

**FACULTY OF ENGINEERING**  
**DEGREE OF BACHELOR OF TECHNOLOGY**  
**IN**  
**FOOD TECHNOLOGY**

**DEPARTMENT OF FOOD TECHNOLOGY**

**CURRICULUM**  
**(2020 -2021)**



**KARPAGAM ACADEMY OF HIGHER EDUCATION**  
(Established Under Section 3 of UGC Act 1956)  
COIMBATORE 641 021 INDIA

**FACULTY OF ENGINEERING**  
**DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY (B. E. /B. Tech.)**

**REGULATIONS**  
**(2020)**

**CHIOCE BASED CREDIT SYSTEM**

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**FACULTY OF ENGINEERING**  
**DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY**  
**REGULAR PROGRAMME**

**REGULATIONS 2020**  
**CHOICE BASED CREDIT SYSTEM**

**These regulations are effective from the academic year 2020 – 2021 and applicable to the candidates admitted to B. E. / B. Tech. during 2020 - 2021 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) (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any similar Examination of any other University or authority accepted by the Karpagam Academy of Higher Education as equivalent thereto.

**(OR)**

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

**1.2** Candidates seeking admission to the first semester of the eight semesters B. Tech. (Food Technology) Degree Programme:

Should have passed the Higher Secondary Examination (10+2) (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry (or) Physics, Chemistry and Biology as three of the four subjects (or) Physics, Chemistry, Botany and Zoology as subjects of study under Part-III or any similar Examination conducted by any other authority accepted by the Karpagam Academy of Higher Education as equivalent thereto.

**(OR)**

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

**1.3 Lateral Entry Admission**

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education, Tamil Nadu or its equivalent and candidates who possess a Bachelor Degree in Science (10+2+3) with Mathematics as one of the subjects, awarded by any University or its equivalent are eligible to apply for admission to the third semester of B. E./B. Tech.. Such candidates shall undergo two additional engineering subjects in the 3<sup>rd</sup> and 4<sup>th</sup> semester as prescribed by the University.

**Eligibility criteria for admission in the first semester is given in the table below**

S.No	Programme	Eligibility criteria
1.	B. E. Automobile Engineering	Diploma in Automobile Engg./ Mechanical Engg / Metallurgy/ Mechanical and Rural Engg. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engg. / Tool and Die Design.
2	B.E Bio Medical Engineering	Diploma in Electrical & Electronics Engg. / Electronics & Communication Engg./ Computer Science Engg/ Mechatronics Engg/Computer Technology/Instrumentation Technology
3.	B. E. Civil Engineering	Diploma in Civil Engg./ Sanitary Engg. / Civil and Rural Engg.
4.	B. E. Computer Science and Engineering	Diploma in Computer Engg. / Electrical Engg./ Electronics Engg. / Electrical & Electronics Engg. / Electronics & Communication Engg. / Electronics & Telecommunication Engg./ Information Technology/ Computer Science / Instrumentation & Control Engg. / Electronics & Instrumentation.
5.	B. E. Electrical and Electronics Engineering	Diploma in Electrical Engg./ Electronics Engg. / Electrical & Electronics Engg. / Electronics & Communication Engg. / Electronics & Telecommunication Engg./ Information Technology/ Computer Science / Instrumentation & Control Engg. / Electronics & Instrumentation.
6.	B. E. Electronics and Communications Engineering	Diploma in Electronics Engg. / Electronics & Communication Engg. / Electrical Engg. / Instrument Technology / Electronics with specialization in Instrumentation / Electrical & Electronics Engg. / Information Technology/ Computer Science / Instrumentation & Control Engg./ Electronics & Telecommunication Engg.
7.	B. E.Mechanical Engineering	Diploma in Mechanical Engg./ Metallurgy/Automobile Engg./ Mechanical and Rural Engg. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engg. / Tool and Die Design
8.	B. Tech Biotechnology	Diploma in Chemical Engineering / Leather Technology / Diploma in Petrochemical Engg.
9.	B. Tech Chemical Engineering	Diploma in Chemical Engineering /Petrochemical Engg./ Chemical Technology/ Petroleum Engg/ Polymer Technology/ Plastic Technology/Sugar Technology/Pulp & Paper Technology/ Petro-Chemical Engg

10.	B. Tech Food Technology	Diploma in Food Technology/Chemical Engineering / Leather Technology / Diploma in Petrochemical Engg.
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#### 1.4 Migration from other University

Candidates who have completed their first to sixth semesters of B. E./B. Tech. study in any University are eligible to apply for admission to their next semester of B. E./B. Tech. in the branch corresponding to their branch of study. 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 Registrar, Competent authority, he/she has undergone. Equivalence Certificate shall be provided by the “Students’ Affairs Committee” of Karpagam Academy of Higher Education. Students’ Affairs Committee comprises all the Heads of the Departments and Dean of the Faculty of Engineering and a nominee of the Registrar.

## 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. Automobile Engineering
2. B.E Bio Medical Engineering
3. B. E. Civil Engineering
4. B. E. Computer Science and Engineering
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
8. B. Tech. Bio-Technology
9. B. Tech Chemical Engineering
10. B. Tech Food Technology

## 3. MODE OF STUDY

### 3.1 Full-Time:

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

**3.2** Conversion from full time mode of study to part time is not permitted.

**3.3** 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, in-plant training, 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/Red Ribbon club/Environment club and Energy club
- Other Co-Curricular and Extra Curricular activities

#### (V) Choice Based Credit System

CBCS is introduced for students admitted in the academic year 2017-18. As per AICTE guidelines, CBCS is an approach in which students opt for courses of their choice. CBCS provides greater flexibility with multiple courses and enable students to undergo additional courses. CBCS is applicable to Full Time Undergraduate & Post Graduate Programmes of study. It provides a choice for students to select from the prescribed courses (Professional soft core, Professional Hard 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 course. Students can exercise their choice among a set of Soft core courses from the list of Soft core courses specified for each Programme of study. The student should meet the criteria for prerequisites to become eligible to register for that course. The student should request for the course for every semester within the first week of semester. Maximum no of students to be registered in each course shall depend on availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

#### 4.2 Each course is normally assigned certain number of credits.

No. of credits per lecture period per week	: 1
No. of credits per tutorial period per week	: 1
No. of credits for 3 periods of laboratory course per week	: 2
No. of credits for 3 periods of project work per week	: 2
No. of credits for 2 periods of Value added course per week	: 1
No. of credits for 3 weeks of in-plant 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 3. However, the total number of courses per semester shall not exceed 8.

**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 are English.

#### 4.6 Value Added Course

Besides core courses and elective courses, value added course is introduced. The blend of different courses is so designed that the student would be trained not only in his / her relevant professional field but also as a socially conscious human being.

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

## **5. DURATION OF THE PROGRAMME**

**5.1** The prescribed duration of the programme shall be

<b>Programme</b>	<b>Min. No. of semesters</b>	<b>Max. No. of semesters</b>
B. E./B. Tech. ( H. Sc. Candidates)	8	14
B. E./B. Tech. (Lateral Entry Candidates)	6	12

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

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

## **6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER**

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

**6.2** A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean. However, the candidate has to pay prescribed condonation fees.

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

## **7. CLASS ADVISOR**

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



progress of the students. Each student shall be provided with course plan for each course at the beginning of each semester.

## **8. CLASS COMMITTEE**

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

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

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

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

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

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

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

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

## **9. COURSE COMMITTEE FOR COMMON COURSES**

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single



department or to several departments. The 'Course Committee' shall meet to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

## 10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

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

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

### THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Assignment	5
2.	Seminar *	5
3.	Attendance	5
4.	Test – I	8
5.	Test – II	8
6.	Test – III	9
<b>Continuous Internal Assessment : TOTAL</b>		<b>40</b>

\*Evaluation shall be made by a committee.

### PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
<b>Maximum Marks</b>	60
<b>Duration</b>	2 Hours
<b>Part- A</b>	1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. (9 x 2 =18Marks).
<b>Part- B</b>	Question 10 to 12 will be of either or type, covering two units of the syllabus. Each Question may have subdivision. (3 x 14 =42 Marks).

### PATTERN OF TEST QUESTION PAPER (Test III)

INSTRUCTION	REMARKS
<b>Maximum Marks</b>	100
<b>Duration</b>	3 Hours
<b>Part - A</b>	Part A will be online Examination. 20 Objective type Questions, Covering all the 5 units. (20 x 1= 20 Marks) (Online Examination).

<b>Part- B</b>	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. <b>(5 x 2= 10Marks).</b>
<b>Part- C</b>	Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. <b>(5 x 14=70 Marks).</b>

#### **PRACTICAL COURSES:**

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

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

#### **INTEGRATED THEORY AND PRACTICAL COURSES:**

The Continuous Internal Assessment for Integrated Theory Course is awarded for 40 Marks with mark split up similar to regular theory course.

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

#### **10.3 ATTENDANCE**

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

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

#### **10.4 PROJECT WORK/ INTERNSHIPS:**

Final year project work will be always 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 reputed institution/research organization/industry. Hence final year students may have commencement of eighth semester classes for 30 days in fast

track mode and complete their final semester and are made eligible for undergoing Internships in Industry and also interested students are permitted for doing projects in Industries.

### 10.5 CERTIFICATION COURSES:

Students have to undergo a minimum of one value added course beyond curriculum as a certified course per semester for duration not less than 30 hours.

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

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

### 12. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

### PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
<b>Maximum Marks</b>	100
<b>Duration</b>	3 Hours
<b>Part - A</b>	Part A will be online Examination. 20 Objective type Questions. Covering all the 5 units. <b>20*1= 20 Marks (Online Examination)</b>
<b>Part- B</b>	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. <b>(5 *2= 10Marks).</b>
<b>Part- C</b>	Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. <b>(5*14=70 Marks)</b>

### 13. PASSING REQUIREMENTS

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

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

**13.3.1** If a candidate fails to secure a pass in value added course, he/she has to appear for the tests when course is conducted subsequently.

#### **13.4 ONLINE COURSE (MOOC) COORDINATOR**

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a MOOC coordinator for the online courses. The Online course MOOC coordinator shall identify the courses which students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinator shall advise the students regarding the online courses and monitors their course.

**13.4.1** Student shall study at least one online course from Swayam/NPTEL in any one of the first seven semesters for which examination shall be conducted at the end of the course by the respective organization body. The student can register to the courses which are approved by the department. The student shall produce a pass certificate from the respective body before the end of the seventh semester.

#### **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:

<b>Letter grade</b>	<b>Marks Range</b>	<b>Grade Point</b>	<b>Description</b>
O	91 – 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE

C	55 – 60	5	AVERAGE
D	50 – 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

## 14.2 GRADE SHEET

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

- The list of courses enrolled during the semester and the grade scored,
- The Grade Point Average (**GPA**) for the semester and
- The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

**GPA** is the ratio of the sum of the products of the number of Credits (**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 semester. **RA** grade and value added course will be excluded for calculating **GPA** and **CGPA**.

## 14.3 REVALUATION

Revaluation and Re-totaling is 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.
- No disciplinary action is pending against him/her.

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 **8** shall be declared to have passed the Examination in First Class with Distinction.

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

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

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

## **17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION**

**17.1** A candidate may for valid reasons and on prior application, be granted permission to Withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

**17.2** Such withdrawal shall be permitted only once during the entire duration of the degree programme. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the Examination

**17.3** Withdrawal application is valid only if it is made within 10 days prior to the commencement of the Examination in that course or courses and recommended by the Head of the Department, Dean and approved by the Registrar.

**17.3.1** Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions may be considered on the merit of the case.

**17.4** Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during III semester.

**17.5** Withdrawal from the ESE is NOT applicable to arrear Examinations.

**17.6** The candidate shall reappear for the withdrawn courses during the Examination conducted in the subsequent semester.

## **18. PROVISION FOR AUTHORISED BREAK OF STUDY**

**18.1** Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying

prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, through the Head of the Department and Dean stating reasons thereof and the probable date of rejoining the programme.

**18.2** The total number of semesters for completion of the programme from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum no. of semesters specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18) in order that he/she may be eligible for the award of the degree (vide Clause 15). The candidate thus permitted to rejoin the programme at the commencement of the semester after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the curriculum and regulations in force at that period of time.

**18.3** The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause 17). However, additional break of study granted will be counted for the purpose of classification.

**18.4** The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18.3) in order that he/she may be eligible for the award of the degree.

**18.5** If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' (Clause 18 and 18 respectively).

**19. 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.

## **20. INDUSTRIAL VISIT**

Every student is required to undergo one industrial visit for every semester, starting from the third semester of the programme.

## **21. 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 into 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.

## **22. REVISION OF REGULATION AND CURRICULUM**

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



**VALUE ADDED COURSES (VAC)**

Value added courses are being offered from different areas for a period of 30 hours. Upon successful completion of VAC, certificates will be provided.

**TECHNOLOGY BUSINESS INCUBATOR (TBI)**

To encourage and motivate students to become an entrepreneur, Technology Business Incubator (TBI) are being initiated and operated to help the students to start their own startups in thrust areas related to their discipline.

**DEPARTMENT OF FOOD TECHNOLOGY****B.TECH FOOD TECHNOLOGY****PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

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

**PROGRAM OUTCOME (PO)**

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

- a. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- b. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- c. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- d. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- e. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- f. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- g. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- i. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give

and receive clear instructions.

- k. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- l. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### PROGRAMME SPECIFIC OUTCOMES (PSO)

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

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

#### PEO-PO mapping

	POa	POb	POc	POd	POe	POf	POg	POh	POi	POj	POk	POl
<b>PEO1</b>	✓	✓	✓	✓	✓					✓		
<b>PEO2</b>		✓	✓	✓		✓	✓	✓				
<b>PEO3</b>				✓					✓		✓	✓

#### PEO-PSO mapping

	PSO1	PSO2
<b>PEO1</b>	✓	✓
<b>PEO2</b>	✓	✓
<b>PEO3</b>		✓

SEMESTER I											
Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTCC101	English	2,3	a, b, e, h, i	2	0	2	3	40	60	100	25
20BTCC102	Mathematics-I	1,2,3	h, i, k, l	3	1	0	4	40	60	100	27
20BTCC103	Engineering Physics	2,3	a, b, c, e, h, i, k	3	1	3	5	40	60	100	29
20BTFT104	Basic Electrical Engineering	2,3	a, b, c, e, i, k	3	1	2	5	40	60	100	31
20BTFT105	Python Programming	1	a, b, d	3	0	4	5	40	60	100	33
TOTAL				15	1	12	22	200	300	500	
SEMESTER – II											
Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTCC201	Communicative English	1,2,3	h, i, k, l	3	1	0	4	40	60	100	36
20BTCC202	Mathematics-II	2,3	a, b, e, h, i	3	0	0	3	40	60	100	38
20BTFT203	Engineering Chemistry	2,3	a, b, c, d, e, f, i, k	3	0	4	5	40	60	100	40
20BTFT204	Engineering Graphics	1	a, d, e	1	0	4	3	40	60	100	43
20BTFT205	Engineering Properties of Food Materials	1,2,3	a, f, g, k ,l	3	0	0	3	40	60	100	45
20BTFT211	Environmental Studies	1,3	f, g, h, l	3	0	0	3	40	60	100	47
20BTFT212	Workshop Practices	2,3	a, c, d, g, i, l	0	0	4	2	40	60	100	49
TOTAL				16	1	12	23	280	420	700	

SEMESTER – III											
Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTFT301	Transforms and Partial differential Equations	1,2	a, b, c, d	3	1	0	4	40	60	100	51
20BTFT302	Food Process Calculations	1,2	a, b, c, d, l	3	0	0	3	40	60	100	53
20BTFT303	Food Microbiology	1,2,3	a, b, g, i, l	3	0	0	3	40	60	100	55
20BTFT304	Thermodynamics	1,2	a, b, c, d	3	0	0	3	40	60	100	57
20BTFT305	Food Chemistry	1,2,3	a, b, c, d	3	0	0	3	40	60	100	59
20BTFT306	Food Additives	1,3	a, h, l	3	0	0	3	40	60	100	61
20BTFT311	Food Microbiology Laboratory	1,2,3	a, b, c, f, i, l	0	0	4	2	40	60	100	63
20BTFT312	Food Chemistry Laboratory	1,2,3	a, b, c, f, i, l	0	0	4	2	40	60	100	64
20BTFT351	Constitution of India	3	L	1	0	0	-	100	-	100	65
TOTAL				19	1	8	23	420	480	900	

SEMESTER – IV											
Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTFT401	Probability and Statistics	2	a, b, c, d, l	3	1	0	4	40	60	100	67
20BTFT402	Fluid Mechanics	2,3	a, b, c, d	3	0	0	3	40	60	100	69
20BTFT403	Heat and Mass Transfer	2,3	a, b, c, d	3	0	0	3	40	60	100	71
20BTFT404	Unit Operations in Food Processing	1,2,3	a, b, c, d, f	3	0	0	3	40	60	100	73
20BTFT405	Food Biochemistry and Human Nutrition	1,2,3	a, c, f, g, l	3	0	0	3	40	60	100	75
20BTFT406	Waste Management in Food Industries	1,2,3	a, c, f, g, l	3	0	0	3	40	60	100	77
20BTFT411	Food Biochemistry Laboratory	1,2,3	a, b, c, d	0	0	4	2	40	60	100	79
20BTFT412	Unit Operation Laboratory	1,2,3	a, b, c, d, f	0	0	4	2	40	60	100	80
TOTAL				18	1	8	23	320	480	800	

SEMESTER – V											
Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTFT501	Dairy Technology	1,3	a, b, c,l	3	0	0	3	40	60	100	81
20BTFT502	Refrigeration, Air conditioning and Cold Storage Construction	1,2	a, g, i	3	0	0	3	40	60	100	83
20BTFT503	Food Safety Regulations	3	a, c , l	3	0	0	3	40	60	100	85
20BTFT504	Food Analysis	2,3	a, b, d, l	3	0	0	3	40	60	100	87
20BTFT505	Fruits and Vegetable Processing Technology	1,2	a, b, c, l	3	0	0	3	40	60	100	89
20BTFT5E	Professional Elective - I	-	-	3	0	0	3	40	60	100	-
20BTFT511	Food Analysis Laboratory	2,3	a , b, c, d, l	0	0	4	2	40	60	100	91
20BTFT512	Fruits and Vegetable Processing Laboratory	2,3	a, b, c, d, f, g,l	0	0	4	2	40	60	100	92
20BTFT551	Food Industry Waste Management / Byproduct Utilization	2,3	a, b, c, f, g, l	0	0	1	-	100	-	100	93
TOTAL				18	0	9	22	420	480	900	

SEMESTER – VI											
Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTFT601	Process Economics and Plant Layout Design	2,3	a, b, c	3	0	0	3	40	60	100	94
20BTFT602	Livestock and Marine Technology	1,2,3	a, c, f, g, l	3	0	0	3	40	60	100	96
20BTFT603	Bakery & Confectionary Technology	1,3	a, g, i, l	3	0	0	3	40	60	100	98
20BTFTOE	Open Elective - I	-	-	3	0	0	3	40	60	100	-
20BTFT6E	Professional Elective - II	-	-	3	0	0	3	40	60	100	-
20BTFT6E	Professional Elective - III	-	-	3	0	0	3	40	60	100	-
20BTFT611	Food Additives and Quality Control Laboratory	2,3	a, b, c, f, g, l	0	0	4	2	40	60	100	100
20BTFT612	Bakery & Confectionery Laboratory	2,3	a, b, c, f, g, l	0	0	4	2	40	60	100	101

20BTFT651	Technical Presentation and Seminar	2,3	a, b, c, d, e, f, g, h, i	1	0	0	-	100	-	100	102
<b>TOTAL</b>				18	0	9	22	420	480	900	
Summer Internship / Mini Project– During Summer Vacation – Non credit course											

