2018.
4. Sahay, K.M. and Singh, K.K., "Unit Operations of Agricultural Processing", Fourth Edition, Vikas Publishing House, New Delhi, 2017.
5. Rao, D.G., "Introduction to Biochemical Engineering", Second Edition, Tata McGraw-Hill Education, New Delhi, 2010.

CO, PO and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|----------|-----|-----|-----|-----|-----|-----|------|------|----------|----------|
| C203.1 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 1 |
| C203.2 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 1 |
| C203.3 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 1 |
| C203.4 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 1 |
| C203.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 1 |
| C203 | 2.6 | 1.6 | 1 | - | - | - | - | - | - | - | - | 2 | 1 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

25BTFT304

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 using pressure measurement devices.
- To analyze the fluid statics on different geometric surface.
- To gain knowledge on equations of motion and kinetics of fluid flow.
- To predict the flow of fluids and energy loss through pipes & pumps

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

- Interpret the various properties of fluids.
- Evaluate the pressure differences in fluids.
- Analyze the fluid statics in different geometric surfaces.
- Solve the basic problems related to fluid flow.
- 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- Viscosity- Thermodynamic properties equation of state – perfect gas - Compressibility and Bulk modulus- Surface tension and capillarity -vapor pressure and cavitations.

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 and types.

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. 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 & PUMPS

9

Reynolds Experiment, Darcy – Weisbach equation for friction head loss – Chezy's formula - Major and minor losses in pipes –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. Pumps- types and working principle.

Total Hours: 45

SUGGESTED READINGS:

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. Grade, RJ, “Fluid mechanics through problems”. Wiley eastern Ltd., Madras,2002.

WEBSITES:

1. https://www.vssut.ac.in/lecture_notes/lecture1427495313.pdf
2. https://mrcet.com/downloads/digital_notes/ME/II%20year/FMHM%20DIGITAL%20NOTES.pdf
3. https://www.pw.live/exams/wp-content/uploads/2023/11/1_Fluid-MechanicsFM_1-13.pdf

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C204.1 | 3 | 3 | - | - | - | - | - | - | 2 | - | - | 2 | 2 |
| C204.2 | 3 | 1 | 2 | - | - | - | - | - | - | - | - | 2 | 2 |
| C204.3 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | 2 |
| C204.4 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 |
| C204.5 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 |
| C204 | 2.2 | 2 | 1.2 | | - | - | - | - | 2 | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 – High, ‘-’- No Correlation

25BTFT341**SEMESTER-III****FOOD MICROBIOLOGY
(THEORY AND 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 the 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 completion of this course, the student 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. classification and nomenclature of microorganisms, microscopic examination of microorganisms, light, and electron microscopy- Gram Positive and Gram – Negative bacteria Factors affecting the growth of microorganisms – pH, water activity, oxidation – reduction potential, nutrient content, inhibitory substances and biological structure –Food spoilage by microorganisms, beneficial microorganisms and its uses.

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 – types, Gram-negative and Gram-positive food-borne pathogens – Salmonella, E. coli, Shigella, Vibrio cholerae, Staphylococcus aureus; Clostridium botulinum; Listeria monocytogenes. Toxigenic algae and fungi; 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. Detection methods for E. coli, Yersinia, Campylobacter, Clostridium Botulinum, Rotavirus, Hepatitis A virus, Listeria monocytogenes from food samples.

Total Hours: 45

SUGGESTED READINGS:

1. Adams, M.R. and Moss, M.O., Food Microbiology, 5th Edition, Royal Society of Chemistry, Cambridge, August 2024.
2. Nehra, M. and Nain, V., Handbook of Industrial Food Microbiology, 1st Edition, Apple Academic Press, August 2024.
3. Adams M.R and Moss M.O, (2007). “Food Microbiology”, 2nd Edition, third reprint, Panima Publishing Corporation, New Delhi,
4. William C Frazier and Dennis C. West off, (2008). “Food Microbiology”, Special Edition, Springer, The Mc Graw-Hill Companies.
5. Montville, Thomas J. and Karl R. Matthews “Food Microbiology: An Introduction”. ASM Press, 2005.

WEBLINKS:

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

CO PO MAPPING:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|------------|-----|-----|-----|-----|-----|-----|----------|------|----------|----------|----------|
| C205.1 | 3 | 3 | - | - | - | - | - | - | 2 | - | 2 | 3 | 3 |
| C205.2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | 3 |
| C205.3 | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |
| C205.4 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C205.5 | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |
| C205 | 3 | 2.2 | - | - | - | - | - | - | 2 | - | 2 | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

(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. To analyze the microbiological quality of water (MPN) and milk.
7. Enumeration of microbes in spoiled food.
8. Determination of Thermal Death Point (TDP) of microorganism.
9. Enumeration of lactic acid bacteria from fermented foods.
10. Culture techniques, isolation, and preservation of cultures – Broth flask, test tubes, solid pour plates, streak plates, slants, and stabs.

Total Hours: 30

**FOOD CHEMISTRY
(THEORY AND 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 the 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 completion of this course, the student 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 of carbohydrates based on structure, Chemical properties of carbohydrates, Changes occurring during cooking, dietary fibres and carbohydrates digestibility, Starch- properties and types, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch-hydrolysates –Pectins, gums & seaweeds- gel formation & viscosity; Emulsion– definition, theory, Non– enzymatic browning, Enzymatic and chemical reactions of carbohydrates

UNIT II – PROTEINS**9**

Classification, structure and properties of amino acids; Essential amino & non-Essential amino acids. Chemical and Physical properties of Proteins. Reactions of proteins in food systems: solubility, hydration, swelling, foam formation & stabilization, gel formation, emulsifying effect, amino acids in Maillard reaction, denaturation; Food enzymes- classification, production and applications; Mechanism of enzyme action.

UNIT III - LIPIDS**9**

Lipids in foods - occurrence, classification, structure of simple, compound and derived lipids. Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, isomerization, unsaturation; interesterification, 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, 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**

Naturally occurring colours, acids, other flavor & aroma components; Synthetic colours and 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 in color, flavor and other components during processing and storage.

Total Hours: 45**SUGGESTED READINGS:**

1. Damodaran, S., Parkin, K.L. & Fennema, O.R., Fennema's Food Chemistry, 5th Edition, CRC Press, 2025.
2. Kontogiorgos, V., Introduction to Food Chemistry, 2nd Edition, Springer, 2024 (first published 2021).
3. Belitz H.-D, Grosch W and Schieberle P. (2004), Food Chemistry, 3rd Revised Edition, Springer-Verlag.
4. Chopra, H.K. and P.S. Panesar, (2010), Food Chemistry, Narosa
5. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|----------|-----|-----|-----|-----|-----|----------|-----|----------|------|----------|----------|
| C206.1 | 3 | 1 | - | - | - | - | - | 2 | - | 2 | - | 2 | 2 |
| C206.2 | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C206.3 | 3 | 1 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C206.4 | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C206.5 | 3 | 1 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C206 | 3 | 1 | - | - | - | - | - | 2 | - | 2 | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

(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.

Total Hours: 30

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.
- Prepare and explain the fundamentals related to various possibilities and probabilities related to quantitative aptitude.
- Understand and solve logical reasoning questions and clear competitive exams.

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 Quantitative Ability (Basic Mathematics)**6**

- 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 Quantitative Ability (Applied & Engineering Mathematics)**6**

- 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 Verbal – Aptitude

3

- 1.1 Words
- 1.2 Idioms
- 1.3 Phrases in Context
- 1.4 Reading comprehension techniques
- 1.5 Narrative sequencing
- 1.6 Data interpretation

Total Hours:15

Textbooks:

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

Websites:

1. <https://prepinsta.com/>
2. <https://www.indiabix.com/>
3. <https://www.javatpoint.com/>

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 ausfüllen**UNIT-III:** Mein Lehrbuch | Meine persönlichen Daten-Mein Arbeitsbuch -Wir beginnen Lektion - Wir lesen Lektion 3**UNIT-IV:** formeller Brief- Wie lernst du Deutsch ? -Wir hören ein deutsches Lied- Wir lernen Hörverstehen | 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>

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

25BTFT391**FIELD PROJECT/ 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

2025-2026

25BTHS402BG

SEMESTER-IV

PROBABILITY AND STATISTICS

4H-4C

Instruction Hours/week: L:3 T:1 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

Pre-Requisites: Numerical Methods

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 **(K2)**
- Explain standard distributions of random variables **(K2)**
- Make use of statistical data for finding the measures of central tendency and measures of dispersion **(K3)**
- Interpret the data using correlation and regression **(K2)**
- Apply small and large sample tests in testing of hypothesis. **(K3)**

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 WMckean, “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, 6th Edition, 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

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C207.1 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 1 | - |
| C207.2 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 1 | - |
| C207.3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 2 | 1 | - |
| C207.4 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 1 | - |
| C207.5 | 3 | 2 | 1 | - | - | - | - | - | - | - | 2 | 1 | - |
| C207 | 2.4 | 1.4 | 1 | - | - | - | - | - | - | - | 2 | 1 | - |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

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 Hours: 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 and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|----------|-----|-----|-----|-----|-----|-----|------|------|----------|----------|
| C208.1 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C208.2 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |
| C208.3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |
| C208.4 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |
| C208.5 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |
| C208 | 2.8 | 1.8 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

25BTFT403

SEMESTER-IV

PLANTATION PRODUCTS AND SPICE 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 the 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, the student 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**

Processed products of Pepper, Cardamom, onion, ginger and turmeric – Oleoresins and essential oils – Method of manufacture, Equipment, Chemistry of the volatiles, Flavor, Quality control of major spices, Enzymatic synthesis of flavor identical; Conditions in storage of spices, Types of dryers used in spice processing-Different uses of minor spices-milling of spices-selection of raw materials

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

Processed products of Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove, Coconut, Oil palm, Arecanut, Cashew and Vanilla, Oleoresins and essential oils– Method of manufacture and Equipment used, Chemistry of the volatiles, Flavor, Quality control of minor spices, microorganisms, plant suspension cultures.

UNIT – III ORGIN & OVERVIEW OF COFFEE PROCESSING**9**

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 – types of coffee and its technology, Instant coffee, technology- sensory properties – Chicory chemistry - Quality grading of coffee.

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

Geographical 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 – ORGIN & OVERVIEW OF TEA PROCESSING **9**

Tea- Geographical 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.

Total Hours: 45

SUGGESTED READINGS:

1. Rajaneesh Singh & Bijendra Kumar Singh, Production Technology of Spices and Plantation Crops, 1st Edition, Daya Publishing House, New Delhi, 2024.
2. S.S. Walia, R.K. Nanwal & Karmjeet Kaur, Production Technology of Spices, Aromatic, Medicinal and Plantation Crops, 1st Edition, Scientific Publishers, 2024.
3. L.K. Dashora, Abhay Dashora, S.S. Lakhawat & L.L. Somani, Production Technology of Plantation Crops, Spices, Aromatic and Medicinal Plants, 4th Edition, AgroTechBooks, Rajasthan, 2023.
4. 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.
5. Handbook on Spices, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C209.1 | 1 | 3 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C209.2 | 1 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C209.3 | 2 | - | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C209.4 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C209.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C209 | 1.6 | 1.7 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

25BTFT404

SEMESTER-IV

**HEAT AND MASS TRANSFER IN FOOD
PROCESSING**

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 the students:**

- 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 this course, the student 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.

9

UNIT – IV MASS TRANSFER

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 CRYSTALLIZATION

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 Hours: 45

SUGGESTED READINGS:

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. Robert Treybal , Mass Transfer operation, McGraw- Hill Chemical Engineering series, Third Edition,2019.
2. Paulsingh R, Dennis R. Heldman. Introduction to Food Engineering. Academic press 5th edition. 2013.

CO PO MAPPING:

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C210.1 | 3 | 3 | - | - | - | - | - | 2 | - | - | - | 2 | 2 |
| C210.2 | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C210.3 | 3 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C210.4 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C210.5 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C210 | 2.2 | 0.8 | - | - | - | - | - | 0.4 | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

25BTFT441

SEMESTER-IV

**UNIT OPERATIONS IN FOOD PROCESSING
(THEORY AND 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 the 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 application of extruders in Food industry.

COURSE OUTCOMES:**Upon completion of this course, the student 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 – Membrane separation processes – Ultrafiltration – Microfiltration - Nanofiltration

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 – Cryogenic grinding

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 – 3D food printing

Total Hours: 45

SUGGESTED READINGS:

1. Nema, P.K., Unit Operations in Food Processing, 1st Edition, New India Publishing Agency, India, 2023.
2. Fellows, P.J., Food Processing Technology: Principles and Practice, 5th Edition, Woodhead Publishing (Elsevier), UK, 2022.
3. Rao DG. Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi, 2009.
4. Geankoplis CJ. Transport Processes and Separation Processes Principles. Prentice Hall India, New Delhi, 5th Edition, 2018.
5. Zeki Berk. 2009. Food Process Engineering and Technology. Academic press, New York, USA.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|-----|-----|-----|-----|-----|----------|-----|------|------|----------|----------|
| C211.1 | 3 | 3 | - | - | - | - | - | 1 | - | - | - | 2 | 2 |
| C211.2 | 3 | 2 | - | - | - | - | - | 1 | - | - | - | 2 | 2 |
| C211.3 | 1 | - | - | - | - | - | - | 1 | - | - | - | 2 | 2 |
| C211.4 | 1 | - | - | - | - | - | - | 1 | - | - | - | 2 | 2 |
| C211.5 | 1 | 2 | - | - | - | - | - | 1 | - | - | - | 2 | 2 |
| C211 | 1.8 | 2.3 | - | - | - | - | - | 1 | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

(ii) 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 ultra-filtration
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. Preparation of Ready-to-Eat (RTE) snack using an extruder
10. Solving problems on single effect evaporator and multiple effect evaporators

Total Hours: 30

25BTFT442

SEMESTER-IV

FOOD BIOCHEMISTRY AND NUTRITION**(THEORY AND LABORATORY)****5H-4C****Instruction Hours/week: L:3 T:0 P:2****Marks: Internal:40 External:60 Total:100****End Semester Exam: 3 Hours****COURSE OBJECTIVES:****The goal of this course is for the students:**

- To explain the digestion, absorption and metabolic pathways of carbohydrates, 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 completion of this course, the student 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, Energy yield from glycolysis, TCA cycle, pentose phosphate pathway, 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.