<b>SEMESTER – VII</b>											
Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CI A	ES E	Total	
								40	60	100	
20BTCC701	Professional Ethics, Principles of Management and Entrepreneurship Development	3	a, h, i, j, l	3	0	0	3	40	60	100	103
20BTFT702	Supply Chain Management	2,3	a, h, i, k	3	0	0	3	40	60	100	105
20BTFT703	Food Packaging Technology	1,2	a, c, e, l	3	0	0	3	40	60	100	107
20BTFTOE	Open Elective-II	-	-	3	0	0	3	40	60	100	-
20BTFT7E	Professional Elective IV	-	-	3	0	0	3	40	60	100	-
20BTFT711	Food Packaging Laboratory	2,3	a, b, c, i	0	0	4	2	40	60	100	109
20BTFT791	Project Work Phase – I	1,2,3	i, j, k, l	0	0	2	1	40	60	100	110
<b>TOTAL</b>				15	0	6	18	240	360	700	

<b>SEMESTER –VIII</b>											
Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CIA	ESE	Total	
								40	60	100	
20BTFT8E	Professional Elective – V	-	-	3	0	0	3	40	60	100	-
20BTFT8E	Professional Elective – VI	-	-	3	0	0	3	40	60	100	-
20BTFT891	Project Work Phase II	1,2,3	i, j, k, l	0	0	12	6	120	180	300	111
<b>TOTAL</b>				6	0	12	12	200	300	500	
<b>TOTAL CREDITS</b>				<b>165</b>							



## Professional Elective - I

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
SEMESTER – V											
20BTFT5E01	Lipid Processing Technology	1,2,3	a, c, d, l	3	0	0	3	40	60	100	112
20BTFT5E02	Beverage Processing Technology	2,3	a, b, d, f, g	3	0	0	3	40	60	100	114
20BTFT5E03	Nonthermal Techniques in Food Processing	1,2	a, c, d, l	3	0	0	3	40	60	100	116
20BTFT5E04	Process Control for Food Engineers	1,2	a, b, d, e	3	0	0	3	40	60	100	118

## Professional Elective – II &amp; III

Course code	Course Title	Objectives & out comes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CIA	ESE	Total	
								40	60	100	
	SEMESTER – VI										
20BTFT6E01	Radiation Preservation and Processing of Food Products	1,3	a, c, d, l	3	0	0	3	40	60	100	120
20BTFT6E02	Plantation Products and Spice Processing Technology	2,3	a, b, d, l	3	0	0	3	40	60	100	122
20BTFT6E03	Milling Technology	2,3	a, c, e, f, l	3	0	0	3	40	60	100	124
20BTFT6E04	Technology of Legumes and Oilseed Processing	1,3	a, b, c, d, l	3	0	0	3	40	60	100	126
20BTFT6E05	Design and Formulation of Foods	1	a,b, c, e	3	0	0	3	40	60	100	128
20BTFT6E06	Design of Food Process Equipment	1,2 ,3	a, b, c, d, e, g, l	3	0	0	3	40	60	100	130
20BTFT6E07	Food Colorants and Flavorants	1	a, g, l	3	0	0	3	40	60	100	131
20BTFT6E08	Postharvest Technology	1,2	a, b, c, d, e, f, g, l	3	0	0	3	40	60	100	133
20BTFT6E09	Cereals and Pulses technology	1,2,3	a, c, f, g, l	3	0	0	3	40	60	100	135

## Professional Elective – IV

Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	POs	L	T	P		CIA	ESE	Total	
								40	60	100	
SEMESTER –VII											
20BTFT7E01	Analytical Methods for Food Products	1, 3	a, b, c, d, l	3	0	0	3	40	60	100	137
20BTFT7E02	Traditional and Organic Foods	1, 3	a, b, d, g, i	3	0	0	3	40	60	100	139
20BTFT7E03	New Product Development and Sensory Science	2	a, b, d, f, l	3	0	0	3	40	60	100	141
20BTFT7E04	Marketing Management and International Trade	1, 2, 3	b, h, i, j, l	3	0	0	3	40	60	100	142

## Professional Elective – V &amp; VI

Course code	Course Title	Objectives & outcomes		Instruction hours / week			Credits	Maximum Marks			Page No
		PEOs	Pos	L	T	P		CIA	ESE	Total	
								40	60	100	
SEMESTER –VIII											
20BTFT8E01	Functional Foods and Nutraceuticals	1,2	a, b, d, f, l	3	0	0	3	40	60	100	144
20BTFT8E02	Food Biotechnology	1,3	a, b, e, f	3	0	0	3	40	60	100	146
20BTFT8E03	Advances in Drying Technology	1, 3	a, b, c, e, l	3	0	0	3	40	60	100	148
20BTFT8E04	Food Fermentation Technology	1,3	a, b, d, g	3	0	0	3	40	60	100	150
20BTFT8E05	Extrusion Technology	1,2	a, c, e, f, l	3	0	0	3	40	60	100	151
20BTFT8E06	Food Allergy and Toxicology	2	a, b, f, g	3	0	0	3	40	60	100	153
20BTFT8E07	Total Quality Management	2,3	a, b, d, g, f, i, l	3	0	0	3	40	60	100	155

**Open Electives I & II (offered by Food Technology)**

Course code	Course Title	Instruction hours / week			Credits	Maximum Marks			Page No
		L	T	P		CIA	ESE	Total	
						40	60	100	
Open Electives									
20BTFTOE01	Processing of Food Materials	3	0	0	3	40	60	100	157
20BTFTOE02	Nutrition and Dietetics	3	0	0	3	40	60	100	159
20BTFTOE03	Ready to Eat Foods	3	0	0	3	40	60	100	161
20BTFTOE04	Agricultural Waste and Byproducts Utilization	3	0	0	3	40	60	100	163

**Open Electives I & II (preferred by Food Technology)**

Course code	Course Title	Instruction hours / week			Credits	Maximum Marks			Page No
		L	T	P		CIA	ESE	Total	
		40	60	100					
Open Electives									
ELECTRICAL AND ELECTRONICS ENGINEERING									
20BEEEOE04	Renewable Energy Resources	3	0	0	3	40	60	100	165
BIOTECHNOLOGY									
20BTBTOE03	Basic Bioinformatics	3	0	0	3	40	60	100	167
COMPUTER SCIENCE AND ENGINEERING									
20BECOE02	Multimedia and Animation	3	0	0	3	40	60	100	169
CHEMICAL ENGINEERING									
20BTCEOE03	Industrial wastewater treatment	3	0	0	3	40	60	100	171

CONTENT	Page No
Value added courses	173
Technology Business Incubator	174

**Course Distribution – Karpagam Academy of Higher Education**

S.No.	Course work-subject area	Credits/ Semester								Credits Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences (HS)	3	3	-	-	-	-	3	-	9	5.50%
2	Basic Sciences (BS)	9	12	4	4	-	-	-	-	29	17.60%
3	Engineering Sciences-Common(ES)	10	5	-	-	-	-	-	-	15	9.10%
4	Professional Subjects-Professional Core (PC)	-	3	19	19	19	13	8	-	81	49.10%
5	Professional Electives (PE)	-	-	-	-	3	6	3	6	18	10.90%
6	Open Electives (OE)	-	-	-	-	-	3	3	-	6	3.60%
7	Project Work (PW)	-	-	-	-	-	-	1	6	7	4.20%
<b>Total Credits</b>										<b>165</b>	<b>100%</b>

## SEMESTER I

**B.Tech –Food Technology**

**2020 -2021**

**20BTCC101**

**Semester - I**

**ENGLISH**

**4H -3C**

**Instruction Hours/week: L:2 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 students to,**

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence.

### Course Outcomes

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

1. Use English language for communication: verbal & non –verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
3. Gain confidence in using English language in real life situations.
4. Improve word power: lexical, grammatical and communication competence.
5. To guide the students to write business letters and other forms of technical writing.
6. To enable students to prepare for oral communication in formal contexts.

### Unit: I - BASIC WRITING SKILLS

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

### Unit: II - VOCABULARY BUILDING

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

### Unit: III - GRAMMAR AND USAGE

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

### Unit: IV - LISTENING AND READING SKILLS

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

### Unit: V-WRITING PRACTICES

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

**Note:** Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

**SUGGESTED READINGS**

1. Sangeeta Sharma , Meenakshi Raman, .(2015), Technical Communication: Principles And Practice, 2<sup>nd</sup> Edition, OUP, New Delhi.
2. Sanjay Kumar and PushpLata, (2011), Communication Skills, Oxford University Press.
3. Liz Hamp - Lyons and Ben Heasley, (2006), Study Writing, Cambridge University Press
4. F.T. Wood., (2007), Remedial English Grammar, Macmillan.
5. Michael Swan, (1995). Practical English Usage, OUP.

20BTCC102

**MATHEMATICS -I****Semester-I  
4H-4C****Instruction Hours/week: L:3 T:1 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objectives****The goal of this course is for students to,**

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To understand geometrical aspects of curvature and elegant application of differential calculus which are needed in engineering applications.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables which is the foundation for many branches of engineering?
- To introduce sequence and series which is central to many applications in engineering?
- Apply differentiation to solve maxima and minima problems which is a foundation course which mainly deals with a single variable.

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

The students will learn:

1. To solve the rank, Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices and the students will be able to use matrix algebra techniques for practical applications.
2. This course equips students to have basic knowledge and understanding in one field of materials, differential calculus
3. Solve simple standard examples using the ideas of differential equations.
4. Apply various techniques to solve Partial Differential Equations
5. To develop the tool of power series for learning advanced Engineering Mathematics.
6. Apply the knowledge acquired to solve various engineering problems.

**UNIT I - MATRICES**

Introduction - Characteristic equation – Eigen values and Eigenvectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic forms – Reduction to canonical form through orthogonal reduction .Simple problems using Scilab.

**UNIT II – DIFFERENTIAL CALCULUS**

Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes- Evolutes as Envelope of normals

**UNIT III - DIFFERENTIAL EQUATIONS**

Linear Differential equations of second and higher order with constant coefficients – Homogeneous equation of Euler's and Legendre's type – Method of variation parameters.

**UNIT IV –FUNCTIONS OF SEVERAL VARIABLES**

Partial derivatives, Homogeneous functions and Euler's theorem, Total derivative, Differentiation of implicit functions, Jacobians, Partial differentiation of implicit functions,



Taylor's series for functions of two variables, Errors and approximations, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

## **UNIT V - SEQUENCES AND SERIES**

**Sequences:** Definition and examples – **Series:** Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

### **SUGGESTED READINGS:**

1. Grewal B.S., (2014), Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi.
2. Erwin Kreyszig, (2016), Advanced Engineering Mathematics, 10th Edition, John Wiley, India.
3. N.P. Bali and Manish Goyal, (2014), A text book of Engineering Mathematics, Laxmi Publications, New Delhi, India.
4. Veerarajan T, (2008), Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
5. Ramana B.V, (2010), Higher Engineering Mathematics, 11th Reprint, Tata McGraw Hill New Delhi.
6. Hemamalini. P.T, (2014), Engineering Mathematics, McGraw Hill Education (India) Private Limited, New Delhi.
7. G.B. Thomas and R.L. Finney, (2002), Calculus and Analytic geometry, 9th Edition, Pearson,

**ENGINEERING PHYSICS**  
**(Theory & Lab.)**

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

**Marks: Internal:40 External:60 Total:100**

**End Semester Exam:3 Hours**

**(i)Theory**

**Course Objectives**

**The goal of this course is for students to,**

- To inculcate the basics of properties of matter and its applications.
- To study the basics of laser and optical fiber with appropriate applications.
- To disseminate the fundamentals of thermal physics and their applications.
- To introduce the concepts of quantum mechanics for diverse applications.
- To impart the basic knowledge of crystal and its various crystal structures.

**Course Outcomes**

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

1. Identify the elastic nature of materials.
2. Infer the characteristics of laser for various engineering applications.
3. Extend the knowledge on optical fiber for communication purposes.
4. Illustrate the thermal properties of materials through various methods.
5. Develop the idea of quantum mechanics through applications.
6. Identify the different atomic arrangements of crystals and its defects.

**UNIT I – PROPERTIES OF MATTER**

Elasticity –Three types of modulus of elasticity – basic definitions, relation connecting the moduli (Derivation)-factors affecting elastic modulus and tensile strength–Poisson's ratio-Torsional pendulum- bending of beams – bending moment – uniform and non-uniform bending – I-shaped girders - stress due to bending in beams.

**UNIT II – LASER AND FIBER OPTICS**

Introduction – emission and absorption process- Einstein's coefficients derivation. Types of LASER – CO<sub>2</sub>, Semiconductor LASER- Applications of LASER in industry and medicine. Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle –derivations, types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram).

**UNIT III – THERMAL PHYSICS**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints – bimetallic strips - thermal conduction, convection and radiation – heat conduction in solids – thermal conductivity – Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV – QUANTUM PHYSICS**

Introduction to quantum theory – Black body radiation – dual nature of matter and radiation – de Broglie wavelength, uncertainty principle –Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, scanning electron microscope.

## UNIT V – CRYSTAL PHYSICS

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances – Coordination number and packing factor for SC, BCC, FCC, HCP – crystal Imperfections: point defects, line defects

### SUGGESTED READINGS

1. Bhattacharya D.K. & Poonam T., (2015) Engineering Physics, Oxford University.
2. Gaur R.K. and Gupta S.L, (2012), Engineering Physics, Dhanpat Rai Publications
3. Pandey .B.K. & Chaturvedi .S, (2012), Engineering Physics, Cengage Learning.
4. Halliday. D, Resnick R. & Walker. J, (2015), Principles of Physics, Wiley
5. Amitkumar J Patel and Maheshkumar K.Patel (2018), Engineering Physics, White Falcon Publishing.
6. Steven M. Girvin, Yale University and Kun Yang (2019), Modern Condensed matter Physics, Cambridge University Press.

### WEBLINKS

1. <https://nptel.ac.in/courses/122/103/122103011/>
2. <https://nptel.ac.in/courses/113/104/113104081/>
3. [https://www.doitpoms.ac.uk/tlplib/crystallography3/unit\\_cell.php](https://www.doitpoms.ac.uk/tlplib/crystallography3/unit_cell.php)
4. <http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html>

### (ii) Laboratory

#### Course Objective:

- To learn the basic concepts in physics relevant to different branches of Engineering and Technology.
- To study the concept of semiconductor and conductivity.
- To learn the properties of materials.

#### Course Outcome:

- 1 Familiarize the properties of material and basic concepts in physics.

### LIST OF EXPERIMENTS – PHYSICS

1. Torsional pendulum – Determination of rigidity modulus of wire & moment of inertia of disc
2. Non-uniform bending – Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge – Determination of thickness of a thin sheet/wire
8. Optical fibre –Determination of Numerical Aperture and acceptance angle
9. Ultrasonic interferometer – determination of velocity of sound & compressibility of liquids
10. Determination of Band gap of a semiconductor.
11. Spectrometer- Determination of wavelength using grating.
12. Viscosity of liquids by Poiseuille's flow.

**BASIC ELECTRICAL ENGINEERING**  
**(Theory & Lab.)**

**Instruction Hours/week: L:3 T:1 P:2**

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

**i)Theory**

**Course Objectives**

**To make the students**

- To impart the basic knowledge about the Electric circuits.
- To understand the working of Electrical Machines and Transformers.
- To understand the working of Power Converters and components of low-voltage electrical installations.

**Course Outcomes**

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

1. To analyse the electric circuits with DC and AC excitation by applying various circuit laws.
2. To analyse the electrical machines and power converters.
3. To analyse the components of low-voltage electrical installations.

**UNIT I - DC CIRCUITS**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

**UNIT II - AC CIRCUITS**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

**UNIT III - ELECTRICAL MACHINES**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, starting and speed control of induction motor. Construction and working of Single-phase induction motor. Construction, working and speed control of separately excited dc motor.

**UNIT IV - TRANSFORMERS AND POWER CONVERTERS**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Overviews of DC-DC buck and boost converters, duty ratio control. Introduction to Single-phase and three-phase voltage source inverters.

**UNIT V - ELECTRICAL INSTALLATIONS**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, RCCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries and its application in Electric Vehicle, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

## SUGGESTED READINGS

1. S.K.Bhattacharya, “Basic Electrical Engineering”, Pearson, 2019.
2. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
3. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
4. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
5. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
6. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

## WEBSITES:

1. <https://nptel.ac.in/courses/108/104/108104139/>
2. <https://nptel.ac.in/courses/108/105/108105112/>

### (i) Laboratory

#### Course Objective

- To impart the basic knowledge about the DC and AC Electric circuits.
- To understand the working of Energy Meter.

#### Course Outcomes (COs)

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

1. To understand and analyze basic electric and magnetic circuits.
2. To study the working principles of Energy Meter.

#### List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law
2. Experimental verification of electrical circuit problems using Kirchoff’s Voltage law.
3. Experimental verification of electrical circuit problems using Kirchoff’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.

**(i) Theory****COURSE OBJECTIVES:**

Students undergoing this course are exposed to:

- Describe the core syntax and semantics of Python programming language.
- Discover the need for working with the strings and functions.
- Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
- Indicate the use of regular expressions and built-in functions to navigate the file system.
- Infer the Object-oriented Programming concepts in Python.
- Students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.

**COURSE OUTCOMES:**

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

1. Explain various operators used in python.
2. Apply the string handling functions to solve the given problem
3. Describe Object oriented concepts with python
4. Use image processing techniques in python programming to solve a given problem
5. Discuss the functions of networking in python
6. Solve a given analogy

**UNIT I INTRODUCTION****(9)**

Installing Python; basic syntax, interactive shell, editing, saving, and running a script variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages.

**UNIT II CONDITIONAL STATEMENT & STRING HANDLING****(9)**

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation – Manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

**UNIT III OBJECT ORIENTED PROGRAMMING WITH PYTHON****(9)**

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects – OOP, continued: inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block

**UNIT IV IMAGE PROCESSING WITH PYTHON****(9)**

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions Simple Graphics and Image Processing: “turtle” module; simple 2d drawing – colors, shapes; digital images, image file formats, image processing Simple image manipulations with ‘image’ module (convert to b/w, rayscale, blur, etc).

## **UNIT V NETWORKING WITH PYTHON**

**(9)**

Multithreading, Networks, and Client/Server Programming; introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming a simple CGI form.

**Total Hours : 45**

### **TEXT BOOK:**

1. Shroff, "Learning Python: Powerful Object-Oriented Programming: 5th Edition, Fifth edition (24 July 2013)
2. Timothy A. Budd 'Exploring Python' – TATA McGRAW-HILL Edition - 2011
3. Vamsi Kurama, "Python Programming: A Modern Approach", Pearson Education, 2018.

### **REFERENCE BOOK:**

1. "Python Essential Reference". Addison-Wesley Professional; 4 edition (July 19, 2009) by David M. Baezly
2. "Python Cookbook" O'Reilly Media; 3rd edition (June 1, 2013) by David M. Baezly.
3. Guido Van Rossum, Fred . L. Drake 'Introduction to Python' – Network Theory Limited – March 2011
4. Alex Martelli 'Python in a Nutshell' - O'Reilly - 2nd Edition, 2006

### **WEBSITES:**

1. <https://www.codecademy.com/learn/python>
2. [www.learnpython.org/](http://www.learnpython.org/)

## **(ii) Laboratory**

### **PYTHON PROGRAMMING**

#### **COURSE OBJECTIVES:**

Students undergoing this course are exposed to:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

#### **COURSE OUTCOMES:**

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

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

#### **LIST OF EXPERIMENTS:**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search



6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball in Pygame

<b>20BTFT201</b>	<b>English</b>	<b>Semester-II</b>
<b>Instruction Hours/week: L:2 T:0 P:2</b>	<b>Marks: Internal:40 External:60 Total:100</b>	<b>4H-3C</b>
<b>End Semester Exam:3 Hours</b>		

### **Course Objectives**

**The goal of this course is for students to**

- To help students acquire their ability to speak effectively in real life situations.
- To enable students to communicate in effective way without any barriers.
- To inculcate the habit of listening and to develop their effective listening skills.
- To ensure that students use different aids in order to attain effective communication.
- To enable students to improve their group behavior and presentation skill.