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.

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, Vegetarian diet – health, problems and advantages,

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. fat replacers, dietary management in acute diseases of the heart

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, nutrition and athletic performance, effective hydration for fitness and sports, water and other fluids, sport supplements.

Total Hours: 45

SUGGESTED READINGS

1. Nutritional Biochemistry, Paperback, MJP Publishers, 17 January 2024.
2. Textbook of Applied Biochemistry and Nutrition & Dietetics, 1st Edition, CBS Publishers, 2022.
3. Sunetra Roday. Food Science and Nutrition. Oxford Education/Oxford University Press, 2nd Edition, 2012.
4. Shubhangini AJ. Nutrition and Dietetics. McGraw Hill education, 4th Edition, 2015.
5. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, US.

CO, PO and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| C212.1 | 3 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C212.2 | 3 | 1 | - | 1 | - | - | - | 2 | - | 1 | 1 | 1 | 1 |
| C212.3 | 3 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C212.4 | 3 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C212.5 | 3 | 1 | 2 | 1 | - | 1 | - | - | - | 1 | 1 | 1 | 1 |
| C212 | 3 | 1 | 2 | 1 | - | 1 | - | 2 | - | 1 | 1 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

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 Hours: 30

Instruction Hours/week: L:1 T:0 P:2**Marks: Internal:100 External:0 Total:100****PRE-REQUISITE: Nil****COURSE OBJECTIVES:****The goal of this course for students is to:**

- Achieve socio economic development through active community engagement.
- Improve the quality of research for better understanding of issues in the society.
- Create awareness on the role of a citizen in improving the community and hence the nation

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

- Interpret the role of community engagement in the development of the nation.
- Infer the role of rural institutions and community involvement
- Explain the social problems, social contribution of community networking and various government schemes supporting the community engagement.
- Analyze the factors that mitigate the distress & disasters
- Understand the role of Indian citizens towards community development by adopting a village and carrying out the field work

UNIT I**5**

Concept, Ethics and Spectrum of Community Engagement-Local community, Rural culture and Practice of community engagement. Stages, Components and Principles of community development, Utility of public resources – Contributions of self-help groups

UNIT II**5**

Rural Development Programs and Rural institutions- Local Administration and Community Involvement

UNIT III**5**

Social contribution of community networking, various government schemes– Programmes of community engagement and their evaluation.

UNIT IV**5**

Community Engaged Research and Ethics in Community Engaged Research- Rural Distress, Rural Poverty, Impact of COVID-19 on Migrant Laborers, Mitigation of Disaster.

UNIT V (Field Work)**25**

Service-learning: address the challenges of a specific community, Community-based Participatory Research (CBPR) approaches, Knowledge sharing and knowledge mobilization to the local community, social innovations by students.

Total hours: 45**REFERENCE BOOKS:**

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

WEB SITES:

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

CO, PO and PSO Mapping

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|-----|-----|-----|-----|-----|-----|-----|------------|------------|------|----------|------|------|
| C213.1 | - | - | - | - | - | 3 | - | 1 | 1 | - | 3 | - | - |
| C213.2 | - | - | - | - | - | 3 | - | 1 | 1 | - | 3 | - | - |
| C213.3 | - | - | - | - | - | 3 | - | 1 | 1 | - | 3 | - | - |
| C213.4 | - | - | - | - | - | 3 | - | 1 | 1 | - | 3 | - | - |
| C213.5 | - | - | - | - | - | 3 | - | 3 | 3 | 3 | 3 | - | - |
| C213 | - | - | - | - | - | 3 | - | 1.4 | 1.4 | 3 | 3 | - | - |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

25BTMC451G

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 -ENTREPRENEURIAL COMPETENCE

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

Unit II -ENTREPRENEURIAL 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.

ESSENCE OF TRADITIONAL INDIAN KNOWLEDGE AND HERITAGE**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.
- Encourage critical appreciation of the Indian thoughts and cultural manifestations.
- Gain knowledge of Indian heritage and cultural heritage on various epistemological inquiries.

COURSE OUTCOMES:

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

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

UNIT I Introduction to Indian Thought and Culture**5**

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**5**

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

UNIT III Protection of Traditional Knowledge**5**

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, the value of TK in the global economy, Role of Government to harness TK.

Total Hours:15**Textbooks:**

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, New Delhi.

SEMESTER V

B.Tech. -Food Technology

2025-2026

25BTFT501

SEMESTER-V

REFRIGERATION AND COLD 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 the 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 this course, the student 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

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants, 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; Cold Storage practice, Stacking and handling of materials, Optimum temperatures of storage for different 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 CHILLING & FREEZING 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 Hours: 45

SUGGESTED BOOKS:

1. Cold Chain Management (Springer Series in Advanced Manufacturing), 1st Edition, Springer International, October 2023.
2. The Complete Book on Cold Storage, Cold Chain & Warehouse, 5th Edition, Ajay Kumar Gupta, Niir Project Consultancy, 2022 (6th edition likely released recently).
3. Adams M.R and Moss M.O, (2007). “Food Microbiology”, 2nd Edition, Third reprint, Panima Publishing Corporation, New Delhi,
4. William C Frazier and Dennis C. Westoff, (2008). “Food Microbiology”, Special Edition, Springer, The Mc Graw-Hill Companies.
5. Montville, Thomas J. and Karl R. Matthews “Food Microbiology: An Introduction”. ASM Press, 2005.

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>

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|------------|-----|-----|-----|-----|-----|----------|-----|----------|------|----------|----------|
| C301.1 | 3 | 3 | - | - | - | - | - | 2 | - | 2 | - | 3 | 3 |
| C301.2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | 3 |
| C301.3 | 3 | 2 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C301.4 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C301.5 | 3 | 2 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C301 | 3 | 2.2 | - | - | - | - | - | 2 | - | 2 | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’ - No Correlatio

DAIRY TECHNOLOGY

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 the 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 this course, the student 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 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

Milk Processing, storage tanks, Pasteurization – HTST –LTLT - UHT methods - Sterilization, Homogenization-theory- Working principle – efficiency, Filtering and Clarification of Milk- Cream separation- Gravity and centrifugal separation– parts-construction and working principle– separation efficiency.

UNIT – III BOTTLE, CAN WASHING AND FILLING EQUIPMENT'S

9

Plant piping and Pumps - Bottle and can washers-types of washers, equipment maintenance and sanitation-Fillers - types of fillers, filling process, pouch filling form fill seal machines - aseptic filling, cleaning and sanitization - CIP cleaning- types of CIP systems – Energy use and conservation in Dairy plant.

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 for cheese production – construction details. Ice cream - ingredients – preparation of ice cream mix - freezing – batch and continuous freezers- Special milks - Quality aspects of dairy products.

9

UNIT – V FERMENTED AND DEHYDRATED DAIRY PRODUCTS

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 hours: 45

SUGGESTED READINGS:

1. Emerging Dairy Processing Technologies: Opportunities for the Dairy Industry, 1st Edition, Wiley-Blackwell, 2022.
2. Novel Dairy Processing Technologies: Techniques, Management and Energy Conservation, 1st Edition, Apple Academic Press, 2018.
3. NIIR Board. Modern Technology of Milk Processing and Dairy Products. NIIR Project Consultancy Services, 4th Edition, 2013.
4. Tufail Ahmad. Dairy Plant Engineering and Management. Kitab Mahal Publishers. New Delhi, 2016.
5. Frazier WC and Westhoff DC. Food Microbiology. McGraw Hill. 11th reprint, 2017.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C302.1 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C302.2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C302.3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C302.4 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C302.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C302 | 2.4 | 1.8 | - | - | - | - | - | - | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

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

COURSE OUTCOMES:

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

- Summarize the proximate composition of the given food sample.
- Interpret the physical, chemical and quality standards of lipids, proteins and carbohydrates.
- Outline 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

Chromatography: Theory & Principle, chromatographic parameter (partition coefficient, capacity factor, retention & dead time, Resolution& their calculation), components of chromatography & types (paper, thin layer & partition) Advance chromatography: GC, HPLC & HPTLC (principle, instrumentation & application). Separation technique & analysis

UNIT – V ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY

9

Electrophoresis: Paper & gel electrophoresis, PAGE, iso-electric focusing, 2D electrophoresis, Immuno electrophoresis. Polarimetry, 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 hours: 45

SUGGESTED BOOKS:

1. Ismail, B. Pam & Nielsen, S. Suzanne (eds.), Nielsen’s Food Analysis Laboratory Manual, 4th Edition, Springer, Cham (2024).
2. Shukla, Ashutosh Kumar (ed.), Advanced Spectroscopic Techniques for Food Quality, Royal Society of Chemistry (May 2022).
3. Nielson, S. Suzanne. Food Analysis. Springer, 5th Edition, 2017.
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 and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|------------|-----|-----|-----|-----|-----|-----|-----|------|------|----------|----------|
| C303.1 | 2 | 3 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C303.2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C303.3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C303.4 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C303.5 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C303 | 2 | 1.6 | - | - | - | - | - | - | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

(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 hours: 30

25BTFT542

SEMESTER-V

**FRUITS AND VEGETABLES PROCESSING TECHNOLOGY
(THEORY AND 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 the students:**

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

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

- Summarize the proximate composition of the given food sample.
- Interpret the physical, chemical and quality standards of lipids, proteins and carbohydrates.
- Outline 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 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- Dole system and Scholle system for bulk storage in Bag and Boxes and Bag & Drums. Storage of Aseptically packed products.

Total hours: 45

SUGGESTED BOOKS:

1. Selvamuthukumar, M. (Ed.), Non-Thermal Processing Technologies for the Fruit and Vegetable Industry, 1st Edition, CRC Press, 2023.
2. Goyal, M.R. & Ahmad, F. (Eds.), Quality Control in Fruit and Vegetable Processing: Methods and Strategies, 1st Edition, Apple Academic Press, 2023.
3. Hui Y. H. Hand Book of Vegetable Preservation and Processing. Mercel Dekker, New York, 2nd Edition, 2015.
4. P. Fellows. Food processing Technology: Principles and Practice”. Wood Head publishing Limited, Cambridge, England, 4th Edition, 2016.
5. James G. Brennan. Food Processing Hand book. Wiley-Ych Verlag GmbH & Co KgaA, Weinheim, Germany, 2006.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|-----|-----|-----|-----|-----|-----|-----|----------|------|----------|----------|
| C304.1 | 1 | 3 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C304.2 | 1 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C304.3 | 2 | - | - | - | - | - | - | - | - | 2 | - | 2 | 2 |
| C304.4 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C304.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C304 | 1.8 | 1.6 | - | - | - | - | - | - | - | 2 | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

(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 hours: 30

25BTMC551G

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, KeyEstablishment Protocols, Introduction, Key transport based on symmetric encryption, RSAKey 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, 3rd Edition 2003, ISBN13: 978-1259029882
3. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, ComputerForensics 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

CO, PO and PSO Mapping

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|----------|-----|-----|-----|-----|----------|----------|-----|----------|----------|----------|----------|
| C305.1 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | 1 | 1 | 1 |
| C305.2 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | 1 | 1 | 1 |
| C305.3 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | 1 | 1 | 1 |
| C305.4 | 3 | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C305.5 | 3 | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C305 | 3 | 2 | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, ‘-’ - No Correlation

25BTFT511

SKILL DEVELOPMENT I
NEW PRODUCT DEVELOPMENT

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. New Food Product Development: Global Strategies and Practices for Successful Innovation, 4th Edition, CRC Press / Taylor & Francis, March 31, 2025.
2. Consumer-based New Product Development for the Food Industry, 1st Edition, RSC Publishing, 2021.
3. Earle, M., & Earle, R. (Eds.). Case studies in food product development. Elsevier, 2007.

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 and PSO Mapping

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|----------|-----|-----|-----|-----|----------|----------|-----|------|----------|------|------|
| C306.1 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | 1 | 1 | 1 |
| C306.2 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | 1 | 1 | 1 |
| C306.3 | 3 | 2 | - | - | - | - | 1 | 1 | - | - | 1 | 1 | 1 |
| C306.4 | 3 | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C306.5 | 3 | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C306 | 3 | 2 | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, '-'- No Correlation

25BTFT591**FIELD PROJECT/ 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

25BTHS601G

Semester-VI

UNIVERSAL HUMAN VALUES

2H - 2C

Instruction Hours/week: L:2 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 help students to understand the need, basic guidelines, content and process of value education and distinguish between values and skills.
- To help students initiate a process of dialog within themselves to know what they ‘really want to be’ in their life and profession
- To help students to understand the meaning of happiness within their selves and the meaning of prosperity for a human being.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Illustrate the significance of value inputs in a classroom, distinguish between values and skills. **(K2)**
- Interpret the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society **(K2)**
- Distinguish between the Self and the Body; understand the meaning of Harmony in the Self the Co-existence of Self and Body. **(K4)**
- Illustrate the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships. **(K2)**
- Identify their role in ensuring a harmonious society. **(K3)**

UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 10

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 10

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 10

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

Total Hours: 30

TEXT BOOKS:

1. R R Gaur, R Sangal and 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, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.
7. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
8. A N Tripathy, 2003, Human Values, New Age International Publishers.