### **Course Outcomes**

**Students undergoing this course will be able to**

- 1 Enrich comprehension and acquisition of listening, speaking & writing ability.
- 2 Gain confidence in using English language and develop leadership qualities.
- 3 To guide the students to effectively manage the team as a team player.
- 4 To develop the students Interpersonal and Interview skills.
- 5 Use English language for communication: verbal & non –verbal
- 6 To enable students to prepare for oral communication in formal contexts.

### **Unit I - COMMUNICATION SKILLS**

Communication Skills: Introduction, Definition, The Importance of Communication  
The Communication Process – Source, Message, Encoding, Channel, Decoding Receiver, Feedback, Context

Barriers to Communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional Barriers

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective-Past Experiences, Prejudices, Feelings, Environment

### **Unit II - ELEMENTS OF COMMUNICATION**

Introduction, Face to Face Communication- Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

Communication Styles: Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.

### **Unit III - BASIC LISTENING SKILLS**

Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations.

Effective Written Communication: Introduction, When and When Not to Use Written Communication-Complexity of the Topic, Amount of Discussion's Required, Shades of Meaning, Formal Communication.

Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience Organization of the Message.

### **Unit: IV - INTERVIEW SKILLS AND GIVING PRESENTATIONS**

Purpose of an interview, Do's and Don'ts of an interview- Interview Handling Skills- Preparation for interviews -Performance during and after interviews -Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.

### **Unit: V-GROUP DISCUSSION**

Group Discussion: Introduction, Personality traits of Group Discussion-Company's Perspective Communication skills in group discussion, Do's and Don'ts of group discussion-E-Mail Etiquette-Memos- Letters

**Note:** Students shall have hands on training in improving Speaking skill in the language laboratory @ 2 periods per each unit.

### **SUGGESTED READINGS**

1. Sanjay Kumar, Pushpalata, (2011), Communication skills, 1st Edition Oxford Press.
2. Konarnira, (2011), Communication Skills for professionals, 2<sup>nd</sup> Edition, New arrivals.
3. John Adair, 4<sup>th</sup> Edition, (2009), Effective communication, 1<sup>st</sup> Edition Cengage Learning India pvt.ltd
4. Butter Field, (2011), Soft skill for everyone, Macmillan.
5. Stephen. P. Robbins, (2013). Communication skills, Oxford Press

**Course Objectives:**

- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To Calculate and establish identities connecting these quantities, to Evaluate line, surface and volume integrals in simple coordinate systems and to Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results
- To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their study as a functions of a complex variables.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, to specify some difficult integration that appears in applications can be solved by complex integration in application areas such as fluid dynamics and flow of the electric current.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

**Course Outcomes:****The students will learn:**

1. To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition to change of order and vector integration.
2. To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines
3. To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions. They will understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
4. To evaluate complex integrals using the Cauchy integral formula and the residue Theorem and to appreciate how complex methods can be used to prove some important theoretical results.
5. Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

**UNIT-I MULTIPLE INTEGRALS**

Double integral – Cartesian coordinates – Polar coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integrals.

**UNIT-II VECTOR CALCULUS**

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem, Gauss divergence theorem and Stoke's theorems (Statement Only)- Surfaces : hemisphere and rectangular parallelopipeds.

**UNIT-III ANALYTIC FUNCTIONS**

Analytic functions - Cauchy-Riemann equations in Cartesian and polar forms – Sufficient condition for an analytic function (Statement Only) - Properties of analytic functions – Constructions of an analytic function - Conformal mapping:  $w = z+a$ ,  $az$ ,  $1/z$  and bilinear transformation.

#### UNIT-IV COMPLEX INTEGRATION

Complex Integration - Cauchy's integral theorem and integral formula (Statement Only) – Taylor series and Laurent series - Residues – Cauchy's residue theorem (Statement Only) - Applications of Residue theorem to evaluate real integrals around unit circle and semi circle (excluding poles on the real axis).

#### UNIT-V LAPLACE TRANSFORM

Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and final value theorems. Inverse Laplace transforms – Convolution theorem (statement only) – Solution of Ordinary Differential Equations with constant coefficients using Laplace transforms – Transform of periodic functions.

#### SUGGESTED READINGS:

1. Grewal, B.S., Higher Engineering Mathematics Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014
2. Kreyszig Erwin, Advanced Engineering Mathematics , John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016
3. Bali.N., Goyal M. and Watkins C, Advanced Engineering Mathematics, Firewell Media (An imprint of Lakshmi Publications Pvt., Ltd.,) New Delhi, 7<sup>th</sup> Edition, 2009
4. Kandasamy. P, Thilagavathy. K, Gunavathy. K. Engineering Mathematics, S Chand & Co. Ltd, New Delhi, 2008.
5. Venkataraman, M. K. Engineering Mathematics. The National Publishing Company, Chennai, 2005
6. Narayanan. S, Manicavachagampillay.T.K and Ramaniah, Advanced Mathematics for Engineering Students, Viswanathan S.(Printers and Publishers) Pvt. Ltd. Chennai. 2002

#### Website

1. [www.intmath.com](http://www.intmath.com)
2. [www.efunda.com](http://www.efunda.com)
3. [www.mathcentre.ac.uk](http://www.mathcentre.ac.uk)
4. [www.sosmath.com/diffeq/laplace/basic/basic.html](http://www.sosmath.com/diffeq/laplace/basic/basic.html)

**Course Objectives**

The goal of this course is for students to,

- Study the basics of Periodic properties, Intermolecular forces
- Understand the terminologies of electrochemistry and to study about energy storage devices
- Understand the concept of corrosion and its prevention
- Comprehend the basic water technology and its purification.
- Study about spectroscopic technique

**Course Outcomes**

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

1. Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
2. Analyse the mechanism of different energy storage devices.
3. Rationalise different types of corrosion and its prevention.
4. List the various methods in the purification of water.
5. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

**Unit I – PERIODIC PROPERTIES, INTERMOLECULAR FORCES AND POTENTIAL ENERGY SURFACES**

Effective nuclear charge, Penetration of orbitals, Variations of s, p, d and f orbital energies of atoms in the periodic table, Electronic configurations, Atomic and ionic sizes, Ionization energies, Electron affinity and Electronegativity, Polarizability, Oxidation states, Coordination numbers, Ionic dipolar and van Der Waals interactions, Equations of state of real gases and critical phenomena.

**UNIT II – WATER TECHNOLOGY**

Sources-Characteristics – Specification for drinking water, BIS &WHO-Alkalinity – Types of alkalinity 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 III – ORGANIC REACTIONS AND GREEN CHEMISTRY**

Introduction to organic reactions and its mechanism involving substitution, addition, elimination, oxidation, reduction, cyclization and ring opening, Greening of chemistry and industry, Waste minimization and atom economy, Reduction of material use, energy requirement, risk and hazard, Sustainable use of chemical feedstock's, water and energy.

#### **Unit IV - STEREOCHEMISTRY**

Introduction nomenclature stereo descriptors R, S, D and L, Meso nomenclature, Stereoisomerism, Classification, Enantiomers – Optical isomerism, Diastereomers, Optical activity – causes, specific rotation, phenomenon of chirality, Racemization and resolution of enantiomers, Biological importance of chirality – taste, odor, chiral foodstuffs, agrochemicals, pharmaceuticals, stereochemical specificity.

#### **Unit V - POLYMER CHEMISTRY**

Introduction functionality degree of polymerization, Classification of polymers, Natural and synthetic, Thermoplastic and thermosetting, Types and mechanism of polymerization addition (free radical, cationic, anionic and living), Condensation and copolymerization, Properties of polymers T<sub>g</sub>, tacticity, molecular weight-weight average, number average and polydispersity index, Techniques of polymerization bulk, emulsion, solution and suspension, Structure, properties and uses of PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy conducting polymers – polyaniline and polypyrrole.

#### **SUGGESTED READINGS:**

1. B. H. Mahan, (2010). University chemistry, Pearson Education,
2. M. J. Sienko and R. A. Plane, Chemistry: Principles and Applications.
3. C. N. Banwell, (1994), Fundamentals of Molecular Spectroscopy, McGraw-Hill,.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web-book)
5. P. W. Atkins, (2009). Physical Chemistry, Oxford University Press,
6. K. P. C. Volhardt and N. E. Schore, (2014). 5th Edition, Organic Chemistry: Structure and Function, W.H. Freeman,
7. P C Jain & Monica Jain, (2015). Engineering Chemistry, Dhanpat Rai Publishing Company

#### **(ii) Chemistry Laboratory**

##### **Course Objectives**

**The goal of this course is for students to**

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

##### **Course Outcomes**

**Upon completion of the course the students will be able to**

1. The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
2. Estimate rate constants of reactions from concentration of reactants/products as a function of time
3. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc

#### **Choice of 10 experiments from the following:**

1. Determination of surface tension and viscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
3. Determination of Ca / Mg using complexometric titration
4. Thin layer chromatography
5. Determination of chloride content of water
6. Determination of the rate constant of a reaction
7. Conductometry - Determination of cell constant and conductance of solutions
8. pH Metry – Determination of Acid / Base
9. Potentiometry - determination of redox potentials and emfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.



**Course objectives**

- To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

**Course outcomes**

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design and engineering graphics standards
3. Exposure to solid modeling ,computer-aided geometric design , creating working drawings and engineering communication

**UNIT I INTRODUCTION**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloids, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales

**UNIT II ORTHOGRAPHIC PROJECTIONS**

Principles of Orthographic Projections- Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

**UNIT III PROJECTION OF POINTS, LINES AND PLANE SURFACES**

Projections of Points and lines located in the first quadrant inclined to both planes - Determination of true lengths and true inclinations; Projection of polygonal surface and circular lamina inclined to both reference planes

**UNIT IV PROJECTION OF SOLIDS**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

**UNIT V - ISOMETRIC PROJECTIONS & COMPUTER GRAPHICS**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software, Introduction to 3D modeling packages

## **SUGGESTED READINGS**

1. Venugopal K and Prabhu Raja V, (2010), Engineering Graphics, New Age International Publishers.
2. C M Agrawal and Basant Agrawal, (2012), Engineering Graphics, Tata McGraw Hill, New Delhi.
3. James D. Bethune, (2015), Engineering Graphics with AutoCAD, Pearson Education.
4. Narayana, K.L. & P Kannaiah, (2008), Text book on Engineering Drawing, Scitech Publishers.
5. Bureau of Indian Standards, (2003), Engineering Drawing Practices for Schools and Colleges SP 46, BIS, New Delhi.
6. Shah, M.B. & Rana B.C., (2008), Engineering Drawing and Computer Graphics, Pearson Education.
7. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House.

**Course Objectives**

**The goal of this course is for students to,**

- Describe the physical properties of food materials
- Explain the rheology of food and use of viscometer and texture analyzer in food industry.
- Develop knowledge on thermal properties of food commodities
- Outline the aerodynamic and hydrodynamic properties of foods
- Define the electrical properties of food and its applications in food engineering.

**Course Outcomes**

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

1. Estimate the physical properties of food materials
2. Report the frictional properties and storage of agricultural crops
3. Compare and contrast the Newtonian and non-Newtonian fluids
4. Express the overall thermal properties of food materials
5. Measure the aero- and hydrodynamic characteristics and the application of frictional properties in grain handling, processing and conveying.
6. Demonstrate the dielectric and radiation heating properties of foods

**UNIT I - PHYSICAL PROPERTIES OF FOODS**

Methods of estimation of Shape, Size, volume, density, porosity and surface area, sphericity, roundness specific gravity. Frictional properties- coefficient of friction, Storage and flow pattern of agricultural crops.

**UNIT II -RHEOLOGICAL PROPERTIES OF FOODS**

Definition – classification – Newton's law of viscosity – momentum-diffusivity-kinematic viscosity – viscous fluids – Newtonian and Non Newtonian fluids- Viscosity Measurements-Viscometers of different types and their applications-Texture measuring instruments-Hardness and brittleness of Food materials.

**UNIT III - THERMAL PROPERTIES OF FOODS**

Definitions of Heat capacity, specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient, Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity, DTA, TGA, DSC.

**UNIT IV - AERODYNAMIC AND HYDRODYNAMIC PROPERTIES OF FOODS**

Drag and lift coefficient, terminal velocity and their application in the handling and separation of food materials. Water activity- measurement-vapor pressure method –freezing point depression method- Effect of temperature, and pressure on water activity-moisture sorption isotherms- models-Henderson, PET and GAB models.

**UNIT V - ELECTRICAL PROPERTIES OF FOODS**

Dielectric properties-dielectric constants, Dielectric measurements- Ionic Interaction-Dipolar rotation. Effect of moisture, temperature and pressure on dielectric properties. Microwave heating-Infrared and Ohmic heating, Irradiation

**SUGGESTED READINGS**

1. Serpil Sahin and Servet Gulum Sumnu. Physical Properties of Foods. Springer. USA, 2007.

2. Nuri N. Mohsenin. Thermal Properties of Food & Agricultural materials”, Gordon and Reach sciencepublishers, 1990.
3. Rao, M.A and S.S.H. Rizvi. Engineering Properties of Foods. Mercel Dekker Inc. New York 4<sup>th</sup> Edition, 2014.
4. Lewis M.J. Physical properties of foods and food processing systems. Wood head publishing Cambridge, UK, 2006.
5. Shafiur Rehman. Food Properties Hand book. CRC press inc. New York, 2<sup>nd</sup> Edition, 2009.

**Course Objectives**

**The goal of this course is for students to**

- Create the awareness about environmental problems among people.
- Develop an attitude of concern for the environment.
- Motivate public to participate in environment protection and improvement.

**Course Outcomes (COs)**

**Upon completion of the course the students will be able to**

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
7. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.

**Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS**

Environment Definition, Scope and importance; 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 - RENEWABLE AND NON-RENEWABLE RESOURCES**

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**

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**

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise 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**

Concept of sustainability and sustainable development. Water conservation -Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols).Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides).Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).Human population growth: Impacts on environment, human health and welfare.

### **SUGGESTED READINGS**

1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wiley and Sons, Inc., New York.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S. Chand & Company Pvt. Ltd., New Delhi.
6. Odum E. P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
7. Rajagopalan, R. 2016.Environmental Studies: From Crisis to Cure, Oxford University Press.
8. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
10. Tripathy. S. N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2<sup>nd</sup> ed.). Vrianda Publications Private Ltd, New Delhi.
11. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology).S. Chand and Company Ltd, New Delhi.
12. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

**COURSE OBJECTIVES**

- To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

**COURSE OUTCOMES**

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. Students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.

**(i) Lectures & videos:****Detailed contents**

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical & Electronics
5. Carpentry
6. Plastic molding, glass cutting
7. Metal casting
8. Welding

**(ii) Workshop Practice:**

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop
6. Casting
7. Plumbing Exercises

**SUGGESTED READINGS**

1. Gowri S, Jeyapoovan, T., Engineering Practices Lab Manual, 5th edition, Vikas Publishing House Pvt. Ltd, Chennai. 2017.
2. Bawa, H.S, Workshop Practice, 2nd edition, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2009.
3. Choudhry S K, Elements of workshop technology, Vol 2, 13th edition, Indian book distributing company, Kolkatta, 2010.
4. D K Singh, Manufacturing Technology, 2nd edition, Pearson Education, 2008.
5. Kalpakjian S., Steven S. Schmid, Manufacturing Engineering and Technology, 4<sup>th</sup> edition, Pearson Education India Edition, 2001.

6. Roy A. Lindberg, Processes and Materials of Manufacture, 4th edition, Prentice Hall India, 1997.
7. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, 4th edition, Tata McGraw Hill House, 2018.



**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION 4H-4C****Instruction Hours/week: L:3 T:1 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course objectives**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**Course outcomes****Upon successful completion of the course, students should be able to:**

1. To solve the given standard partial differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
4. Apply the mathematical principles of transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
5. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.
6. The learners can equip themselves in the transform techniques and solve partial differential equations

**UNIT-I PARTIAL DIFFERENTIAL EQUATIONS**

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non homogeneous types.

**UNIT-II FOURIER SERIES**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

**UNIT-III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

**UNIT-IV FOURIER TRANSFORMS**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

#### **UNIT-V Z - TRANSFORMS AND DIFFERENCE EQUATIONS**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

#### **SUGGESTED READINGS**

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay. T. K and Ramanaiah. G "Advanced Mathematics for Engineering Students", Vol. II & III, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
4. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
5. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
6. James, G., "Advanced Modern Engineering Mathematics", 5th Edition, Pearson Education, 2012.
7. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
8. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**FOOD PROCESS CALCULATIONS**

**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:**

1. Enumerate the units and dimensions of various physical quantities.
2. Explain the laws and theory of gases and vapors.
3. Calculate the material balance in food processing units.
4. Verify the energy balance involved in food processing operations.
5. Describe the types and properties of fluid flow.
6. Demonstrate the processes of agitation in fluids

**UNIT I -DIMENSIONS AND UNIT**

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

**UNIT II-GASES AND VAPORS**

Behavior of Gases – Kinetic Theory of gases – Perfect Gas – Gas laws – Ideal gas laws – Real gas- Van der Waal's equation -pure component vapour pressure- partial pressure Dalton's law. Pure component volume-Amagat's law, Boyles law, Charles law, Raoult's law.

**UNIT III-MATERIAL BALANCE**

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**

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.

**UNIT V-FLUID MECHANICS AND AGITATION OF FLOW THROUGH PACKINGS**

Fluid – properties – compressible, incompressible fluids, Newtonian and Non Newtonian Fluids, Fluid statics for compressible & incompressible. Agitation – power requirement, Flow in packed columns, flow in fluidization columns, settling phenomena, Flow measurement, pumping of liquids and gases – equipments.

## **SUGGESTED READINGS**

1. Romeo T. Toleda. (2000). “Fundamentals of Food Process Engineering “, Chapman & Hall, USA, CBS publications, New Delhi.
2. Smith, PG. (2004). “Introduction to Food Process Engineering “, Springer.
3. Paul Singh R and Dennis R. Heldman (2004) “Introduction to Food Engineering”. Academic Press – Elsevier India Private Ltd. New Delhi.

**FOOD MICROBIOLOGY**

**Instruction Hours/week: L:2 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,**

- Describe the basic concepts and factors affecting the growth of microorganisms.
- Define the preservation of foods using temperature as a parameter.
- Analyze the role of drying, additives and radiation in the food preservation..
- Identify the microorganisms associated with the food fermentation processes.
- Explain about the food borne illness and sanitation in food industries.

**Course Outcomes**

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

1. Recognize the general concepts and factors affecting the growth of microorganisms.
2. Infer the different temperature range as control agent for food preservation.
3. Outline the methods include drying, additives and radiation to prevent microbial spoilage.
4. Select the microbial cultures for preparing various fermented food products.
5. Evaluate the pathogenesis of food borne pathogens and food poisoning.
6. Enumeratethe bacteriology of water and sanitation measures in food industries

**UNIT I FOOD AND MICROORGANISMS**

General concepts about molds, bacteria and yeasts. Factors affecting growth of microorganisms – pH, water activity, oxidation – reduction potential, nutrient content, inhibitory substances and biological structure – combined effects of factors affecting growth. Genetically modified crops and its health effects.

**UNIT II MICROBIOLOGY OF PRESERVATION – HIGH AND LOW TEMPERATURES**

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. Pasteurization and canning Growth of microorganisms at low temperatures, temperatures employed in low temperature storage, Freezing – preparation, freezing and changes occur in foods, response of microorganisms to freezing.

**UNIT III MICROBIOLOGY OF PRESERVATION – DRYING, ADDITIVES AND RADIATION**

Drying – Methods, factors in the control of drying, treatments before and after drying, microbiology of dried foods and specific dried foods, IMF. Additives – Antimicrobial preservatives, antibiotics and developed preservatives. Radiation – Ultraviolet radiation, factors influencing, ionizing radiations - effect on microorganisms and foods, Microwave processing.

**UNIT IV FOOD FERMENTATION**

General principles of culture maintenance and preparation – Bacterial, Yeast and mold cultures. Manufacture, spoilage and defects of Bread, malt beverages – beer and related beverages, wines, distilled liquors, vinegar, fermented vegetables – sauerkraut and pickles, fermented dairy products – yogurt, kefir, kumiss, probiotics and prebiotics cheese, SCP, oriental fermented foods – soy sauce, tempeh, miso, ang-khak, idli, natto, soybean cheese, Minchin, fermented fish, preserved eggs, and poi.