Website URLs:

1. <https://fdp-si.aicte-india.org/>
2. https://uhv.org.in/UHV-I_Course_Material
3. <https://uhv.org.in/>

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|-----|-----|-----|-----|-----|----------|----------|----------|-----|------|----------|------|------|
| C307.1 | - | - | - | - | - | - | 3 | 2 | - | - | 2 | - | - |
| C307.2 | - | - | - | - | - | - | 3 | 2 | - | - | 2 | - | - |
| C307.3 | - | - | - | - | - | 1 | 3 | 2 | - | - | 2 | - | - |
| C307.4 | - | - | - | - | - | - | 3 | 2 | - | - | 2 | - | - |
| C307.5 | - | - | - | - | - | - | 3 | 2 | - | - | 2 | - | - |
| C307 | - | - | - | - | - | 1 | 3 | 2 | - | - | 2 | - | - |

25BTFT641

SEMESTER-VI

**FOOD ADDITIVES
(THEORY AND 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 the 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 this course, the student 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), 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.

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.

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

Role of emulsifiers, different classes of emulsifiers, 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.

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, 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. Trends in food colors and sweeteners.

Total Hours: 45

TEXT BOOKS:

1. Food Additives and Their Impact on Health, 1st Edition, Delve Publishing, 2025.
2. Chemistry of Food Additives and Preservatives, 1st Edition, Wiley, 2023–24.
3. Peter A Williams and Glyn O Philips, “Gums and stabilizers for the Food Industry”, RSC, 2006.

REFERENCE BOOKS:

1. Wilson, R. “Ingredient Handbook Sweeteners”, Blackwell, 2007.
2. Emerton, V. “Food Colors”, Blackwell, 2008.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|-------------|-----|-----|-----|-----|-----|-----|-----|------|------|----------|----------|
| C308.1 | 2 | 3 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C308.2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C308.3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C308.4 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C308.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C308 | 2 | 1.16 | - | - | - | - | - | - | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

(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 Hours: 30

25BTFT642

SEMESTER-VI

**BAKERY AND CONFECTIONARY TECHNOLOGY
(THEORY AND 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 the students:**

- To summarize the principles of baking on bread and cake.
- To demonstrate 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 this course, the student 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, Contemporary status of bakery in India structure, Types of wheat, Dough rheology, baking principles, Role of ingredients: essential and optional and its chemistry - Emphasis on modern alternatives such as plant-based shortenings, clean label emulsifiers, and antioxidants- Types of flour, enrichment of flour-Varieties of bread- Methods of bread preparation, advantages and disadvantages, qualities of a good loaf, bread spoilage: causes and prevention. cake- types of cakes- cake mixing methods – Preparation of cakes- 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 of confectionary products - 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- Processing steps and technologies for hard candy- Manufacturing processes for fondants, powdered fondants, and creams- Processing techniques: mixing, emulsification, cooking,

browning, cooling, and forming.

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-Rates of mixing, energy input in mixing & Froude number- emulsification and homogenization. Forming-Pie & biscuit formers- Bread and confectionery moulders- Design and maintenance of bakery and confectionery plants: principles of food plant design, site selection, and layout. Detailed exploration of classical and modern layouts.

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. V. Lakshmi Jagarlamudi (Ed.), “Bakery and Confectionery Products: Processing, Quality Assessment, Packaging and Storage Techniques”, CRC Press (Taylor & Francis), 2024.
2. S.M.D. Mathuravalli, “Textbook of Bakery and Confectionery”, New Pragati House, 2021.
3. The Complete Technology Book on Bakery Products: Baking Science with Formulation & Production, 5th Revised Edition, August 2023.

CO, PO and PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|-------------|----------|----------|-----|-----|-----|-----|-----|------|------|----------|----------|
| C309.1 | 2 | 3 | 1 | 1 | - | 1 | - | - | 1 | - | 1 | 2 | 2 |
| C309.2 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | - | 1 | 2 | 2 |
| C309.3 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | - | 1 | 2 | 2 |
| C309.4 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | - | 1 | 2 | 2 |
| C309.5 | 2 | 1 | 1 | 1 | - | 1 | - | - | 1 | - | 1 | 2 | 2 |
| C309 | 2 | 1.16 | 1 | 1 | - | 0.4 | - | - | 1 | - | 1 | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

(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 Hours: 30

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 the 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 this course, the student 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, Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials-Cleaning and Disinfection- Risk Assessment, Risk management, Risk Communication- 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 - Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC) - Advisory mechanisms: JECFA, JEMRA, JMPR- Codex Alimentarius Commission - CODEX European Food Standards Authority (EFSA) – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – 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 – 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 POINTS**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 Hours: 45**SUGGESTED READINGS:**

1. Virag Gupta, “The Food Safety and Standards Act, 2006 along with Rules and Allied Regulations”, 18th Edition, Commercial Law Publishers, New Delhi, 2025.
2. FSSAI, “Manual for Food Safety Officers”, First Edition, Food Safety and Standards Authority of India, New Delhi, 2017.
3. Barach JT. FSMS and Food Safety Systems: Understanding and implementing the rules. Wiley, 1st Edition, 2017.
4. Fortin ND. Food Regulation. Wiley, 2nd Edition, 2016.
5. Shaw IC. Food Safety: The science of keeping food safe. Wiley-Blackwell Publishing. 2nd Edition, 2018.
6. Mariott NG, Schilling MW and Gravani RB. Principles of Food Sanitation. Springer, 6th Edition, 2018.

CO, PO and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|-------------|----------|-----|-----|-----|-----|-----|-----|------|------|----------|----------|
| C310.1 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C310.2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C310.3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C310.4 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| C310.5 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |
| C310 | 2 | 1.16 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |

1 - Low, 2 -Medium, 3 - High, ‘-’ - No Correlation

25BTFT611

SKILL DEVELOPMENT II

Semester-VI

FOOD QUALITY DETECTION AND ANALYSIS

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 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**9**

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**9**

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**9**

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**9**

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**9**

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

TEXT BOOKS:

1. Ashutosh Kumar Shukla (Ed.), "Spectroscopic Tools for Food Analysis", IOP Publishing, 1st Edition, 2020.
2. R. Jeya Shakila & G. Jeyasekaran, "Aquatic Food Quality and Safety Assessment Methods", CRC Press, 1st Edition, 2021.
3. Adriana S. Franca and Leo M.L. Nollet (Eds.), "Spectroscopic Methods in Food Analysis", CRC Press, 1st Edition, 2018.