## **UNIT V FOOD BORNE ILLNESS AND SANITATION**

Food borne diseases – Clostridium, E.coli, Listeria, Bacillus, Mycotoxins – Aflatoxin, Patulin and ochratoxin, seafood toxicants – shellfish poisoning, ciguatera, scombroid fish poisoning, 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).

### **SUGGESTED READINGS:**

1. Adams M.R and Moss M.O, (2007). “Food Microbiology”, 2<sup>nd</sup> Edition, Third reprint, Panima Publishing Corporation, New Delhi,
2. Sivasankar B, (2009). “Food Processing and Preservation”, 6th edition, PHI Learning Private Limited, Eastern Economy Edition, India.
3. William C Frazier and Dennis C. Westoff, (2008). “Food Microbiology”, Special Edition, Springer, The Mc Graw-Hill Companies.

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

- State the fundamentals and calculations involved in zeroth law of thermodynamics.
- Discuss the applications of first law of thermodynamics.
- Illustrate the knowledge on second law of thermodynamics and entropy
- Describe thermodynamic properties of pure substances, its phase change processes and to study the working principle of steam boilers.
- 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,**

1. Understand the laws, concepts and principles of thermodynamics.
2. Apply first law of thermodynamics to closed and open systems.
3. Solve problems related to cycles and cyclic devices using second law of thermodynamics.
4. Calculate the thermodynamic properties of pure substances and phase change processes
5. Discuss the classification, working and accessories of steam boilers
6. Understand the working of carnot, vapour compression, vapor absorption and air refrigeration systems.

**UNIT I - BASIC CONCEPTS AND FIRST LAW**

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 equivalent 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 of thermodynamics

**UNIT II - APPLICATION OF FIRST LAW OF THERMODYNAMICS TO NON-FLOW AND FLOW PROCESSES**

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 - SECOND LAW OF THERMODYNAMICS**

Kelvin planck and Clausius statements. Heat engine, heat pump and refrigeration. Relation between heat and entropy – Importance and units of entropy – Clausius inequality - available and unavailable heat energy.

**UNIT IV - STEAM PROPERTIES AND BOILERS**

Formation of steam at a constant pressure – Temperature vs total heat during steam formation. Wet, dry saturated and super heated steam – Dryness fraction of wet steam – Enthalpy and specific volume of steam – uses of steam tables. Boilers: Classification of steam boilers,

Vertical and Cross tube Cradley boiler, Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories.

## **UNIT V - REFRIGERATION SYSTEMS AND COMPONENTS**

Principles of refrigeration, choice of refrigerants, components of refrigeration cycle. Types of refrigeration: Carnot refrigeration, vapor compression cycle, air refrigeration cycle, absorption refrigeration cycle.

### **SUGGESTED READINGS:**

1. Narayanan, K.V. (2013). A Text book of chemical engineering thermodynamics. 2nd Edition. PHI Learning Private Limited.
2. Rajput, R.K. (2009). Engineering Thermodynamics. 3rd Edition. Laxmi Publication. New Delhi.
3. Nag, P.K. (2017). Engineering Thermodynamics. 6th Edition. McGraw Hill Education (India) Private Limited.



**Course Objectives**

The goal of this course is for students,

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

**Course Outcomes**

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

1. Summarize the structure of molecules, its reactions and interactions of food components in food products
2. Recall the use of food composition tables and databases.
3. Categorize the physical and chemical properties of food.
4. Recognize the analysis test of proteins and lipids.
5. Assess the importance of minerals and vitamins in food.
6. Employ the use of color and other flavor compounds present in food

**UNIT I - CARBOHYDRATES**

Simple Sugars: mono and disaccharides, Hygroscopicity & solubility, optical rotation, mutarotation; sensory properties-sweetness index, caramelization, Maillard reaction; Glucose syrup, high fructose corn syrup, Dextrose Equivalent, Degree of polymerisation; Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch- amylose and amylopectin- properties, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolysates – Maltodextrins and dextrans; Pectins, gums & seaweeds- gel formation & viscosity. Fiber Cellulose & hemicellulose; Food sources, functional role and uses in foods.

**UNIT II - PROTEINS**

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

**UNIT III - LIPIDS**

Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, isomerisation, unsaturation; Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization; Hydrolytic rancidity & oxidative rancidity; radiolysis Shortening power of fats, tenderization, emulsification, frying - smoke

point, autooxidation, polymerization; Fat replacements; Food sources, functional role and uses in foods.

#### **UNIT IV WATER, MINERALS AND VITAMINS**

Water: Structure of water molecule, Chemical and physical properties of water, Types of water: free, bound & entrapped water, water activity. Drinking water, mineral water, water hardness, water quality for food process in. Minerals & vitamins: Mineral & vitamin content of foods- Food and Pharmaceutical grades; stability & degradation in foods.

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

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

#### **SUGGESTED READINGS:**

1. Belitz H.-D, Grosch W and Schieberle P.(2004), Food Chemistry, 3rd Revised Edition, Springer-Verlag.
2. Meyer, Lillian Hoagland(1987), Food Chemistry, CBS Publishers
3. DeMan, John M.(1999), Principles of Food Chemistry - 3rd Edition, Springer
4. Chopra, H.K. and P.S. Panesar,(2010), Food Chemistry, Narosa
5. Vaclavik, V. A. and Christian E. W.,(2003), Essentials of Food Science - 2nd Edition, Kluwer Academic, Springer

### **Course Objectives**

**The goal of this course is for students,**

- To explain the basic concepts of food additives.
- To describe the types, chemical properties, levels of addition and toxicity of acidulants.
- To discuss the types, chemical properties, levels of addition and toxicity of humectants.
- To outline the types, chemical properties, levels of addition and toxicity of fat substitutes and replacers.
- To summarize the types, chemical properties, levels of addition and toxicity of sweeteners, chelating agents, anti-browning agents and nutritional additives.

### **Course Outcomes**

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

1. Report the classification, safety levels and toxicity of food additives
2. List the properties, levels of addition and toxicity data of various food additives.
3. Illustrate the importance of additives in maintaining or improving food quality.
4. Develop the various instant premixes by addition of preservatives within the permissible limits.
5. Explain the principles of food additives to study the toxicity
6. Identify and design newer products, with better quality using additives which are economical and safe.

### **UNIT I - INTRODUCTION**

Food additives - definition and classification, food safety levels as per the specifications, safety evaluation of additives – determination of acute and chronic toxicity - NOEL, ADI, LD50value, PFA regulations, GRAS status.

### **UNIT II - ACIDULANTS**

Types, chemical properties, levels of additions in individual products, toxicity data of Acidulants – Preservatives – Emulsifiers and gums – Antioxidants.

### **UNIT III - HUMECTANTS**

Types, chemical properties, levels of additions in individual products, toxicity data of Dough conditioners - flour improvers – Humectants

### **UNIT IV –COLORANTS, FLAVORANTS, FAT SUBSTITUTES & REPLACERS**

Types, chemical properties, levels of additions in individual products, toxicity data of Colourants – Natural and artificial, Flavourants, Flavour enhancers, Fat substitutes and replacers.

### **UNIT V - NUTRITIONAL ADDITIVES**

Types, chemical properties, levels of additions in individual products, toxicity data of Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents, Nutritional additives.

### **SUGGESTED READINGS:**

1. Cheung PCK, and Mehta BM. Handbook of Food Chemistry. Springer-Verlag Berlin Heidelberg, 1<sup>st</sup> Edition, 2015.
2. Velisek J. The Chemistry of Food. Wiley-Blackwell Publishing. 1<sup>st</sup> Edition, 2014.
3. Smith J and Hong-Shum L. Food Additives Data Book. Wiley-Blackwell Publishing. 2<sup>nd</sup> Edition, 2011.
4. Brannen A.L., Davidson P.M., Salminen S. and Thorngate J.H. (2002), “Food additives” Second Edition, Revised and Expanded. Marcel Dekker Inc. USA.

20BTFT311

Semester-III

**FOOD MICROBIOLOGY LABORATORY**

4H-2C

**Instruction Hours/week: L: 0 T: 0 P: 4****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 working principle of microscopes and sterilization techniques.
- To outline the preparation of media for the cultivation of microorganisms.
- To identify the isolated strains using staining techniques and biochemical tests.
- To perform staining techniques and practice various staining methods.
- To apply various biochemical test to identify microorganisms in contaminated food.

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

1. Perform aseptic technique to properly handle microorganisms to avoid contamination.
2. Use the knowledge to handle microscopes to observe stained microorganisms.
3. Enumerate the microorganisms to check the quality characteristics of food.
4. Isolate the pure culture from mixed population found in contaminated foods.
5. Identify the microorganisms using staining techniques.
6. Test the quality of water and milk.

**List of Experiments**

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

**Laboratory****Course objectives**

**The goal of this course is for students,**

- To compare the various physical and chemical properties of foods
- To illustrate the analysis of proteins and lipids
- To analyze rancidity property of fatty acids.
- To calculate the isoelectric effect of milk.
- To demonstrate browning effects in food

**Course outcomes**

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

1. Categorize the physical and chemical properties of food.
2. Recognize the analysis test of proteins and lipids.
3. Discuss the rancidity of fats.
4. Evaluate gelling properties of starch and electrophoresis
5. Test rennin on milk proteins and isoelectric effect.
6. Determine browning properties in food.

**LAB COMPONENTS**

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

**SUGGESTED READINGS:**

1. Weaver, C.M, and J.R. Daniel (2005), The Food Chemistry Laboratory – A Manual for Experimental Foods, Dietetics & Food Scientists - 2nd Edition, CRC Press.

**Course Objectives**

The goal of this course is for students,

- To summarize about Indian constitution.
- To describe about central and state government functionalities in India.
- To recall about Indian society and political party involved.
- To recognize the structure and function of Central and State Government.
- To list the Rights of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections

**Course Outcomes**

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

1. Enumerate the functions of the Indian constitution.
2. Recall and abide the rules of the Indian constitution.
3. Extend the knowledge about the central and state government functionalities in India.
4. Outline the laws of Indian society and the political parties involved.
5. Outline the structure and function of Central and State government.
6. Summarize and appreciate different culture among the people.

**UNIT I - INTRODUCTION**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

**UNIT II - STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT**

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

**UNIT III - STRUCTURE AND FUNCTION OF STATE GOVERNMENT**

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

**UNIT IV - CONSTITUTION FUNCTIONS**

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries – Assessment of working of the Parliamentary System in India.

**UNIT V- INDIAN SOCIETY**

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

### **SUGGESTED READINGS:**

1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, New Delhi
2. R. C. Agarwal, (1997).Indian Political System ,S. Chand and Company, New Delhi,
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, New Delhi
4. K. L. Sharma(1997)., Social Stratification in India: Issues and Themes , Jawaharlal Nehru University, New Delhi,
5. Sharma, Brij Kishore (2011)., Introduction to the Constitution of India, Prentice Hall of India, New Delhi,
6. U. R. Gahai, (1998).Indian Political System, New Academic Publishing House, New Delhi.
7. R.N. Sharma, (1987).Indian Social Problems, Media Promoters and Publishers Pvt. Ltd, New Delhi,



**Mathematics-IV  
(Probability And Statistics)****4H-4C****Instruction Hours/week: L:4 T:0 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objectives:**

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems?
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

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

1. Explain the fundamental concepts of probability and standard distributions which can describe real life phenomenon.
2. Explain the basic concepts of one and two dimensional random variables and their applications in engineering.
3. Apply the concept of testing of hypothesis for small and large samples in real life problems.
4. Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
5. Discuss the notion of sampling distributions and statistical techniques used in engineering and management problems.
6. Discuss about the techniques in quality control that model engineering problems.

**UNIT I-PROBABILITY AND RANDOM VARIABLES**

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

**UNIT II-TWO - DIMENSIONAL RANDOM VARIABLES**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression using SPSS tool– Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

**UNIT III TESTING OF HYPOTHESIS**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chisquare and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

**UNIT IV DESIGN OF EXPERIMENTS**

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design –  $2^2$  factorial design using SPSS tool.

**UNIT V STATISTICAL QUALITY CONTROL**

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

#### **SUGGESTED READINGS:**

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
4. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
5. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
6. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
7. Walpole. R.E., Myers. R.H., Myers. S. L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

**Course Objectives**

The goal of this course is for students,

- To outline the concepts of fluid mechanics.
- To evaluate the pressure variations in fluids and measurement devices.
- To determine the fluid statics on variable surface conditions.
- To derive the equations of motion and kinetics of fluid flow.
- To analyze the flow of fluids in various geometries of pipes.

**Course Outcomes**

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

1. Recognize the various properties of fluids.
2. Recall the pressure differences in fluids.
3. Categorize the different devices to measure the pressure of fluids.
4. Calculate the forces acting on bodies submerged in different positions in liquids.
5. Employ the basic design calculations for fluid flow in pipes
6. Summarize the flow behavior of fluids in pipes.

**UNIT I -PROPERTIES OF FLUIDS**

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

**UNIT II-PRESSURE AND ITS MEASUREMENT**

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.

**UNIT III- FLUID STATICS**

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.

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

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

**UNIT V- FLOW THROUGH PIPES**

Reynolds Experiment- Laminar and turbulent flow- Loss of energy in pipes- Loss of energy due to friction- Minor energy Losses-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.

**SUGGESTED READINGS:**

1. Bansal, R.K., (2011). “Fluid Mechanics and Hydraulic Machines”, 9<sup>th</sup> 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” 2<sup>nd</sup> edition, Tata McGraw Hill.

**Course Objectives**

The goal of this course is for students,

- To define laws of heat conduction and theories of insulation.
- To evaluate the different modes of convection heat transfer.
- To compare the different modes of radiation heat transfer.
- To classify the types of heat exchanger and their applications in food industry.
- To summarize the diffusion mass transfer.

**Course Outcomes**

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

1. Express the conduction mode of heat transfer in simple and composite systems
2. Evaluate heat transfer coefficients for natural convection.
3. Discuss the influence of radiation in food processing operations
4. Predict heat exchanger performance by using the method of heat exchanger effectiveness
5. Analyze heat exchanger performance by using the method of log mean temperature difference.
6. Illustrate the basics of diffusion mass transfer and its application in food Processing.

**UNIT I - HEAT TRANSFER – CONDUCTION**

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**

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**

Basics of Radiation heat transfer- Types of surfaces – Kirchhoff's Law-radiation from a body and emissivity (Stephan Boltzmann Law) to a small object from surroundings –Planck's Distribution law-Wein's Displacement law- combined Radiation and Convection Heat Transfer.

**UNIT IV - HEAT EXCHANGERS**

Types-Overall Heat Transfer Coefficient-Shell and Tube1-1, 1-2, 2-4 passes –Plate Heat Exchanger-tubular heat exchanger-Parallel Flow and Counter Flow- Cross flow Types- Scraped surface exchangers-Compact Heat exchanger- Heat exchanger Analysis-Log mean Temperature Difference

## **UNIT V - MASS TRANSFER**

Mass transfer – introduction – Fick's law for molecular diffusion - molecular diffusion in gases – equimolar counter 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.

### **SUGGESTED READINGS:**

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

**Course Objectives**

The goal of this course is for students,

- To discuss the various types of equipments involved in drying and dehydration.
- To explain the operations involved in mechanical separations.
- To define the various attributes of evaporators in food processing.
- To recognize the role of milling equipments in size reduction.
- To outline the agitation and types of impellers employed in mixing.

**Course Outcomes**

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

1. Explain the models involved in the moisture and its measurements.
2. Summarize the various dryers employed in drying of food.
3. Demonstrate the filtration, sedimentation and centrifugal separations.
4. Evaluate the heat transfer coefficients and economy of different types of evaporators.
5. Estimate the energy and power requirement for the different size reduction operations.
6. Design and develop the agitators and impellers for mixing operations.

**UNIT I - DRYING AND DEHYDRATION**

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.

**UNIT II - MECHANICAL SEPARATION**

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 – gravitational sedimentation – Stoke's law – sedimentation in cyclones. Centrifugal separations – rate of separation – centrifuge equipment.

**UNIT III - EVAPORATION**

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. Heat transfer coefficients – 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**

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

## **UNIT V - MIXING AND FORMING**

Mixing and forming characteristics of mixtures-measurements of mixing –particles mixing-rates of mixing, energy input in mixing, liquid mixing-power & Froude number-mixing equipment-liquid, powder and particles mixtures, dough and paste mixtures. Forming-Pie & biscuit formers-Bread and confectionery moulders.

### **SUGGESTED READINGS:**

1. Rao DG. Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi, 2009.
2. Geankoplis CJ. Transport Processes and Separation Processes Principles. Prentice Hall India, New Delhi, 5<sup>th</sup> Edition, 2018.
3. Warren, L McCabe, J.C. Smith and Peter Harriot. Unit Operations of Chemical Engineering McGraw Hill International Edition, Singapore, 7<sup>th</sup> Edition, 2004.
4. Earle, R.L. Unit Operations in Food Processing”. Pergamon Press. UK, 2<sup>nd</sup> Edition, 2003.



**FOOD BIOCHEMISTRY AND HUMAN NUTRITION 3H-3C****Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:100 External:-Total:100****End Semester Exam:3 Hours****Course Objectives****The goal of this course is for students,**

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

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

1. Illustrate the structure of ATP and identify the major class of macromolecules to which ATP belongs.
2. List the stages in the catabolism of food molecules and describe what occurs during each stage.
3. Outline the biochemistry process, basic concept of human nutrition and the relationship of the consumption of foods to nutritional status and health
4. Evaluate the biological functions of foods for health in addition to nutritional values
5. Recall the dietary management system for nutrition and disorder with organs and inborn errors
6. Design and develop new range of food products and nutritional supplements for different age group people, pregnancy and other.

**UNIT I –METABOLISM OF CARBOHYDRATES**

Carbohydrate – Digestion and absorption, Glycolysis (EMP) pathway, CORI's cycle, Energy yield from glycolysis, TCA cycle – Energetics, HMP or PP pathway, Gluconeogenesis, Glycogenolysis, Glycogenesis

**UNIT II-METABOLISM OF FATTY ACIDS AND PROTEINS**

Fatty acids – Digestion and absorption, Synthesis of TAG's, Metabolism of adipose tissue – fatty liver and lipotropic factors, Cholesterol – biosynthesis and metabolism

Proteins – Digestion and absorption, General metabolism of amino acids – transdeamination, transamination and oxidative deamination, Urea cycle, Metabolism of serine, cysteine, valine, leucine, isoleucine, tryptophan

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

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

## **UNIT IV-NUTRITIONAL DISORDERS**

Dietary management – Fever – definition, effects on metabolic processes and diet modifications: Overweight, underweight and obesity – definitions, types, causes, factors responsible, measurement of obesity, importance of weight regulation, diet during obesity, psychological disorders during dieting, practical suggestions for reducing weight: Burns – types and nutritional management: CVD – types of cardiac disorders, risk factors, dietary management in atherosclerosis and hyperlipidaemia, fat replacers, dietary management in acute diseases of the heart, cardiological society of India: Cancer – diets and effects of cancer: Skin care, Diabetes – causes, factors predisposing diabetes, classification, symptoms, tests, acute and chronic complications, use of artificial sweeteners, hypoglycaemic drugs, oral hypoglycaemic drugs, medicinal plants in control of diabetes: Inborn errors of metabolism – diet therapy, amino acid disorders, carbohydrate disorders.

## **UNIT V-SPECIALIZED NUTRITION**

Nutritional requirement for infants – food and feeding, advantages and disadvantages of formula feeding, advantages of breast feeding for infants and mothers, feeding of solid foods: Food and feeding of toddler, preschool, school children and adolescent: Nutrition for aging and the aged- young, middle and older adulthood, biological changes in the aging process, problems of the aging process, nutritional requirement for adults, complications commonly occurring in late adulthood: Sports and fitness – measurement of body composition, energy from major nutrients, factors affecting fuel utilization, nutrition and athletic performance, effective hydration for fitness and sports, nutrition requirement for athletes, water and other fluids, sport supplements, broad guidelines for sports persons, pre-competition, during competition and post competition meal: Pregnancy and lactation – exercise, nutrition requirement, complications during pregnancy, nutrition during lactation.

## **SUGGESTED READINGS:**

1. Sunetra Roday. Food Science and Nutrition. Oxford Education/Oxford University Press, 2<sup>nd</sup> Edition, 2012.
2. Shubhangini AJ. Nutrition and Dietetics. McGraw Hill education, 4<sup>th</sup> Edition, 2015.
3. Avantina Sharma. Principles of Therapeutic and Nutrition Dietetics. CBS Publishers and Distributors, 1<sup>st</sup> Edition, 2017.
4. Ambika Shanmugam. Fundamentals of Biochemistry for Medical Students. Nagaraj and Company Pvt Ltd. 7<sup>th</sup> Edition (reprinted), 2005.
5. Vasudevan DM and Sreekumari S. Textbook of Biochemistry. Jaypee Brothers Medical Publishers Pvt Ltd. New Delhi, 3<sup>rd</sup> Edition, 2001.

**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,**

- Importance of treating waste product from food industry.
- Treatment methods and recycling of waste product from food industry
- Effective utilization or disposal of food waste
- 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,**

1. Awareness of Importance in treating waste product from food industry.
2. Knowledge of Treatment methods and recycling of waste product from food industry
3. Handle industrial waste with necessary precautions to avoid infection and cross contamination
4. To enable the student to understand the methods of treatment
5. Monitor the sludge and effluents discharged from food industries meet the limitation by law
6. Control environmental pollution by proper treatment of food waste

**UNIT I –INTRODUCTION**

Environmental problems – Pollution – soil, water and Air Pollution. Classification and characterization of waste from various food industries; Need for treating waste from various food industries

**UNIT II –FOOD INDUSTRY WASTES AND ENVIRONMENTAL POLLUTION**

Food Industries – Pollution due to Food Industry wastes - solid and liquid wastes – characteristics and impact on environmental quality. Wastes from fruit and vegetable processing, meat, fish, dairy waste, Coffee and sago processing industries – characteristics and effect on soil, water and air quality.

**UNIT III -WASTEWATER MANAGEMENT IN FOOD INDUSTRIES**

Principles of Physical treatment - 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**

Solid waste management techniques – Principles and practices, 3R concept, resource recovery. Composting – methods of composting , vermicomposting. Incineration, pyrolysis, Briquetting - value addition – SCP, enzymes, pectin and other products.

## **UNIT V-ENVIRONMENTAL PROTECTION AND POLLUTION CONTROL IN FOOD INDUSTRIES**

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 - Bio colorants - 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.

### **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, Springer Verlag 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, 1<sup>st</sup> edition,2008

**Course Objectives**

**The goal of this course is for students,**

- To calculate the protein content present in the given food sample.
- To determine the amount of carbohydrate in the food materials.
- To analyze the content of ash and ascorbic acid present in the given foods.
- To identify the method of lipid extraction and measure the percent of cholesterol in the given sample.
- To recognize the calculations based on measuring protein quality indices.

**Course Outcomes**

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

1. Examine the protein content of food samples using Lowry's and Biuret method
2. Perform the tests on quantifying carbohydrate content in the food samples.
3. Evaluate the amount of ascorbic acid in the given food materials.
4. Calculate the ash content and sample preparation of the AAS analysis.
5. Determine the fat and cholesterol content in the food samples.
6. Assess the calculations on protein quality indices.

**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. Calculation of protein quality indices using amino acid values of given sample

**Course Objective**

**The goal of this course is for students,**

- To analyze the various flow measuring equipment involved in food industries.
- To determine the pressure drop at various columns
- To discuss various experiment on heat exchanger and their applications in food industry.
- To evaluate the filtration efficiency using continuous rotary filtration
- To calculate the heat transfer through composite wall

**Course Outcomes**

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

1. Calculate the discharge coefficient of fluids at various conditions
2. Perform the experiment on flow of fluids
3. Assess the pressure drop across different columns
4. Demonstrate the heat transfer equipment and their performance.
5. Measure the efficiency of filtration process
6. Evaluate the heat transfer through composite wall

**List of Experiments**

1. Determination of coefficient of discharge of Venturi meter
2. Determination of coefficient of discharge of Orifice meter
3. Calibration of Rotameter
4. Determination of flow measurement and pressure drop in pipes
5. Pressure drop across packed column
6. Pressure drop across Fluidized bed columns
7. Heat transfer studies in a tubular heat exchanger (Parallel and counter flow)
8. Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
9. Heat transfer studies of a shell and tube heat exchanger
10. Experiment on continuous rotary filtration
11. Heat transfer through composite wall

## SEMESTER - V

B. Tech - Food Technology

2020 - 2021

20BTFT501

Semester-V

### DAIRY 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 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 discuss the production of milk and milk based products.
- To recall the working principle and construction of equipment like spray drier, drum drier.

#### Course Outcomes

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

1. Infer the physical, chemical and functional properties of milk.
2. Perform the qualitative tests on milk quality.
3. Assess the dairy processing equipment for specific applications.
4. Illustrate the processes involved in packaging and storage of milk.
5. Develop the various types of fermented milk products.
6. Prepare the different types of dehydrated milk products.

### UNIT I - DAIRY CHEMISTRY AND MICROBIOLOGY

Introduction - Basic dairy terminology - milk as raw material – composition - nutritive value - Physico-chemical constituents of milk and its constituents – contaminants - microbiology of milk- milk collection - cooling and milk transport - milk reception -Quality control tests - applications of enzymes in dairy industry.

### UNIT II - DAIRY PROCESSING AND EQUIPMENT'S

Milk processing equipment – filtration/clarification – Pasteurization – HTST – LTLT - UHT methods - storage tanks - Cream separating Centrifuges - Homogenization – theory - working principle of homogenizers – homogenization efficiency - cream separation – principles – gravity and centrifugal separation – centrifugal separator – parts – construction and working principle – separation efficiency.

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

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

#### **UNIT IV - MILK PRODUCT PROCESSING**

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

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

Fermented products – Yoghurt – Curd – cultured butter milk Bulgarian butter milk – Kefir – paneer - acidophilus milk etc. - Concept of Probiotics and prebiotic foods – Vacuum Evaporators - drying of milk - drum drier and spray drier - components - construction and working principles.

#### **SUGGESTED READINGS:**

1. Tomar S. An Introduction to Dairy Technology. Pragun Publication, 2012.
2. NIIR Board. Modern Technology of Milk Processing and Dairy Products. NIIR Project Consultancy Services, 4<sup>th</sup> Edition, 2013.
3. Tufail Ahmad. Dairy Plant Engineering and Management. Kitab Mahal Publishers. New Delhi, 2016.
4. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression, 2006.
5. Walstra P, Wouters JTM, Geuris TJ. DairyTechnology. Taylor& Francis, 2005.
6. Frazier WC and Westhoff DC. Food Microbiology. McGraw Hill. 11<sup>th</sup> reprint, 2017.



**Course Objectives**

**The goal of this course is for students,**

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

**Course Outcomes**

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

1. Discuss refrigeration of food and its operational components.
2. Locate food refrigeration in plants, stores and logistics.
3. Recognize food freezing concepts and techniques.
4. Report food safety aspects of chilled foods and frozen foods.
5. Evaluate the cold storage and packaging of frozen perishable products.
6. Employ the cold chain management system in the food distribution sector.

**UNIT I - PRINCIPLES OF REFRIGERATION**

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

**UNIT II - COLD STORAGE**

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**

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 Systems.

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

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**

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, transportation via land, air and sea. Grocery stores and display cases, Home refrigerators - Cooling chain summary – Storage and packaging.

### **SUGGESTED READINGS:**

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

**FOOD SAFETY REGULATIONS****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 functions, responsibilities and concepts of various food regulatory bodies.
- To define the overall functions and responsibilities of food authority of India.
- To describe the need, limitations and standards for labeling of various food products.
- To outline the importance and implementation of HACCP in food industries.
- To recall the safety, regulations and guidelines of packing water.

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

1. Express the functions, responsibilities and concepts of various food regulatory bodies.
2. Report the overall functions and responsibilities of food authority of India.
3. List the overall requirements needed for labeling of various food products.
4. Design and implement the HACCP system in the food industries.
5. Assess the safety, regulations and guidelines of packing water.
6. Infer the US and EU guidelines and standards governing the food safety and quality.

**UNIT I - FOOD GROUPS & REGULATIONS**

Food groups, proximate composition, methods of evaluation & labelling - food composition tables, food composition databases: USDA Database, UK Database. World Trade order – Functioning and responsibilities of the WTO – Codex Alimentarius –History, operations of Codex alimentarius, Responsibilities – Codex standards and Maximum residue limits – Current Issues under consideration – SPS (Sanitary and phytosanitary measures) agreement. World Health Organisation – History and mandate – Operations and responsibilities – ICGFI – Functions and responsibilities. Concept of Six Sigma.

**UNIT II - FOOD AUTHORITY IN INDIA**

Food safety and Standards Act – organizational chart – role of individual authority – principles to be followed –Provisions as to articles of food –imported items –Responsibilities of the food business operator – Liability of manufacturers, packers, wholesalers, distributors and sellers –Enforcement of the act – Licensing and registration of food business – Food safety officer and their powers – Analysis of food – regulations regarding labs involved in food analysis – Offences and penalties –Adjudication and food safety appellate tribunal – Laws relating to Food Processing Industries in India - FPO,MMPO, PFA, AGMARK, Essential Commodities Act, BIS.

**UNIT III - FOOD LABELING**

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

## **UNIT IV - MICROBIOLOGICAL FOOD SAFETY**

Concept of HACCP – 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 CCPs- Establishing monitoring procedures- establishing corrective actions – establishing verification. Halal certification – license and standards - meat processing sector.

## **UNIT V - SAFETY ASPECTS OF WATER**

Safety aspects of drinking water (microbiological and chemical)- the epidemiological triangle diseases caused by drinking of contaminated water , bottled water – setting of guideline values (microbiological and chemical) – risks and advantages of chlorination of water-Bottled water –origin of water- nutritional and physiological aspect – safety aspects – microbiological and chemical quality –Regulations for bottled water – EU, US and India

### **SUGGESTED READINGS:**

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

**Course Objectives**

The goal of this course is for students,

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

**Course outcomes**

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

1. Test the proximate composition of the given food sample.
2. Determine the physical, chemical and quality standards of lipids, proteins and carbohydrates.
3. Measure the adulterants in the given food commodities.
4. Examine the composition of foods using spectroscopic methods.
5. Inspect the food materials using chromatographic techniques.
6. Perform the tests on food substances using the principles of electrophoresis, refractometry and polarimetry.

**UNIT I INTRODUCTION**

Introduction, Food Regulations and Standards - Sampling methods - Sample preparation for analysis; Statistical evaluation of analytical data - Official Methods of Food 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**

Determination of Total fat in foods by different methods; 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; determination of total carbohydrates, starch, disaccharides and simple sugars in foods.

**UNIT III SPECTROSCOPIC TECHNIQUES**

Basic Principles- 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**

Basic Principles, detection of adulterants in foods by paper chromatography and thin layer chromatography, column chromatography for purification analysis; analysis of food additives, sugars, phytochemicals and aflatoxins, contaminants and other food components by HPLC, GC analysis of fatty acids, cis, trans Isomers - volatile oils, flavours and pesticides,

contaminants and other volatile derivatives of food components; Significance MS detector in HPLC and GC.

## **UNIT V ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY**

Basic Principles, application of electrophoresis in food analysis, refractive indices of oils and fats, total soluble solids in fruit juice and honey, specific rotation of sugars, estimation of simple sugars and disaccharides by polarimeter; Immunoassay techniques and its applications in foods.

### **SUGGESTED READINGS:**

1. Nielson, S. Suzanne. Food Analysis. Springer, 5<sup>th</sup> Edition, 2017.
2. Wood R, Foster L, Damant A and Key Pauline. Analytical Methods for Food Additives. CRC Wood head Publishing 2004.
3. Pomeranz, Yeshajahu and Clifton E. Meloan “Food Analysis: Theory and Practice”, 3<sup>rd</sup> Edition, Springer, 2004.
4. Nollet, Leo M.L. “Handbook of Food Analysis” 2<sup>nd</sup> Edition, Vol. 1-3. Marcel Dekker, 2004.
5. Hurst, Jeffrey W. “Methods of Analysis for Functional Foods and Nutraceuticals” 2<sup>nd</sup> Edition, CRC Press, 2008.

**Course Objectives**

**The goal of this course is for students,**

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

**Course Outcomes**

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

1. Identify the nutritionally important fruits and vegetables and its processing methods.
2. Demonstrate the manufacture, preservation and packaging of jam, jelly, marmalade, pickles and preserves.
3. Explain the different types of driers involved in the production of dehydrated fruit products.
4. Illustrate the minimal processing and fermentation methods of fruits and vegetables.
5. Enumerate the canning and bottling operations of fruits and vegetables.
6. Discuss the aseptic processing, packaging and storage of fruit juices.

**UNIT I – PROCESSING BY CHEMICAL METHOD**

Importance and scope of fruit and vegetables preservation. Nutritive value, nutraceutical properties – Definition and need for value addition. Methods of fruit and vegetable preservation - Processing using sugar – 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**

Drying and dehydration -Types of driers - Solar, cabinet, fluidized bed drier, spouted bed drier, heat pump drier, vacuum drier and freeze drier. Preparation of product. Changes during drying and dehydration. Problems related to storage of dried and dehydrated products

**UNIT III - MINIMAL PROCESSING AND FERMENTATION**

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. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

**UNIT IV- CANNING AND BOTTLING**

Canning - principles, types of cans– preparation of canned products - packing of canned products - spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

## **UNIT V - ASEPTIC PROCESSING**

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, Dole system and Scholle system for bulk storage in Bag and Boxes and Bag & Drums. Storage of Aseptically packed products.

### **SUGGESTED READINGS:**

1. Hui Y. H. Hand Book of Vegetable Preservation and Processing. Mercel Dekker, New York, 2<sup>nd</sup> Edition, 2015.
2. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology. Marcel Dekker Press, USA, 2003.
3. L. R. Verma and V. K. Joshi. Post Harvest Technology of fruits and vegetables. Indus Publishing Co, New Delhi, 2000.
4. P. Fellows. Food processing Technology: Principles and Practice”. Wood Head publishing Limited, Cambridge, England, 4<sup>th</sup> Edition, 2016.
5. James G. Brennan. Food Processing Hand book. Wiley-Ych Verlag Gmbh & Co KgaA, Weinheim, Germany, 2006.



**Instruction Hours/week: L: 0 T: 0 P: 4****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objectives****The goal of this course is for students,**

- To predict the saponification and iodine value of lipids
- To interpret the reducing sugar, iodine content and iron content in the given food sample
- To determine the swelling ratio and extract release of meat
- To analyze the curcumin, gingerol, and fat content in the food commodities
- To discuss the nitrogen estimation by Kjeldhal nitrogen analyzer

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

1. Test the iodine content in iodized salt
2. Identify the saponification and iodine value of lipids
3. Estimate the fat, iron and reducing sugar in the given foods
4. Evaluate the swelling ratio and extract release of meat
5. Assess the curcumin and gingerol content in the spices
6. Calculate the nitrogen content by Kjeldhal analyzer

**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

**FRUITS AND VEGETABLE PROCESSING LABORATORY 4H-3C****Instruction Hours/week: L:0 T:0 P:4****Marks: Internal:40 External:60-Total:100****End Semester Exam:3 Hours****Course Objective****The goal of this course is for students,**

- To list the ingredients needed for preparations of food products.
- To calculate the quantity of ingredients for preparations of food products.
- To generate different types of flour based products.
- To develop products from fruits and vegetables.
- To perform cost analysis for the developed products.

**Course Outcome****Upon completion of the course, students will be able to,**

1. Choose the appropriate ingredients for preparing food products.
2. Measure and calculate the quantity of ingredients for preparations of food products.
3. Formulate the ingredients for preparing variety of flour based bakery products.
4. Develop the ingredients for preparing variety of fruit and vegetable based products.
5. Assess the cost of the developed products.
6. Examine sensory tests for the developed products.

**List of Experiments:**

1. Preparation of RTS beverage
2. Preparation of squash
3. Preparation of nectar
4. Preparation of cordial
5. Preparation of Jam and marmalades
6. Preparation of ketchup and tomato sauce
7. Preparation of basic bread
8. Preparation of butter scotch cookies
9. Preparation of salt and sweet biscuits
10. Preparation of sponge, pound and angel cake

**Course objective**

**The goal of this course is for students,**

- Develop number of value added products from the waste generated in the grain, oil, fruit and vegetable processing industries.

**Course Outcome**

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

1. Design, formulate and produce the value added products from the industrial wastes of grain, oil, fruit and vegetable processing sectors.

**List of activities**

1. Waste utilization from fruits and vegetable processing sector
2. Waste utilization from oil processing industries
3. Waste utilization from grains processing industries

### **Course Objectives**

**The goal of this course is for students to,**

- State the different specifications and processes involved in the design and development of food processing plant
- Define the processes involved in layout design
- Evaluate the projects and cost estimation of designing food plant
- Outline the product cost and plant overheads
- Perform profitability analysis in food processing industry.

### **Course Outcomes**

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

1. Design and construct the well equipped food processing plant for effective processing
2. List the start – to – end facilities, infrastructure, utilities, investments along with the government regulations and specifications for plant layout
3. Evaluate and estimate the capital investments and methods of cost estimation of designing food plants
4. Assess the overall production cost, profitability and factors involved in the cost estimation of products manufactured
5. Analyze the problems involved in deciding the level of manufacture of a food product
6. Develop own industry or plan turn-key projects based on the request from customers

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

Technical feasibility survey of Food Industry, process development, Food Process flow sheets – Hygienic food process design - equipment design and specifications – Computed-aided process design – Principles of spread-sheet aided process design (Basic concepts only).

### **UNIT II - PLANT LAYOUT**

Marketability of the product, availability of technology, raw materials, equipments, human resources, land and utilities, site characteristics, waste disposal, Government regulations and other legal restrictions, community factors and other factors affecting investment and production costs. Plant Layout based on process and product. Richard Muther's Simple Systematic Plant Layout.

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

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**

Manufacturing costs – Direct production costs(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.). – Process Profitability - Application to a Food Processing plant e.g. Tomato processing- Administration, safety and other auxiliary services, 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**

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.

### **SUGGESTED READINGS:**

1. Peters and Timmer haus. Plant design and Economics for Chemical Engineers. McGraw Hill 5<sup>th</sup> Edition, 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. 2<sup>nd</sup> Edition. Elsevier, 2012.

**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 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 determine the processing of different marine based products.

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

1. Enumerate the chemical composition, structure, color, flavor, and microbial safety of meat.
2. Demonstrate the slaughtering, carcass processing methods and equipment used for processing meat.
3. Determine the various technological ideas in preparation of various types of meat products and design of equipment used for processing meat.
4. Adapt the HACCP and GMP of meat processing.
5. Evaluate the processing of poultry meat, meat products and egg products.
6. Assess the production, processing, spoilage, preservation and storage of marine products

**UNIT I - CHEMISTRY AND MICROBIOLOGY OF MEAT**

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 colour, flavors of meat products, meat microbiology and safety.

**UNIT II - SLAUGHTERING AND CARCASS PROCESSING**

Modern abattoirs and some features, Ante mortem handling and welfare of animals, design of handling facilities, Hoisting rail and traveling pulley system and stunning methods, stunning pen, slaughtering equipment, Washing area, Sticking, bleeding, dressing, Beef/Sheep and Pig Dressing operations, Offal handling and inspection, Inedible by products: Carcass processing equipment, Operational factors affecting meat quality, effects of processing on meat tenderization; meat processing equipment, electrical gadgets and manual gadgets; Typical lay outs.

**UNIT III - MEAT PRODUCTS**

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; Meat plant hygiene, Good manufacturing practice and HACCP.