CO, PO and PSO Mapping

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|----------|-----|-----|-----|-----|----------|-----|-----|----------|----------|----------|----------|
| C310.1 | 3 | 2 | - | - | - | - | 1 | - | - | 1 | 1 | 1 | 1 |
| C311.2 | 3 | 2 | - | - | - | - | 1 | - | - | 1 | 1 | 1 | 1 |
| C311.3 | 3 | 2 | - | - | - | - | 1 | - | - | 1 | 1 | 1 | 1 |
| C311.4 | 3 | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C311.5 | 3 | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| C311 | 3 | 2 | - | - | - | - | 1 | - | - | 1 | 1 | 1 | 1 |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

Instruction Hours/week: L:0 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

2025-2026

25BTFT701

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 issues – 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 Hours: 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 and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|----------|-----|-----|-----|-----|----------|----------|-----|-----|------|------------|------|------|
| C401.1 | 2 | - | - | - | - | 2 | 3 | - | - | - | 2 | - | - |
| C401.2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| C401.3 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| C401.4 | - | - | - | - | - | - | - | - | - | - | 3 | - | - |
| C401.5 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| C401 | 2 | - | - | - | - | 2 | 3 | - | - | - | 2.2 | - | - |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

25BTFT702

SEMESTER-VII

**PROCESS ECONOMICS AND PLANT
LAYOUT DESIGN**

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 the 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, the student 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**

Introduction, food process in Technical feasibility survey of Food Industry, process development, - Food Process flow sheets, Hygienic food process design – CIP Systems- Working principles and operating procedures. 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 food 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 Plant Layout based on process and product.

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). – 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 Hours: 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 and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|------------|-----|-----|----------|----------|----------|----------|----------|----------|----------|----------|
| C402.1 | 2 | 1 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 1 |
| C402.2 | 2 | 1 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 1 |
| C402.3 | 3 | 2 | 2 | - | - | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 |
| C402.4 | 2 | 1 | 1 | - | - | - | 1 | - | 1 | 1 | 1 | 1 | 1 |
| C402.5 | 2 | 1 | 1 | - | - | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 |
| C402 | 2.2 | 1.2 | 1.2 | - | - | 1 |

1 - Low, 2 -Medium, 3 - High, '-' - No Correlation

25BTFT741

SEMESTER-VII

**FOOD PACKAGING TECHNOLOGY
(THEORY AND 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 the 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, the student 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 controlling of 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, Gas and water vapour transmission rates.

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

Metallic can types - Tin cans and Aluminum 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 - Sustainable alternatives to metal cans and Glass jars.

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, Polyvinylidene Chloride, Polyvinyl chloride, Copolymers and their applications - 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 – Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements - Filling and sealing of pouches - Applications of form fill seal machines – Automated and AI driven packaging processes.

UNIT V - ADVANCES IN FOOD PACKAGING**9**

Aseptic Packaging, Active packaging, Modified atmosphere packaging – principles, applications. Biodegradable packaging & Sustainable packaging, Antimicrobial Packaging, Edible packaging films and coating. Packaging for non-thermal food products. Sensors in food packaging with their applications, Intelligent Packaging – Time-temperature indicators, RFID, Tamper evident packaging – Nanotechnology in Food Packaging.

Total Hours: 45**SUGGESTED READINGS:**

1. Avik Mukherjee, Santosh Kumar, Manjusri Misra & Amar K. Mohanty (Eds.), “Smart Food Packaging Systems”, Wiley, 1st Edition, November 2024.
2. Ashutosh Kumar Shukla (Ed.), “Food Packaging: The Smarter Way”, Springer Singapore, 1st Edition, January 2022.
3. Amrita Poonia & Tejpal Dhewa (Eds.), “Edible Food Packaging: Applications, Innovations and Sustainability”, Springer Singapore, 1st Edition, February 2022.
4. Gordon L. Robertson. Food Packaging Principles & Practice. CRC Press, 2016.

CO, PO and PSO Mapping

| CO's | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---------------|------------|------------|-----|-----|-----|------------|-----|----------|----------|----------|----------|----------|------------|
| C403.1 | 3 | 1 | - | - | - | 1 | - | - | 2 | 1 | 2 | 1 | 1 |
| C403.2 | 3 | 1 | - | - | - | 1 | - | - | 2 | - | 2 | 1 | 1 |
| C403.3 | 3 | 1 | - | - | - | 1 | - | - | 2 | - | 2 | 1 | 1 |
| C403.4 | 2 | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 1 | 1 |
| C403.5 | 3 | 1 | - | - | - | 2 | - | 1 | 2 | 1 | 2 | 1 | 2 |
| C403 | 2.8 | 1.4 | - | - | - | 1.2 | - | 1 | 2 | 1 | 2 | 1 | 1.2 |

1 - Low, 2 -Medium, 3 - High, ‘-’- No Correlation

(ii) Laboratory

List of Experiments:

1. Measurement of thickness of packaging material
2. Measurement of basic weight and grammage of paper and paperboards
3. Measurement of water absorption of paper and paper boards (cobb tests)
4. Study of vacuum packaging and machine, bottle filling machine and form-fill seal machine.
5. Determination of lacquer integrity test.
6. Determination of water vapor transmission rate of packaging material
7. Determination of grease resistance of papers used in food industry – butter paper and toffee wraps
8. Estimation of the shelf life of edible coated food samples
9. Experiment on sealing of plastic cups
10. Determination of Oxygen Transmission Rate (OTR) of packaging films

Total Hours: 30

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

2025-2026

25BTFT891

PROJECT WORK PHASE II

**Semester-VIII
16H-8C**

Instruction Hours/week: L:0 T:0 P:16

Marks: Internal:160 External: 240 Total:400

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

2025 - 2026

25BTFT5E01

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 -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, rotary, hydraulic press, screw press, expellers - principle of operation and maintenance. Solvent extraction process – batch and continuous process-Extraction process for rice bran, soy bean, sunflower, groundnut and cotton seed. Production of special oils – palm oil and virgin coconut oil.

UNIT III - REFINING OF OILS

9

Refining of oils – objectives – degumming – deacidification process – continuous acid refining-bleaching of oil – deodorization- winterization -hydrogenation of oil –selectivity – catalyst –batch type hydrogenation – production process- 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 Hours: 45**SUGGESTED READINGS:**

1. Wolf Hamm, Richard J. Hamilton & Gijs Calliauw (Eds.), “Edible Oil Processing”, 2nd Edition, Wiley-Blackwell, 2013.
2. Ernesto M. Hernandez & Afaf Kamal-Eldin, “Processing and Nutrition of Fats and Oils”, 1st Edition, Wiley-Blackwell (IFT Series), 2013.
3. Gunstone F.D., (2011) “Vegetable Oils in Food Technology: Composition, Properties and Uses”, 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

25BTFT5E02

FOOD PROCESSING AND PRESERVATION**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 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.

Total Hours: 45

SUGGESTED READINGS:

1. B. Sivasankar, “Food Processing and Preservation”, PHI Learning Pvt. Ltd., 2013.
2. Ramaswamy H. and Marcotte M., “Food Processing: Principles and Applications”, 2nd Edition, CRC Press, 2014.
3. Khetarpaul, Neelam. “Food Processing and Preservation.” Daya Publications, 2005
4. Singh, M.K. “Food Preservation” Discovery Publishing, 2007.
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.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’ - No Correlation

CEREALS AND PULSES TECHNOLOGY

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.