#### **UNIT IV - PROCESSING OF POULTRY PRODUCTS**

Poultry industry in India, measuring the yields and quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Plant sanitation; Poultry meat processing operations in detail along with equipment used – De feathering, bleeding, Scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.

#### **UNIT V - FISH AND OTHER MARINE PRODUCTS PROCESSING**

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.

#### **SUGGESTED READINGS:**

1. Hui, Y.H., Nip, W.K., Rogers, R.W. Meat Science and Applications”. Marcel Dekkar Inc. New York, 1<sup>st</sup> Edition, 2001.
2. Sabel Guerrero and Hui YH. Handbook of Poultry Science Technology Volume-1. Wiley Publishing. 1<sup>st</sup> Edition, 2010.
3. Sabel Guerrero and Hui YH. Handbook of Poultry Science Technology Volume-2. Wiley Publishing. 1<sup>st</sup> Edition, 2010.
4. Balachandran, K. K. Post Harvest Technology of Fish and Fish Products. Daya Publishing House, New Delhi, 2002.

**Course Objectives**

**The goal of this course is for students,**

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

**Course Outcomes (COs)**

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

1. Discuss the rheology and chemistry of ingredients used in baking and confectionary.
2. Prepare the different types of breads, cakes, biscuits and cookies.
3. Assess the faults and remedies of baking processes.
4. Produce the various types of confectionary products.
5. Design and develop the equipment employed for baking and confectionary.
6. Choose the appropriate packaging materials and audit quality standards required for baking and confectionary.

**UNIT I BAKING PRINCIPLES AND BREAD & CAKE**

Types of wheat, Dough rheology, Baking principles - Role of ingredients and its chemistry. Bread-Ingredients, additives - Varieties of bread. Methods of bread preparation – bread spoilage and remedies. Advantages and disadvantages of various methods of bread-making. cake- types of cakes - role of ingredients - cake mixing methods – Preparation. Fancy cakes and preparation–Bread, cake- faults and remedies.

**UNIT II BISCUIT AND COOKIES**

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. Production of biscuits and cookies. Selection and preparation of mould. Cookies classification - Quality control for biscuits and cookies. Faults and causes

**UNIT III CONFECTIONERY PRODUCTS**

Introduction - importance of sugar confectionery and flour confectionery. Ingredients used in confectionery. Role of chemical additives in confectionery. Cocoa products and its uses in confectionery. Types of confectionery products-chocolate boiled sweets, caramels toffees, fondants.

**UNIT IV BAKERY EQUIPMENTS**

Machineries for a bakery unit - Bulk handling of ingredients, Dough mixers, Dividers, rounding, sheeting, and laminating machines .Ovens and Slicers, Packaging materials and equipment.



## **UNIT V PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT**

Packaging requirements and materials. Standards and regulations for bakery and confectionery products. Production standards and quality control - Good Manufacturing Practices (GMP) and other practices.

### **SUGGESTED READING:**

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

**Instruction Hours/week: L:0 T:0 P:4****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 Chemistry of the additives added to food
- State the importance of additives in maintaining or improving food quality
- Develop newer additives with improved safety standards.
- Investigate the properties of toxicity data of various food additives.
- Use food additives in food industries

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

1. Report the classification, safety levels and toxicity of food additives
2. List the properties, levels of addition and toxicity data of various food additives.
3. Illustrate the importance of additives in maintaining or improving food quality.
4. Develop the various instant premixes by the addition of preservatives within the permissible limits.
5. Apply the principles of food additives to study the toxicity
6. Identify and design new products, with better quality using additives which are economical and safe.

**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.

**Instruction Hours/week: L:0 T:0 P:4****Marks: Internal:40 External:60 Total:100  
End Semester Exam:3 Hours****Course Objective****The goal of this course is for students to,**

- List the ingredients needed for preparations of food products.
- Calculate the quantity of ingredients for preparations of food products
- Prepare different types of milk based products
- Explain the production of milk powder using the spray drier
- Perform cost analysis of the developed products

**Course Outcome****Upon completion of this course, students will be able to,**

1. Choose the appropriate ingredients for preparing food products
2. Measure and calculate the quantity of ingredients for preparations of food products.
3. Formulate the ingredients for preparing a variety of milk based products
4. Apply the principle of spray drying to develop value added products from milk
5. Analyze the cost of the developed products
6. Conduct sensory tests for the developed products

**List of Experiments**

1. Preparation of khoa, chana and paneer
2. Preparation of Gulab Jamun
3. Preparation of Rasagulla
4. Preparation of Sandesh and peda
5. Preparation of Kalakhand
6. Preparation of shrikand
7. Preparation of butter and ghee
8. Preparation of chikki
9. Preparation of milk beverage
10. Studies on preparation of milk powder using spray drier

**Course Objectives:**

**The goal of this course is for students to,**

- To equip the students for effective technical presentation
- To improve body language and posture for effective public speaking.

**Course Outcomes:**

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

- To get familiarize in the teaching presentation skills.
- To gain confidence in the teaching process.

During the seminar session, each student is expected to prepare and present a topic on food technology and its allied sectors, for duration of about 8 to 10 minutes. In a week, one hour will be allotted to present seminars. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in presentation skills and facing the interviews.

**PROFESSIONAL ETHICS, PRINCIPLES OF MANAGEMENT  
AND ENTREPRENEURSHIP DEVELOPMENT****3H-3C****Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:100 External:-Total:100****End Semester Exam:3 Hours****Course Objectives:****The goal of this course is for students to,**

- Practice the students to create an awareness on Engineering Ethics
- Incorporate Moral and Social Values and Loyalty
- Appreciate the rights of other
- Motivate the leadership skills
- Train to become an entrepreneur

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

1. Explain the engineering ethics
2. Outline the Moral and Social Values and Loyalty
3. Justify the rights of other
4. Illustrate the values of leadership skills
5. Assess the skills of entrepreneur
6. Discuss the management skills

**UNIT I ENGINEERING ETHICS**

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 – uses of ethical theories.

**UNIT II FACTORS OF CHANGES**

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

**UNIT III HISTORICAL DEVELOPMENT, PLANNING, ORGANISING**

Definition of Management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies and Planning Premises– Forecasting – Decision-making – Formal and informal organization – Organization Chart

**UNIT IV DIRECTING AND CONTROLLING**

Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment –Process of Communication – System and process of Controlling – Requirements for effective control – Control of Overall Performance – Direct and Preventive Control – Reporting

**UNIT V ENTREPRENEURSHIP AND MOTIVATION**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth– Major Motives Influencing an

Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

### **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, 2<sup>nd</sup> Edition, 2011.
4. Harold Kooritz and Heinz Weihrich. Essentials of Management. Tata McGraw Hill, New Delhi, 2010.
5. Khanka S.S. Entrepreneurial Development. S. Chand and Co. Ltd., New Delhi, 2006.

**Course objectives**

**The goal of this course is for students to,**

- Introduce students to key aspects of supply chain (SC) management which are critical to improving the overall resilience of the global food supply network.
- Make them aware about various global regulatory guidelines in food supply management.

**Course outcomes**

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

1. Assess the impact of different SC strategies on the competitive strategy in the Food and Drinks industry.
2. Design a successful collaborative initiative through the use of frameworks and tools.
3. Examine the challenges around managing sustainable supply chains.

**UNIT I-INTRODUCTION**

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**

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**

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**

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**

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

### **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, 5<sup>th</sup> edition, 2013
4. Logistics Engineering and Management, Blanchard, pearson, 6th edition 2004



**Course Objectives**

The goal of this course is for students to,

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

**Course Outcomes**

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

1. Discuss the need and functions of packaging as a solution to various factors affecting food.
2. Estimate the shelf life of food packed in different types of packaging materials
3. Explain the different packaging materials, their manufacturing process and equipment involved.
4. Compile the various closures and sealing mechanisms for different packaging materials.
5. Select the different printing and labeling methods with legislative requirements.
6. Devise innovations in food packaging and their applications.

**UNIT I - INTRODUCTION TO FOOD PACKAGING**

Functions of packaging, Effect of environmental factors - light, Oxygen, Moisture, Temperature, mechanical forces and biological factors on quality of food. Estimation of shelf life. General Approach, analysis of storage requirement, accelerated storage studies: Vacuum and Inert Gas Packaging: Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.

**UNIT II - METAL CANS AS PACKAGING**

Metallic can types - Tin cans and Aluminum cans. Specialty of Open top sanitary cans, Lacquers and their use, Three piece cans and Two piece cans, Aerosol Cans, Basics of Canning operations – Can Reformer, Flanger, Seaming, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles.

**UNIT III - FLEXIBLE FILMS PACKAGING**

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

## **UNIT IV - FILLING AND SEALING OPERATIONS FOR VARIOUS TYPES OF PACKAGES**

Closing and sealing of rigid plastic containers. Filling and sealing of Flexible plastic containers, Seal types-Bead seals, Lap Seals and Fin seals –Differences and advantages, Hot wire sealing, hot bar sealing and impulse sealing – differences and relative advantages, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements. Filling and Sealing of pouches, pouch from fill seal machines.

## **UNIT V - INNOVATIONS IN FOOD PACKAGING**

Aseptic Packaging. Active packaging, Moisture control, CO<sub>2</sub> and Oxygen scavenging. Modified atmosphere packaging – principles, applications. Permeability of gases in packs. Antimicrobial Packaging, Edible packaging films and coating. Packaging for non-thermal food processing. Intelligent Packaging – Time-temperature indicators, RFID, Tamper evident packaging.

### **SUGGESTED READINGS:**

1. Coles R and Kirwan J. Food and Beverage Packaging Technology. Wiley-Blackwell Publishing. 2<sup>nd</sup> Edition, 2011.
2. Coles, R., Dowell, D.M., Kirwan, J. Food Packaging Technology, Black Well Publishing Ltd, 2009.
3. Gordon L. Robertson. Food Packaging Principles & Practice. CRC Press, 2016.
4. Kit L Yam and Dong Sun Lee. Emerging Food Packaging Technologies: Principles and Practice. Wood head Publishing Ltd, 2012.
5. Jung H. Han. Innovations in Food Packaging. Biogreen Elsevier India, 2<sup>nd</sup> Edition, 2016.

**Course Objectives**

**The goal of this course is for students to,**

- Determine the quality of different types of packaging materials
- Determine the migration characteristics of the various packaging materials
- Investigate the water vapour transmission rate of packaging materials
- Develop skills related to basic tests on food packaging materials
- Infer the basics for operating the different types of packaging equipments

**Course Outcomes**

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

1. Test the quality of different types of packaging materials
2. Experiment the migration characteristics of the given packaging materials
3. Conduct test on water vapour transmission rate of packaging materials
4. Examine the water absorption capacity of paper and paperboards
5. Illustrate the working of different packaging equipments
6. Demonstrate packaging requirements and their selection for raw and processed foods

**List of Experiments**

1. Measurement of thickness of packaging materials
2. Measurement of basic weight and grammage of paper and paperboards
3. Measurement of water absorption of paper and paper boards (Cobb Test)
4. Identification of plastic films
5. Study of vacuum packaging machine, bottle filling machine and form-fill-seal machine
6. Determination of lacquer integrity test
7. Determination of seal integrity, ink adhesion
8. Measurement of grease resistance of papers
9. Determination of the migration characteristics of the given material – acid as stimulant
10. Determination of the migration characteristics of the given material – alcohol as stimulant
11. Determination of the water vapor Transmission rate of the given packaging material.

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

The students will be directed to do a project work which will be the Phase I if their main project works that will be performed in the eighth semester during. Their projects will be evaluated for forty percentages in Continuous Internal Assessment and sixty percentages in End Semester Examination.

End Semester Examination evaluation will be based on the report submitted by the student after the completion of the project work.

## SEMESTER - VIII

**B.Tech – Food Technology**

**2020 - 2021**

**20BTFT891**

**Semester-VIII**

### **PROJECT WORK PHASE-II**

**12H-6C**

**Instruction Hours/week: L:0 T:0 P:12**

**Marks: Internal:120 External:180 Total:300**

**End Semester Exam:3 Hours**

The students will be performing their main project work as a continuation of the Phase I project completed in the seventh semester. Their projects will be evaluated for a total of three hundred marks, out of which one twenty marks will be for Continuous Internal Assessment and one hundred and eighty marks for End Semester Examination.

End Semester Examination evaluation will be based on the report submitted and presentation of his/her work by the student to a panel of evaluators after the completion of the project work.

**PROFESSIONAL ELECTIVE  
SEMESTER V**

**B.Tech – Food Technology**

**2020 - 2021**

**20BTFT5E01**

**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,**

- To understand the physical and chemical properties of fats and oils.
- To study the extraction and refining processes of various oils and fats.
- To learn 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,**

1. To enumerate the importance of fats and oils.
2. To describe the manufacturing process of oils and fats.
3. To apply knowledge on manufacture of designer fats.
4. To appraise the quality attributes of oils and fats.
5. To design suitable packaging materials.
6. To invent methods for industrial applications of oils and fats.

**UNIT I - PHYSICAL AND CHEMICAL PROPERTIES**

Fats and oils – formation – functions of oil in human body - fatty acids – double bonds and their position in oil – Geneva type classification - sources of vegetable oils – production status-oil content – coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil – physical and chemical properties of fats and oils - chemical reactions of oil – hydrolysis –hydrogenation, oxidation and polymerization.

**UNIT II - EXTRACTION METHODS**

Oil extraction methods –mechanical expression – ghani, power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance solvent extraction process – steps involved, batch and continuous-continuous solvent extraction process for rice bran, soy bean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils – palm oil, virgin coconut oil – extraction process.

**Unit III - REFINING OF OILS**

Refining of oils – objectives – characterization - degumming – Zeneath process – deacidification process – continuous acid refining-bleaching of oil – continuous bleaching process – decolourising agents-deodorization process winterization processes-hydrogenation of oil –selectivity – catalyst –batch type hydrogenation – regeneration of Catalyst-Vanaspati, ghee and margarine – production process-partial sterilization, emulsification, chilling, kneading and rolling, incorporation of salt, colouring substances production of special fats – butter – types - production and storage.

#### **UNIT IV - PACKAGING OF EDIBLE OILS**

Packaging of edible oils – requirements – types – tinsplate, 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 - INDUSTRIAL APPLICATIONS AND QUALITY STANDARDS**

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.

#### **SUGGESTED READINGS:**

1. Harry Lawson, (1997) “Food oils and Fats - Technology, Utilization and Nutrition”, CBS Publishers and Distributors, New Delhi.
2. Gunstone F.D., (2008) “Oils and Fats in Food Industry”, Blackwell Publishing, United Kingdom, ISBN – 13: 9781405171212.
3. Gunstone F.D., (2011) “Vegetable Oils in Food Technology: Composition, Properties and Uses”, 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681.

**Course Objective**

**The goal of this course is for students to,**

- To understand the types of ingredients used in beverage production.
- To impart knowledge on processes involved in carbonated beverage production
- To define the processes and unit operations involved in noncarbonated beverage production
- To outline the various grades , equipments used and ingredients for the production of alcoholic beverages
- To discuss the quality standards, regulations and sanitation for beverage processing industries.

**Course Outcome**

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

1. Capable of formulating beverages using various ingredients.
2. Demonstrate various unit operations involved in the food beverage manufacturing
3. Understand the various production techniques in beverages.
4. Apply the knowledge obtained to produce nonalcoholic beverages
5. Evaluate the quality parameters of all beverages
6. Familiarize with food laws and regulations of beverages

**UNIT I INGREDIENTS IN BEVERAGES**

Beverage-definition-ingredients- water, quality evaluation and raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nano-emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers,

**UNIT II CARBONATED BEVERAGES**

Procedures- ingredients- preparation of Syrup making, carbonation of soft drinks. Carbonation equipments 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**

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**

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 SANITATION AND QUALITY CONTROL**

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

### **SUGGESTED READINGS:**

1. L. Jagan Mohan Rao and K. Ramalakshmi (2011)“Recent trend in Soft beverages”, Woodhead Publishing India Pvt Ltd.
2. Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.
3. Hui, Yiu H., et al., eds (2004) Handbook of food and beverage fermentation technology. Vol. 134. CRC Press.
4. Mitchell, Alan J. (199) “Formulation and Production Carbonated Soft Drinks”. Springer Science & Business Media,
5. Woodroof, Jasper Guy, and G. Frank Phillips.(1981)Beverages: carbonated and noncarbonated. AVI Pub. Co.

**Course Objectives**

**The goal of this course is for students to,**

- To impart understanding about different emerging technology in Food Processing.
- To enable the students to apply the knowledge in real time food processing innovations.
- To innovate new technologies or hurdle combinations for unexplored realms of food processing.

**Course Outcomes**

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

1. To know the emerging technologies applied to food processing.
2. To understand the relative advantages and disadvantages of emerging technologies over existing technologies.
3. To visualize the equipment used and process stages of emerging technologies.
4. To apply the non thermal technologies as alternative food processing methods.
5. To identify the potential of newer technologies for commercialization.
6. To develop strategies for applying the technologies to wide range of food.

**UNIT I - HIGH PRESSURE PROCESSING OF FOODS**

Principles – applications to food systems – effect on quality – textural, nutritional and Microbiological quality – factors affecting the quality – modelling of high pressure processes – High Pressure Freezing, Principles and Applications

**UNIT II - RADIATION PROCESSING OF FOODS**

Principle, Types of radiation sources. Biological effects of irradiation, Irradiation of Foods– Gamma Irradiation, X-Ray Irradiation, UV Irradiation–Combined treatments. Applications and Limitations.

**UNIT III - OSMOTIC DEHYDRATION OF FOODS**

Principle – Mechanism of osmotic dehydration – Effect of process parameters on mass transfer – Methods to increase the rate of mass transfer – Applications – Limitations of osmotic Dehydration – Management of osmotic solutions

**UNIT IV - OHMIC AND ULTRASOUND PROCESSING OF FOODS**

Principle of ultrasound – Fundamentals – Ultrasound as a processing and preservation aid – Effect on properties of foods Basics of ohmic heating – Electrical conductivity - generic configurations- treatment of products.

**UNIT V - PULSED LIGHT AND HURDLE TECHNOLOGY**

Basics of hurdle technology – Mechanism Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plant derived antimicrobials – Antimicrobial enzymes – bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle).

## **Pulsed Electric Field Processing Of Foods**

Principles – Mechanism of action – PEF treatment systems – Main processing parameters – PEF Technology – Equipments – Mechanism of microbial and enzyme inactivation- safety aspects– Processing of liquid foods using PEF – Process models – Comparison of High pressure processing and PEF – Enzymatic Inactivation by PEF, Examples – Microbiological and chemical safety of PEF foods.

### **SUGGESTED READINGS:**

1. Da-wen Sun: Emerging Technologies for Food Processing, Elsevier Academic Press and Marcel Dekker Inc, 2014.
2. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food stability safety and quality, Kluwer Academics / Plenum Publishers, 2002.
3. Gustavo V. Barbosa- Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Novel Food Processing Technologies (Food Science and Technology Series), CRC Press,2004.

**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,**

- Contrast the fundamentals of sensors and control concepts.
- Explain the concepts of system analysis and control.
- Summarize the knowledge about the working of various sensors.
- Define mathematical model for a system
- Interpret the suitable control schemes of particular system.

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

1. Represent the mathematical model of a system.
2. Determine the response of different order systems for various test inputs.
3. Analyze the stability of the system.
4. Apply the knowledge of various Measuring Instruments design a simple Instrumentation system.
5. Derive the Mathematical Model of a physical system.
6. Analyze and decide suitable control schemes for a particular system.

**UNIT I - INTRODUCTION TO PROCESS CONTROL**

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 – laplace transform – transforms of simple functions – step function, exponential function, ramp function and sine function.

**UNIT II - CONTROL SYSTEMS**

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**

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**

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**

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.