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 - Bran and 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.

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 – Pulse milling machineries - dehusking in Pulse Pearler - Mini dhal mill - working principle - advantages and disadvantages – pulse milling efficiency.

Total Hours: 45

SUGGESTED READINGS:

1. Gopal Kumar Sharma, Anil Dutt Semwal & Dev Kumar Yadav (Eds.), “Advances in Cereals Processing Technologies”, CRC Press / NIPA, 1st Edition, 2022.
2. Chakraverty, A. Post-Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 3rd Edition, 2018.
3. Harish Kumar Sharma & Navneet Kumar, “Agro-Processing and Food Engineering: Operational and Application Aspects”, Springer, 2022.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 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 Hours: 45

SUGGESTED READINGS:

1. Bryan McGee & Peter Erling (Eds.), “Handbook Grain Milling and Hulling”, 1st Edition, Erling Verlag GmbH, 2024.
2. Gopal Kumar Sharma, Anil Dutt Semwal & Dev Kumar Yadav (Eds.), “Advances in Cereals Processing Technologies”, 1st Edition, CRC Press / NIPA, 2022.
3. Khader, Vijaya and Vimala, V., —Grain Quality and Processing, Agrotech Publishing, Udaipur, 2007.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’ - No Correlation

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 Hours: 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.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Professional Elective – II

B. Tech. – Food Technology
25BTFT5E06

2025 - 2026
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 Hours: 45

SUGGESTED READINGS:

1. Shivani Pathania and Brijesh K. Tiwari (Eds.), “Food Formulation: Novel Ingredients and Processing Techniques”, John Wiley & Sons, 1st Edition, April 2021.
2. Jennifer E. Norton, Peter Fryer & Ian T. Norton (Eds.), “Formulation Engineering of Foods”, Wiley, 1st Edition, August 2013.
3. Ken Prusa & Kate Gilbert, “Food Product Development Lab Manual”, 1st Edition, Iowa State University Digital Press, Ames, USA, August 2021.
4. J Pokorny, N Yanishlieva, and M Gordon, 2001, Antioxidants in Food, Published by Woodhe Publishing Limited, Abington Hall, Abington.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

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 & PREBIOTIC**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 Hours: 45**SUGGESTED READINGS:**

1. Dejian Huang, Liangli (Lucy) Yu (Eds.), “Evidence-based Nutraceuticals and Functional Foods”, Royal Society of Chemistry (RSC), 1st Edition, May 2025.
2. Watson, Robald Ross “Functional Foods and Nutraceuticals in Cancer Prevention”. Blackwell Publishing, 2007.

CO, PO and PSO Mapping

| CO's | 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 | 2 |

1 - Low, 2 - Medium, 3 - High, '-'- No Correlation

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**

Confectionery: Definition and types, Traditional confectionery goods, Forms of sugar in confectioneries and their properties: caramel, maltose, corn syrup, glucose syrup, honey, icing sugar, colours used in confectionery, High boiled sweets, flavouring in confectionery, Industrial production, factors affecting quality.

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 Hours: 45

SUGGESTED READINGS:

1. R. Guy (Ed.), "Extrusion Cooking: Technologies and Applications", Woodhead Publishing, 2001.
2. S.N. Saxena, "Snack Foods Processing", CBS Publishers & Distributors Pvt. Ltd., 2021.
3. B.D. Kulkarni, "Modern Technology of Extruded Snacks Food", Asia Pacific Business Press Inc., 2016.

CO, PO and PSO 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 | 2 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

**ANALYTICAL METHODS FOR
FOOD PRODUCTS****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, 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, 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

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). Preparation of sample for Fish and Processed Fish, Frozen Fish- Determination of Histamine, Dried fish- Moisture content, Sodium chloride content, Acid insoluble ash. Detection test for adulterants and contaminants, Alkaline phosphatase test, Turbidity test, Determination of Total solids, Determination of fat.

Total Hours: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 and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours:45

SUGGESTED READINGS:

1. D.G. Rao, “Fundamentals of Food Engineering (Chapter on Beverages)”, PHI Learning Pvt. Ltd., 2010.
2. Ramesh C. Chandan and Arun Kilara, “Dairy Processing and Quality Assurance”, Wiley-Blackwell, 2011.
3. L. Jagan Mohan Rao and K. Ramalakshmi (2011) “Recent trend in Soft beverages”, Woodhead Publishing India Pvt. Ltd.
4. Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.
5. Ashurst, P.R, “Chemistry and technology of Soft drink and fruit juices”, 2nd edition, Blackwell Publishing Ltd. 2005.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 | 2 | 2 |
| Avg. | 2 | 1.16 | 1 | - | - | - | - | - | - | - | 1 | 2 | 2 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

PROFESSIONAL ELECTIVE - III

B. Tech. - Food Technology
25BTFT6E01

2025 - 2026
Semester-VI

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 – TYPRES OF 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 IN NEW PRODUCT DEVELOPMENT**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 Hours:45**SUGGESTED READINGS:**

1. Varela, P. e G. Ares; Novel Techniques in Sensory Characterization and Consumer Profiling, CRC Press, 2014.
2. Schaffner, D. J., W. R. Schroeder e M. D. Earle; Food Marketing: An International Perspective 2nd ed, McGraw Hill, 2003.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

**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 Hours: 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. C.N. Sontakki. 2014. Marketing Management. Kalyani Publishers, New Delhi.
3. 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 and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 SYSTEMS

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 develop Total Hours.

Total Hours:45

SUGGESTED READINGS:

1. Jain, M. K., Iyengar, S. R. K. and Jain, (New Age International, 2007)
2. Sastry, S. S. Introductory Methods of Numerical Analysis. (Prentice Hall of India, 2007)
3. I. Atkinson, K. Elementary Numerical Analysis, (Wiley, 2006)

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 | 1.1 | 1 | - | - | - | - | - | - | - | - | 2 | 2 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

ENERGY CONSERVATION IN FOOD DESIGN

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 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, Waste-Heat 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 Hours:45

SUGGESTED READINGS:

1. Wang, L. Energy Efficiency & Management in Food Processing (CRC Press, 2009)
2. I. Mattsson, B. and Sonesson, U. Environmentally Friendly Food Processing, (CRC Press, 2003)

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours: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, nineteenth reprint.
4. S. Baskar (2004),” Instrumentation control system measurements and controls”Anuradha Agencies Publishers.
5. Bakshi.U.A and A.V.Baksi 2004. Measurements and Instrumentation. Technical Publications Pune.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

PROFESSIONAL ELECTIVE – IV

B. Tech. Food Technology

2025-2026

25BTFT6E06

Semester-VI

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 industrial waste 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-PRODUCT 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 Hours:45

SUGGESTED READINGS:

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 2008.
2. S.N. Jogdhand, Environmental Biotechnology: Industrial Pollution Management, (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 - Human Exposure and Risks, John Wiley & Sons Publishers, 2003.
6. Vasso Oreopoulou and Winfried Russ. “Utilization of by-products and Treatment of Waste in the Food Industry”. Springer, 2007.
7. Patwardhan., Industrial Waste Water Treatment, Prentice-Hall of India Pvt Ltd, 1st edition, 2008.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours:45**SUGGESTED READINGS:**

1. Suvendu Bhattacharya, Conventional and Advanced Food Processing Technologies, Wiley Publishers, 2015.
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. Heath, HB, Flavour chemistry and technology, CBS Publ., New Delhi, 2005.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours:45

SUGGESTED READINGS:

1. Meskin, Mark S., W.R. Bidlack and R.K. Randolph. "Phytochemicals : Nutrient-Gene Interactions". CRC / Taylor & Francis, 2006.
2. Premier, Robert. "Phytochemicals in Food". Blackwell, 2010.
3. Johnson, Ian and Gary Williams. "Phytochemical Functional Foods". CRC Press, 2003.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours:45

SUGGESTED READINGS:

1. V. P. Singh, “Livestock Products Technology”, 1st Edition, NIPA, New Delhi, 2021.
2. Faslu Rahman C. K., Bedika Bora & Ashim Kumar Biswas, “Encyclopedia of Livestock Products Technology: A Comprehensive Reference”, 1st Edition, Elite Publishing House, 2023.
3. Jhari Sahoo Chatli & Manish Kumar, “Textbook on Meat, Poultry and Fish Technology”, 1st Edition, Daya Publishing House, 2021.
4. Mead, G. C.2004. Poultry meat processing and quality. CRC Press. Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, England.

CO, PO, PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

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 Hours: 45**SUGGESTED READINGS:**

1. Kshirod Kumar Dash & Sourav Chakraborty (Eds.), “Food Processing: Advances in Non-Thermal Technologies”, 1st Edition, CRC Press, 2021.
2. M. Selvamuthukumaran (Ed.), “Non-Thermal Processing Technologies for the Fruit and Vegetable Industry”, 1st Edition, CRC Press, 2023.
3. O.P. Chauhan, “Non-Thermal Processing of Foods”, 1st Edition, Taylor & Francis (CRC Press), 2025.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| CO1 | 2 | - | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 |
| CO2 | - | - | - | - | - | - | - | - | 1 | 1 | 1 | 2 | 2 |
| CO3 | - | - | 2 | - | 3 | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO4 | 1 | - | - | 2 | 3 | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO5 | 1 | 1 | - | - | - | - | - | - | 2 | 2 | - | 1 | 2 |
| Avg. | 1.3 | 1 | 2 | 2 | 3 | - | - | - | 1.4 | 1.4 | 1.6 | 1.8 | 2 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

PROFESSIONAL ELECTIVE V

B. Tech. – Food Technology

2025 - 2026

25BTFT7E01

Semester-VII

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 Hours: 45

SUGGESTED READINGS:

1. Dr. Prerana Shere and Dr. Rinku Agrawal, “Extrusion Technology: Transforming Food Processing”, B.P. International, 1st Edition, April 2024.
2. Leszek Moscicki (Ed.), “Extrusion-Cooking Techniques: Applications, Theory and Sustainability”, Wiley-VCH, 1st Edition, 2011.
3. Richardson P., Thermal Technologies in Food Processing, Wood head Publishers, Cambridge, CRC Press, 2001.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’- No Correlation

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 Hours: 45

SUGGESTED READINGS:

1. Helferich, William and Carl K.Winter, Food Toxicology, CRC Press, 2001.
2. Alluwalla 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 and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours: 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 and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|--------|-----|-----|-----|------|-----|-----|-----|-----|-----|------|------|------|------|
| 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’ - No Correlation

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 cryogenics (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 Hours: 45

SUGGESTED READINGS:

1. Zuyu Zhao & Chao Wang (Eds.), “Cryogenic Engineering and Technologies: Principles and Applications of Cryogen-Free Systems”, 1st Edition, CRC Press, 2020.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, ‘-’ - No Correlation

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

- To discuss in detail 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 Hours: 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 and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

**PROFESSIONAL ELECTIVE VI
SEMESTER VII**

B. Tech. – Food Technology

2025 - 2026

25BTFT7E06

FOOD BIOTECHNOLOGY

**Semester-VII
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, 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 Hours: 45

SUGGESTED READINGS:

1. B.D. Singh. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
2. Bielecki S., Ed., Polak J., J. and Bielecki, Tramper S., Food Biotechnology, Elsevier Science Publishing Company, New Delhi, 2000.
3. Gutierrez, Gustavo F., Food Science and Food Biotechnology, CRC Press, New York, 2003.
4. Rita Singh, Food Biotechnology, Global vision publication house, Delhi, 2004.
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 | 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 | 2 |
| Avg. | 2 | - | - | 1.5 | - | 2 | 2 | 2 | - | - | 2 | 2 | 2 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25BTFT7E07

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 Hours: 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 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours: 45

SUGGESTED READINGS:

1. Hui Y. H., "Food Drying Science and Technology, Microbiology, Chemistry, Application", CHIPS, 2008
2. Paul Singh, R and Dennis R. Heldman. Introduction to Food Engineering Academic Press, 2001
3. Loasecke H.W.V., Drying and dehydration of Foods, Agrobios, Jodhpur, 2001
4. Kudra, T and Majumdar, A.S., Advanced Drying Technologies, Marcel Dekker Inc., New York, 2002.
5. Loeseck ,H. W. V, "Drying & Dehydration of Foods", Published by Agrobios, 2005.
6. Arun S. Mujumdar, "Handbook of Industrial Drying", CHIPS, 3rd Edition, 2006.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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, lipolytic 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 Hours: 45

SUGGESTED READINGS:

1. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009
2. L.E.Casida, Industrial Microbiology, New Age International(p) Ltd N Delhi, 2007
3. W.C.frazier and D.C.Westhoff, Food Microbiology, Tata McGraw Hill publisher, 3rd edition, 2008

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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 Hours: 45**SUGGESTED READINGS:**

1. M.A. Rao, Rheology of Fluid and Semisolid Foods: Principles and Applications, Springer, 2014.
2. Jianshe Chen and Andrew Rosenthal, Modifying Food Texture: Volume 1 – Novel Ingredients and Processing Techniques, Woodhead Publishing, 2015.
3. Berk, Zeki. “Food Process Engineering and Technology”. Elsevier, 2009.

CO, PO and PSO Mapping

| CO No. | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | 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 |

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

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.

Total Hours: 45**SUGGESTED READINGS:**

1. Yesim Ozogul (Ed.), “Innovative Technologies in Seafood Processing”, CRC Press, 1st Edition, 2020.
2. Ioannis S. Boziaris (Ed.), “Seafood Processing: Technology, Quality and Safety”, Wiley, 1st Edition, 2013.

CO, PO and PSO Mapping

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

1 - Low, 2 - Medium, 3 - High, ‘-’ - No Correlation