#### **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, 2<sup>nd</sup> edition, nineteenth reprint.
4. S. Baskar (2004), "Instrumentation control system measurements and controls" Anuradha Agencies Publishers.
5. Nagrath, M and Gopal, I.J (2003), "Control Systems Engineering", Wiley Eastern Limited, Third Edition Reprint.
6. Renganathan (2003), "Transducer engineering, Allied publishers, New Delhi.
7. Patranabis (2004), "Principles of industrial instrumentation", Prentice Hall India. Patranabis, D., (1997) Second Edit Tata McGraw Hill Publishing Co. Ltd.. New Delhi. ISBN 0074623346.

**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,**

- Study the importance of non-thermal methods like irradiation as an alternative to conventional methods of processing.
- Understand the effect of radiation as a processing and preservation method
- Study the importance and safety issues of the irradiated foods

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

1. Interrelate the non- thermal technologies for the purpose of food processing and preservation
2. Apply the novel preservation technologies over the food and improve the marketability consumability.
3. Critique the radiation preservation technology suitable to all sort of food materials

**UNIT I BASICS OF RADIATION CHEMISTRY**

Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods.

**UNIT II RADIATION CHEMISTRY OF FOOD COMPONENTS**

Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

**UNIT III MICROWAVES IN FOOD PROCESSING**

Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures.

**UNIT IV INFRA RED RADIATION**

Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits.

**UNIT V RADIO FREQUENCY HEATING PRINCIPLES**

RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.

### **SUGGESTED READINGS:**

1. Welter M. Urbain: (1986) "Food Irradiation" Academic Press, New York.
2. Ohlsson and Bengtson, (2002, "Microwave Processing Technologies" Wood head Publishing, Cambridge,UK.
3. Gould G.W., (1999), "New Methods of Food Preservation", Aspen Publishers Inc., Maryland.
4. S. G. Llyasor and V.V. Krasnikov, (1991) "Physical Principles of Infra Red Irradiation of Food Stuffs" Hemisphere Publishing Corporation, London, 1991.
5. Philip Richardson, (2001), "Thermal Technologies for Food Processing", Wood head Publishing Limited, CRC Press.
6. Robert V. Decareau, Microwave Foods, New Product Development Food & Nutrition Press Inc., USA, 1992.

**Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objectives****The goal of this course is for students to,**

- To study about the various methods of processing tea products.
- To demonstrate a basic knowledge on process of coffee, and cocoa.
- To develop an awareness of various processing procedure for major spices & minor spices.

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

1. To define the different unit operations and its equipments involved in coffee, tea and cocoa processing
2. To gain knowledge in processing of plantation crops and spices and also its value added products.
3. To outline ways in which quality loss can be minimized during preparation and processing
4. To develop value added products from plantation products and spices
5. To demonstrate appropriate technique for the extraction of spice oil and oleoresin with quality standards
6. To acquire a confident to get placement in any kind of cereals and spices industry with minimum post harvest losses and maximum benefit to the industry.

**UNIT I - CHEMISTRY AND TECHNOLOGY OF COFFEE**

Coffee – Occurrence – chemical constituents– harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting –Process flow sheet for the manufacture of coffee powder – Instant coffee, technology – Chicory chemistry - Quality grading of coffee.

**UNIT II - CHEMISTRY AND TECHNOLOGY OF TEA**

Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process – Green tea manufacture – Instant tea manufacture – Grading of tea.

**UNIT III - CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS**

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 IV - CHEMISTRY AND TECHNOLOGY OF MAJOR SPICES**

Pepper, Cardamom, ginger, Chili, mint, and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavor identical - Quality control of major spices.



## **UNIT V - CHEMISTRY AND TECHNOLOGY OF MINOR SPICES**

Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove Vanilla, Coconut, Areca nut, Oil palm and Cashew - Oleoresins and essential oils –Method of manufacture – Chemistry of the volatiles – Quality control of minor spices

### **SUGGESTED READINGS:**

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

**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,**

- Emphasize the various processing methods involved in converting raw material into quality food products
- Exposed to the various equipments used for milling process of food materials

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

1. Understand the byproducts obtained from milling and its wastes.
2. Recognize the significance of quality parameters in selection, product development and value addition

**UNIT I GRAIN PROPERTIES**

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.

**UNIT II RICE MILLING**

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.

**UNIT III WHEAT MILLING**

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. Milling of Corn: Corn–types. Dry and wet milling of corn–flow sheet and explanation, Byproducts from corn milling, corn starch, corn syrup, corn flakes. Waste utilization.

**UNIT IV PULSE MILLING**

Importance of legumes. Milling and processing of Legumes- Methods of milling of pulses. Processing methods- dehulling losses and effect of dehulling on nutritive value. Grading methods, cooking quality.

**UNIT V OIL SEED MILLING**

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, hydrogenation, winterization, changes during storage. Oil seed flour concentrates and isolate.

### **SUGGESTED READINGS:**

1. Kulp K and Pont J G, —Handbook of Cereal Science and Technology, Second Edition, Chips Ltd. USA, 2000.
2. Khader, Vijaya and Vimala, V., —Grain Quality and Processing, Agrotech Publishing, Udaipur, 2007.
3. Harry Lawson. —Food Oils and Fats, Technology, Utilization and Nutrition, CBS Publishers and Distributors, New Delhi, 1997.
4. Chakraverty, A. —Post Harvest Technology of Cereals, Pulses and Oil Seeds, Third Edition, Oxford & IBH publishing & Co., New Delhi, 2000.
5. Sahay, K.M. and Singh. K.K. Unit operations of Agricultural Processing, Vikas Publishing House, New Delhi, 1996.

**TECHNOLOGY OF LEGUMES AND OILSEEDS****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,**

- Develop the knowledge in the area of legumes and oil seed processing and technology
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Understand the specific aspects of food processing related to these foods

**Course Outcome****Upon completion of this course, students will be able to,**

1. Understand and identify the specific processing technologies used for legumes and oil seeds and the various products derived from these materials.
2. Grasp the changes in the composition of foods with respect to the type of processing technology imparted.
3. Develop competence in processing of legumes and Oilseeds technology.

**UNIT I INTRODUCTION**

Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds Chemical composition, nutritional value and anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti- nutritional compounds

**UNIT II PULSE PROCESSING**

Pulse milling: Home scale, cottage scale and modern milling methods, machines, milling quality, milling efficiency Factors affecting milling quality and quantity; Problems in dhal milling Industry

**UNIT III NUTRITION CHANGES AND COOKING METHODS**

Nutritional changes during soaking and sprouting of pulses; Cooking quality of dhal, methods, factors affecting cooking of dhal; Quick cooking dhal, instant dhal; Soybean milk processing and value addition; Fermented products of legumes

**UNIT IV OILSEED PROCESSING AND STAGES OF REFINING**

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; Refining of oils: Degumming, neutralization, bleaching, filtration, deodorization, winterization and their principles and process controls; Hydrogenation of oils; New technologies in oilseed processing;

**UNIT V UTILIZATION OF BYPRODUCTS**

Utilization of oil seed meals for different food uses: High protein products like protein concentrates and isolates; By-products of pulse and oil milling and their value addition.

## **SUGGESTED READING:**

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, 6<sup>th</sup> Ed., Vols. 1 to 6. John Wiley and Sons, Inc. Hoboken, New Jersey, USA.
5. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.
6. K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing, 2<sup>nd</sup> Ed. Vikas Publishing House Pvt. Ltd., Noida.

**Course Objectives**

The goal of this course is for students to,

- Appreciate the importance of early eating habits on the shaping of later eating behavior and health status
- Understand how food nourishes the body
- Develop skills to assess and apply nutrition standards and guidelines for achieving optimum human nutrition and health

**Course Outcomes**

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

1. Know the nutritional value of different food groups
2. Identify the nutritional requirements of infants, preschool going children and athletes
3. Learn the principles of menu planning process and understand and use the concept of food exchange lists.
4. Design therapeutic diets for diseases like diabetes, and CHD
5. Identify anti-nutritional factors present in different foods with their properties and ill effects

**UNIT-I NUTRITION AND BALANCED DIET**

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

**UNIT II- MENU PLANNING**

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

**UNIT III-BALANCED DIET**

Diets during normal life cycle- 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**

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.

## **UNIT V- FUNCTIONAL AND SPECIAL FOODS**

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.

### **SUGGESTED READINGS:**

1. C Gopalan, BV Ramshastri, S C Balasubramaniam, 1989, Nutritive Value of Indian Foods Nation Institute of Nutrition, Hyderabad
2. M Swaminathan, 1974, Essentials of Nutrition, Ganesh Co.
3. K.H. Steinkrauss, 1995, Handbook of Indigenous Fermented Foods, Marcel Dekker.
4. J Pokorny, N Yanishlieva, and M Gordon, 2001, Antioxidants in Food, Published by Woodhe Publishing Limited, Abington Hall, Abington
5. N N Potter, and J H Hotchkiss, 1995, Food Science, (5<sup>th</sup>Edition), Aspen Publishers, Inc., Gaithersbur Maryland.
6. Food and Nutrition Bulletin, Vol. 23, 24, 25 and 26. The United Nations University, Press.
7. G Mazza, 1998, Functional Foods. Biochemical and Processing Aspects, Technomic Publ. Co.
8. Corrine Robinson, 1975, Basic Nutrition and Diet Therapy, Macmillan.
9. F.P. Antia, 1974, Clinical Dietetics and Nutrition, Oxford Medicine Publications
10. Davidson and Passmore, 1986, Human Nutrition and Dietetics, Churchill Livingstone

**Course Objective**

**The goal of this course is for students to,**

To enable the student to design and develop equipments used in Food Processing operations.

**Course Outcome:**

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

To gain technical know-how about the material requirements and design of various equipments needed in Food industries.

**Unit I - MATERIALS**

Metals and non metals, design of pressure vessels – cylindrical shell –internal and external pressure -under continued loadings. Numerical problem and design of pressure vessel.

**Unit II - STORAGE VESSELS**

Design of storage vessels – Rectangular Tank without stiffeners –with stiffeners – shell design – Numerical problem and design.

**Unit III - REACTION VESSELS**

Design of Reaction vessels – materials -classification – jackets-Design of vessel shell with half coil – Design of vessel shell with jacket – Numerical problem and design.

**Unit IV - HEAT EXCHANGERS**

Design of Heat exchangers – types – materials – Design pressure and temperature- shell design – tubes – Numerical problem.-Design of Equipment. Evaporator: Materials of concentration – types – design-consideration – Design of agitators – power requirements – Design based on Torque – critical speed.

**Unit V – DRYERS**

Types - General considerations – Design of Tray dryer , Rotary Dryer – Material Balance, Thermal energy Requirements , electrical energy Requirements, Performance Indices

**SUGGESTED READINGS:**

1. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc. ISBN-0824743113, 2003.
2. Joshi M.V, “Process Equipment Design”, Macmillan India Ltd.,1985
3. Coulson ,J.M. and Richardson, J. F,“Chemical Engineering “ Butterworth-Heinemann Elsevier, ISBN-0750644451, 2002



**FOOD COLORANTS AND FLAVORANTS****3H-3C****Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objective****The goal of this course is for students to,**

- To understand the different food colors.
- To understand the properties and application of food colors
- To understand different food flavors and its applications
- To know the Quality control techniques and regulations involved in colors and flavors

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

1. Understand about synthetic and natural colors and flavors
2. Know the importance of colors and flavors
3. Gain knowledge of Regulations involved in the safer use of colors and flavors in foods

**UNIT-I FOOD COLOURS**

Introduction – Natural and Synthetic food Colours – Class and description of food colours – Physical form of food colours – Stability, storage and solubility of food colours – Regulations and safety assessment – Labeling requirements for food containing colour additives – Adulteration and misbranding of colour additives in foods

**UNIT-II PROPERTIES AND ANALYSIS OF FOOD COLOURS**

Food colour stability, Importance of food colours for food products - Methods of analysis for food colour - Quality and safety assessment – Applications of natural and synthetic food colours

**UNIT-III FOOD FLAVOURS**

Introduction – 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. Effects of storage, processing, transportation and environmental conditions on flavour components/constituents.

**UNIT-IV FOOD FLAVOR: APPLICATIONS AND RECENT DEVELOPMENT**

Culinary and Meat Products, bakery products, snack foods, sugar based confectionary products, dairy products and soft drinks - Changes in food flavor due to processing – flavor release from foods – Factors that affect the flavour and control of flavour in processed foods. Recent developments in flavor research, processing and technology.

**UNIT-V FOOD FLAVOR: QUALITY CONTROL**

Flavouring and coating technologies for preservation and processing of foods. Natural flavor enhancers for food and beverage, Quality Control – analytical, sensory and adulteration testing. Measurement of flavour, particularly for wine, tea, coffee, species and condiments.

### **SUGGESTED READINGS:**

1. Spices and Flavor Technology. J.S. Pruthi, ICAR Publications, 2<sup>nd</sup> Edition, 1998.
2. Fenaroli, G, Handbook of flavour ingredients, CRC Press. Boca Raton, 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. Suwendu Bhattacharya, Conventional and Advanced Food Processing Technologies, Wiley Publishers, 2015
6. Heath, HB, Flavour chemistry and technology, CBS Publ., New Delhi, 2005

**Course Objectives**

**The goal of this course is for students to,**

To gain knowledge on post harvest storage practices

To minimize post harvest losses of different food grains

To learn the proper storage practices

To improve the economy

To preserve food products from pests and losses during unit operations in industries

**Course Outcomes**

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

The students apply their knowledge of processing methods of cereals and pulses

The students acquire knowledge on fruit and vegetable processing

**UNIT I OVERVIEW OF POST-HARVEST TECHNOLOGY**

Concept and science, Introduction to different agricultural crops, their cropping pattern, production, harvesting and post-harvest losses, reasons for losses, importance of loss reduction, Post-Harvest Handling operations.

**UNIT II CLEANING SORTING AND GRADING**

Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Peeling Sorting, grading, methods of grading; Grading- Size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance

**UNIT III SEPARATION, DECORTICATING AND SHELLING**

Magnetic separator, destoners, electrostatic separators, pneumatic separator Principles of working, design and constructional details, operating parameters, maintenance, etc. of various decorticators/dehullers/shellers, description of groundnut decorticators, maize shellers, etc.

**UNIT IV MILLING AND MATERIALS HANDLING**

Milling, polishing, grinding, milling equipment, dehuskers, polishers (abrasion, friction, water jet), flour milling machines, pulse milling machines, grinders, cutting machines, oil expellers, machine efficiency and power requirement Introduction to different conveying equipment used for handling of grains, fruits and vegetables; Scope and importance of material handling devices

**UNIT V STUDY OF DIFFERENT MATERIAL HANDLING SYSTEMS**

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

## **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.

**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 recognize the milling techniques of cereals and pulses.
- To outline the byproducts obtained during processing along with their uses.
- To develop value added products from maize.
- To analyze various aspects of milling of pulses.

### **Course Outcomes**

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

1. Evaluate the basic composition and structural parts of food grains.
2. Practice the various methods on drying of grains.
3. Illustrate the techniques of rice, wheat and pulse milling.
4. Prepare value added products from the byproducts obtained during milling.
5. Assess the production, processing and preparation of value added products from maize.
6. Demonstrate the equipment involved in the milling of pulses.

### **UNIT I - PADDY PROCESSING**

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 - Flattened and Puffed Rice.

### **UNIT II - RICE MILLING**

Rice milling flow chart - Modern Rice Milling equipments – paddy milling -Dehusking of paddy - 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 Broken separators - Rice mill yields and loss due to broken at different stages of milling – milling efficiency -Use of Rice Bran in Edible oil Industry.

### **UNIT III - WHEAT MILLING**

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**

Structure and composition of maize – milling methods - Precleaning-cleaning equipment degermination and dehusking- Dry milling of maize – wet milling – flow chart- Products of milling – Flour – Semolina - 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, MaltoDextrin and other products - Extraction and refining of Corn oil in brief.

## **UNIT V - MILLING OF PULSES**

Structure and composition – need for pulse milling – Unit operations of pulse milling – domestic and commercial scale pulse milling methods – Dry and wet milling, CFTRI, CIAE, Jadavpur methods - Process flow chart – Pulse milling machineries - dehusking in Pulse Pearler - splitting of pulses in Pulse splitter - Mini dhal mill - working principle - advantages and disadvantages – pulse milling efficiency - Grinding of split pulses - pulse flour products - their applications and equipments used.

### **SUGGESTED READINGS:**

1. KM. Sahay and KK. Singh. Unit operations of Agricultural Processing, Vikash Publishing house PVT Ltd. Delhi, 2<sup>nd</sup> Edition, 2004.
2. Chakraverty, A. Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 3<sup>rd</sup> Edition, 2018.
3. Karel Kulp and Joseph P Pante. Handbook of Cereal Science and Technology, Marcel Dekker, USA, 2<sup>nd</sup> edition, 2000.

**Course objectives****The goal of this course is for students to,**

- Expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.
- Enable the students about the quality analysis of the functional groups in fruits and vegetables

**Course outcomes****Upon completion of this course, students will be able to,**

1. Understand the principles behind analytical techniques in food analysis.
2. Know the methods of selecting appropriate techniques in the analysis of food products.
3. Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries.
4. Familiarize with the current state of knowledge in food analysis.

**UNIT I -ANALYSIS OF WATER**

Parameters tested as per FSSAI Regulations- Organoleptic and Physico-chemical Parameters- Colour ,Odour, pH, Taste, Turbidity, General Chemical parameters- Ammoniacal nitrogen, Anionic surface active agent, Boron, Nitrate, Chloride, Magnesium, Fluoride, Total hardness, Alkalinity, Sulphates, Residual free chlorine& Chloramines Sulphide , Cyanide, Calcium, Total Dissolved Solids, Phenol, Sodium , Hexavalent chromium ,Total solids, Nitrite , Mineral Oil, Estimation of Anions in Drinking water by Ion Chromatography, Metals A By AAS- By Flame AAS (Zn, Mg, Ca,), By Graphite furnace AAS(Al, Cu, Fe, Mn, Se, Ag, Cd, Pb, Hg, Mo, Ni, As, Cr), By Cold Vapour AAS (Hg) B. By ICP-MS (Zn, Mg, Ca, Al, Cu, Fe, Mn, Se, Ag, Cd, Pb, Hg, Mo, Ni, As, Cr, Hg), Toxic substances- Pesticide Residues, Polychlorinated Biphenyls, Polyaromatic Hydrocarbons, IS protocol 10500 and 14543.

**UNIT II-ANALYSIS OF PLANTATION PRODUCTS**

Tea & Coffee- Preparation of sample, Moisture content, Total ash, Water soluble ash, Determination of Caffeine content by different methods, Microscopic examination, Determination of solubility in boiling water, Determination of Iron filings and size of the particles, Test for presence of added colouring matter

Spices- Sample preparation, Determination of moisture, Acid insoluble ash, Determination of Cold Water Extract, Determination of Alcohol Soluble Extract , Calcium Oxide, Non Volatile Ether Extract, Volatile Oil, Crude Fibre, Allyl isothiocyanate in Mustard, p-hydroxybenzyl isothiocyanate in white mustard, Microscopic Examination of Spices, Black Pepper- Determination of Bulk density, Light berries, Piperine content, Turmeric- Determination of curcumin content, Starch content, Detection of chromate content, Detection of Argemone seeds in Mustard, Detection of Mineral Oil in Black Pepper, Detection of Papaya seeds in Black Pepper, Detection of Turmeric in Chillies and Coriander, Detection of Oil Soluble Colour, Determination of Light and Heavy Filth in Spices and Condiments, Determination of capsaicin content in chilli powder.

**UNIT III-ANALYSIS OF FRUIT & VEGETABLE PRODUCTS, OILS & FATS**

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**

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**

Preparation of Sample for Meat and Processed Meat products, Determination of Nitrite in Processed animal foods, Determination of Ascorbic acid, Alternate method for Determination of Ascorbic acid, Determination of Total Phosphorous, Test for presence of Polyphosphates, Determination of Glucono-delta-lactone, Additional tests ,Determination of physico-chemical quality of meat and meat products- pH, Extract Release Volume (ERV) ,Meat Swelling Capacity (MSC), Total Volatile Basic Nitrogen (TVBN), Picric Acid Turbidity (PAT), Determination of dye reduction capacity.

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

#### **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



**Course objectives**

The goal of this course is for students to,

- Understand the traditional methods of food processing and production.
- Understand the commercialization and health aspects of traditional and organic foods.

**Course Outcomes**

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

1. Understand the historical and traditional perspective of foods and food habits
2. Understand the wide diversity and common features of traditional Indian foods and meal patterns.
3. Familiarize with health benefits of bioactive components rich traditional foods over junk foods

**UNIT I - HISTORICAL AND CULTURAL PERSPECTIVES**

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

**UNIT II - TRADITIONAL METHODS OF FOOD PROCESSING**

Traditional methods of milling grains – rice, wheat and corn – equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sun drying, osmotic drying, brining, pickling and smoking.

**UNIT III TRADITIONAL FOOD PATTERNS**

Typical breakfast, meal and snack foods of different regions of India. Regional 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 IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS**

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

**UNIT V HEALTH ASPECTS**

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments / illnesses. Organic foods types of organic foods, identifying organic foods, organic food & preservatives.

### **SUGGESTED READINGS:**

1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005.
2. Davidar, Ruth N. “Indian Food Science A Health and Nutrition Guide to Traditional Recipes, East West Books, 2001.

**Course objectives**

**The goal of this course is for students to,**

- To acquaint the students with the Sensory evaluation techniques and steps for the development of new food products.

**Course outcomes**

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

1. Describe the importance and applications of sensory analysis of foods
2. Practice the various methods and tests involved in sensory analysis of different types of foods
3. Select and train the assessors to conduct successful sensory evaluation of foods

**UNIT I INTRODUCTION TO SENSORY ANALYSIS**

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

**UNIT II METHODOLOGY OF SENSORY ANALYSIS**

Preparation of trial, Location of test and tasting Rooms, Sensory evaluation techniques, Types of tests Differentiation sensory tests, Variables and scales, Descriptive sensory tests Affective sensory tests

**UNIT III ASSESSORS**

Selection, training and monitoring, Assessors, Types of assessors, Factors influencing sensory evaluations, Features of assessors, Selection, training and monitoring of assessors: Recruitment, Selection, Training, Monitoring

**UNIT IV CONCEPTS**

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, building up strategy, product development programme.

**UNIT V PRODUCT DEVELOPMENT PROCESS**

The product development process - product strategy, product design and process development, product commercialization, product launch and evaluation.

**SUGGESTED READINGS:**

1. Meilgaard Morten; Sensory evaluation techniques Stone Herbert; Sensory evaluation practices. ISBN: 0-12-672690-6
2. Schaffner, D. J., W. R. Schroeder e M. D. Earle; Food Marketing: An International Perspective - 2nd ed, McGraw Hill, 2003. ISBN: 978-0072952889
3. Varela, P. e G. Ares; Novel Techniques in Sensory Characterization and Consumer Profiling, CRC Press , 2014. ISBN: ISBN 9781466566293

**Course objectives**

**The goal of this course is for students to,**

- Understand the concepts in marketing management and realize its scope.
- Explain the consumers buying behavior and information systems in marketing.
- Understand the marketing planning processes and classify the types of food consumption across the globe.
- Outline the concepts involved in international marketing and trading.
- Explain the major role of government in trading process.

**Course outcomes**

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

1. Discuss the concepts of marketing and market Structure.
2. Discuss the market segmentation and market resources.
3. Interpret the policies in marketing planning and advertisements.
4. Understand the overall concepts involved in international marketing and trade developments.
5. Discuss the role of export and import strategies and government roles in marketing.
6. Summarize the marketing principles, its structure and government policies in export and import tradings.

**UNIT I-CONCEPTS OF MARKETING AND MARKET STRUCTURE**

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, Concept of market structure, Marketing environment -Micro and macro environments

**UNIT II- CONSUMERS BUYING BEHAVIOR**

Consumers buying behaviour, consumerism, Marketing opportunities analysis: marketing research and marketing information systems, Market measurement- present and future demand, market forecasting, Market segmentation, targeting and positioning, Allocation and marketing resources

**UNIT III-MARKETING PLANNING PROCESS AND ADVERTISING**

Marketing planning process, Product policy and planning : product-mix, product line, product lifeCycle, 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**

International marketing and international trade, salient features of international marketing

Composition & direction of Indian exports, international marketing environment, deciding which & how to enter international market

#### **UNIT V- EXPORTS AND ROLE OF GOVERNMENT AGENCIES IN TRADE**

Exports- direct exports, indirect exports, Licensing, Joint ventures, Direct investment  
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

#### **SUGGESTED READINGS:**

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithileshwar Jha. 2013. Marketing Management: A South Asian Perspective, 14th Ed. Pearson Education.
2. William J. Stanton. 2010. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.
3. C.N. Sontakki. 2014. Marketing Management. Kalyani Publishers, New Delhi.
4. John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. 2013. International Business, 15th Ed., Pearson Education. Aswathappa. International Business. Tata McGraw-Hill Education, New Delhi.

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**Instruction Hours/week: L:3 T:0 P:0**
**Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course objectives****The goal of this course is for students to,**

- To understand the basics of nutraceuticals and functional foods
- To study the significance of nutraceuticals and their role in disease prevention
- To identify new strategies for marketing of traditionally known nutraceuticals

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

1. To understand the importance of Functional food for preventive therapy
2. To develop methods for extraction and identification of nutraceutically significant molecules.

**UNIT I-NUTRACEUTICALS: HISTORICAL, TECHNOLOGICAL ASPECTS AND CLASSIFICATIONS**

Introduction – Historical Reviews - Teleology of nutraceuticals - Organization models for nutraceuticals – Classification of Nutraceuticals based on the sources– Animal, Plant and Microbial – Nutraceuticals in specific foods - Mechanism of Action - Chemical nature.

**UNIT II- FLAVANOIDS AND CAROTENOIDS AS ANTIOXIDANTS**

General background on phytochemicals as antioxidants - Flavonoids and Lipoprotein oxidation - Evidence for specific Antioxidant mechanisms of Flavonoids - Dietary carotenoid and carotenoid absorption - Approaches to measurement of absorption - Metabolism of Carotenoids – Carotenoids as anticancer agents.

**UNIT III-OMEGA-3 FATTY ACIDS AND CLA**

Introduction to Lipoprotein metabolism – PUFA and Cardiac Arrhythmias - Preventative role of n-3 fatty acids in cardiac arrhythmias -Mechanism of action on n-3 PUFA's -  $\omega$  – 3 fish oils and their role in Glycemic control-  $\omega$  –3 fatty acids and rheumatoid arthritis - Chemistry and Nomenclature of CLA – Analysis of CLA in food and biological samples – CLA in food products and biological samples –Biological actions and potential health benefits of CLA – Mechanisms of CLA action – Potential adverse effects of CLA

**UNIT IV-LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS**

Lycopene overview – lycopene and disease - Garlic – Chemistry – Implication in Health - Olive oil – CHD – Cancer - Nuts – Nutrient components and Composition – Nut Consumption and CHD epidemiological evidence, Human nutritional studies on nut consumption and serum lipid changes, Mechanism of action- Probiotics- criteria – products on market – probiotic products – Microbiology of the gastrointestinal tract - Prebiotics – future for probiotics and prebiotics.

**UNIT V-HERBS AS FUNCTIONAL FOODS, STABILITY, TESTING AND MARKETING ISSUES FOR NUTRACEUTICALS AND FUNCTIONAL FOODS**

Herbal medicine – Herbs as ingredients in functional foods – actions of herbal and evidence of efficacy -Kinetic modelling of chemical reactions – Accelerated shelf life testing - Evolution of marketing environment for Functional foods and nutraceuticals - Regulatory background - Introduction to consumer marketing issues for nutraceuticals - Potential product positioning.

## **SUGGESTED READINGS:**

1. Shi, John, Fereidoon Shahidi and Chi-Tang Ho “Asian Functional Foods”. CRC/Taylor & Francis, 2007.
2. Watson, Robald Ross “Functional Foods and Nutraceuticals in Cancer Prevention”. Blackwell Publishing, 2007.
3. Gibson, G.R. and C.M. Willams. “Functional Foods: Concept to Product”. Woodhead, 2000
4. Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, 2nd Edition, CRC, 2001.
5. Wildman, Robert “Handbook of Nutraceuticals and Functional Foods”. CRC, 2006.
6. Webb, P P. “Dietary Supplements and Functional Foods”. Blackwell, 2006.
7. Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier, 2005.

**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,**

- Provide knowledge of methods and tools applied to the production of biotechnologically derived foods and food ingredients.
- Understand safety assessment strategies for food developed through genetic engineering and to impart knowledge pertaining to development of foods that promote health and well-being.

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

1. Understand application of biotechnology in Food processing industries.
2. Appraise the applications and implications of genomics and genetic modification on foods.
3. Critique the ethical concerns associated with modern biotechnology processes

**UNIT I-INTRODUCTION TO BIOTECHNOLOGY**

Introduction -Biotechnology relating to the food industry – application of genetics to food production – Genetic Engineering Techniques- Recombinant DNA Techniques and Cloning Strategies - role of bio process engineering in biotechnology industry. Regulatory and Social aspects of biotechnology of foods. Biotechnological approaches to improve nutritional qualities and shelf life of fruits and vegetables, live stock, poultry and fish products.

**UNIT II-PRODUCTION OF PRIMARY AND SECONDARY METABOLITES**

Production of commercially important metabolites – citric acid, lactic acid, gluconic acid, amino acids, Flavoring agents, colouring agents and vitamins. New protein foods - SCP; mushroom; algal proteins. Natural bio-preservatives – Nisin, Lacticin.

**UNIT III - DOWNSTREAM PROCESSING**

Principle of downstream processing –stages in downstream processing- solid liquid separation flotation-flocculation-filtration-types-centrifugation-cell disruption-concentration-evaporation liquid - liquid extraction-membrane filtration precipitation-adsorption-purification by chromatography.

**UNIT IV-MOLECULAR DIAGNOSTIC TOOLS**

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; Genetic based diagnostic systems - Polymerase Chain Reaction (PCR). Micro array diagnostic methods to detect pathogens, pesticides, and toxins in the raw materials and food.



## **UNIT V-BIOSENSORS AND GM FOODS – SOCIAL AND ETHICAL ISSUES**

Biosensors: Introduction, classification and application in food industries Potential Impact of Biotechnology on Food Industries. GM foods and food security- Safety aspects and social acceptance - Ethical issues. GMOs- current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects

### **SUGGESTED READINGS:**

1. Bielecki S., Ed., Polak J., J. and Bielecki, Tramper S., Food Biotechnology, Elsevier Science Publishing Company, New Delhi, 2000.
2. Gutierre, Gustavo F., Food Science and Food Biotechnology, CRC Press, New York, 2003.
3. Rita Singh, Food Biotechnology, Global vision publication house, Delhi, 2004.
4. B.D. Singh. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
5. Meenakshi Paul. 2007. Biotechnology and Food Processing Mechanics. Gene-Tech Books, New Delhi.
6. James D. Watson. 2013. Molecular Biology of the Gene, 7th Ed. Benjamin Cummings, San Francisco, USA.
7. Oliver Brandenburg, Zephaniah Dhlamini, Alessandra Sensi, Kakoli Ghosh and Andrea Sonnino 2011.

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

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**Course objectives****The goal of this course is for students to,**

- To understand the basic theory of drying and its significance in food systems
- To understand the importance of drying as a method of food processing
- Understand drying mechanism of food products.
- Understand moisture content measurement and thermal properties related to drying
- Judge quality of dried product
- To learn about the relative advantages / disadvantages of each method of drying

**Course outcomes****Upon completion of this course, students will be able to,**

1. Understand novel and hybrid drying technology.
2. Select suitable dryer meeting requirement.
3. Develop functional design of dryers.
4. Understand the importance of drying as a method of food processing
5. Understand the principle and working of various types of dryers.
6. Apply the knowledge on drying technology in various food industries.

**UNIT I – PRINCIPLES OF DRYING**

Principles of drying – Fundamentals of air-water mixtures – Psychrometric chart – Problems based on psychrometry – Drying curves – constant and falling rate period - Heat and mass transfer in dryers – with and without recirculation. Water content in foods and its determination - Cabinet drying – Vacuum drying.

**UNIT II -DRUM DRYING, FOAM MAT DRYING AND OSMOTIC DEHYDRATION OF FOODS**

Drum driers - Types of Drum Dryers - Principles of Operation of the Drum Dryer – Steam Consumption – Types of Feeding – Final product form. Foam Mat Drying- Principles- Equipments- Factors affecting Foam mat drying. Osmotic dehydration – Principles – Factors affecting osmosis- Equipment used. Rotary Dryer.

**UNIT III -SPRAY DRYING OF FOODS**

Fundamentals –Nozzles, Rotary atomizers and two fluid feeds- Interaction of droplets with air- Drying of droplets with soluble and insoluble solids – Microstructure of spray dried products – Reconstitution – Foam spray drying – Applications in the Food industry.

**UNIT IV – FLUIDIZED BED, PNEUMATIC AND FREEZE DRYING**

Fluidized bed drying – Introduction – Effect of operating parameters – conventional and modified 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**

Special drying techniques - contact-sorption drying - drying on inert particles – pulse combustion drying - drying with induction heating - novel dryers - dehydration of foods using cyclic pressure.

### **SUGGESTED READING:**

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

**Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100  
End Semester Exam:3 Hours****Course objectives****The goal of this course is for students to,**

- To provide students with the skill to produce some foods and drinks resulting from alcoholic or acidic fermentation process.

**Course outcomes****Upon completion of this course, students will be able to,**

1. Understand the basics of fermentation process and their benefits.
2. Adapt the Impact of fermented products and its benefits
3. Preserve fermented Foods by adapting technology to meet demands

**UNIT I - INTRODUCTION TO FERMENTATION**

Definition - benefit of fermentation - nutritive value of fermented foods - microbial changes in fermented foods - micro organism - proteolytic, lipolytic and fermentative bacteria.

**UNIT II - CULTURE MAINTENANCE**

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**

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Butter milk and the fermented milks. Spoilages and defects of fermented dairy products and their control. Fermented meat and fish products, Oriental fermented foods

**UNIT IV - FERMENTED DRINKS**

Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg. Rum, gin, whisky), Fermented Vegetables (Pickles).

**UNIT V - MICROBIAL PROTEINS**

Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases, protease, lipases, pectinases, rennin), HFCS(High Fructose Corn Syrup)

**SUGGESTED READINGS:**

1. K.H. Steinkrus, Handbook of Indigenous Fermented Foods, Marcel Dekker publisher, 1983.
2. Sukumar De, Outlines of Dairy Technology, Oxford University Press N Delhi, 1991.
3. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009
4. L.E.Casida, Industrial Microbiology, New Age International(p) Ltd N Delhi, 2007
5. W.C.frazier and D.C.Westhoff, Food Microbiology, Tata McGraw Hill publisher, 3rd edition, 2008.

**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,**

- Impart knowledge to the students about extrusion technology, principle of working, classification of extruders according to process and construction, extruded products and their processing.
- Create entrepreneurship opportunities and skills by exposing to extruded processing and products.

**Course outcomes****Upon completion of this course, students will be able to,**

1. Learn about preparation of breakfast cereals and snack foods using extruder
2. Study processing parameters of extruders for preparing different food products
3. Prepare extruded products and texturized vegetable Protein by extruder

**UNIT I-INTRODUCTION**

Extrusion: definition, introduction to extruders and their principles, types of extruders. Extruders in the food industry: History and uses of extruders in the food industry.

**UNIT II-PRECONDITIONING**

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.

**UNIT III-SINGLE AND TWIN SCREW EXTRUDER**

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.

**UNIT IV-CHARACTERISTICS OF VARIOUS EXTRUDED FOOD PRODUCTS**

Rheological properties, textural properties. Sensory characteristics and nutritional value. Chemical and nutritional changes in food during extrusion. 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**

Cold extrusion; extrusion cooking, New extrusion technology for confectionery product; Breakfast cereal products. Breakfast cereals: introduction, type of cooking - High shear cooking process, steam cookers, low shear, low pressure cookers and continuous steam pre-cooking, available brands. 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

#### **SUGGESSTED READINGS:**

1. Richardson P., Thermal Technologies in Food Processing, Wood head Publishers, Cambridge, CRC Press, 2001.
2. Guy R. Extrusion Cooking, Technologies and Applications. Wood head Publishing Limited, Abington, Cambridge, 2001.
3. Fast R.B. and Caldwell E.F. Breakfast Cereals and How they are made. American Association of Cereal Chemists, St. Paul, Minnesota, 2000.

**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,**

- Familiarize with hazards, and toxicity associated with food and their implications for health.
- Know the various kinds of allergens and basis of allergic reactions
- The objective of the course is to introduce food related toxicological compounds in different foods
- To understand the protocols of sampling techniques in food toxicology measurements
- To gain the knowledge on level of processing of food to destroy allergens / toxins
- Creates an awareness to choose food with highly safe

**Course outcomes****Upon completion of this course, students will be able to,**

1. Awareness about the different types of allergens and Natural toxins associated with food
2. Understand about food toxicology and its hazards
3. Understand about food sensitivity and allergy
4. Analyze food toxin in food samples
5. Adapting toxin formed during processing and controlling
6. To prepare or process foods with zero toxicity

**UNIT I-INTRODUCTION**

Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humoral and cell media resources. Allergen and mechanism of allergic resources.

**UNIT II-FOOD ALLERGY AND SENSITIVITY**

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

**UNIT III-PRINCIPLES OF TOXICOLOGY**

Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. 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**

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.

**UNIT V-TOXICANTS FORMED DURING FOOD PROCESSING**

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,

**SUGGESTED READINGS:**

1. Helferich, William and Carl K. Winter, Food Toxicology, CRC Press, 2001.
2. Alluwalia and Vikas, Food Hygiene and Toxicology, Paragon International Publishers, 2007.
3. Shibamoto, Taka yuki and Leonard F. Bjeldanzes, Introduction to Food Toxicology, 2nd Edition, Academic Press, 2009.
4. Maleki, Soheila J. A. Wesley Burks, and Ricki M. Helm, Food Allergy, ASM Press, 2006.
5. Cliver, Dean O. and Hans P. Riemann, Food Borne Diseases, 2nd Edition, Academic Press/Elsevier, 2002.
6. Riemann, Hans P. and Dean O. Cliver, Food Borne Infections and Intoxications, 3rd Edition, Academic Press/Elsevier, 2006.



**Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100  
End Semester Exam:3 Hours****Course objectives****The goal of this course is for students to,**

- To make the students understand the basic concepts of total quality management and appreciate its importance in today's business environment.
- To enable them to acquire required diagnostic skills and use various quality tools.
- To familiarize the students about the Quality Management System
- To understand the various principles, practices of TQM to achieve quality.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

**Course outcomes****Upon completion of this course, students will be able to,**

1. Capable of applying TQM concepts for improving the quality of products and services.
2. Use tools and techniques of TQM for continuous improvement in quality.
3. Implement Quality Management System
4. Ability to understand principles, practices and statistical techniques
5. Ability to understand quality, systems, tools and techniques.
6. To prepare food products with high quality

**UNIT I-INTRODUCTION**

Introduction - Need for 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**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

**UNIT III-TQM TOOLS & TECHNIQUES I**

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 – Stages, Types.

**UNIT IV-TQM TOOLS & TECHNIQUES II**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures - BPR.

**UNIT V-QUALITY SYSTEMS**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

### **SUGGESTED READINGS:**

1. Besterfield, Dale H. et al., "Total Quality Management", 4th Edition, 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.
3. Oakland, J.S. "TQM – Text with Cases", 3rd Edition. Butterworth – Heinemann, 2003.
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.

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 milling, extraction and manufacture of tremendous products from cereals, pulses and oil seeds
- Summarize the production and processing methods of fruits and vegetables
- Discuss the chemical composition, processing, production, spoilage and quality of milk and milk products
- Outline the overall processes involved in the production of meat, poultry and fish products
- Review the production and processing methods of plantation and spice products

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

1. Discuss the basics of food processing.
2. Demonstrate the various processing technologies involved in fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products.
3. Infer the basics on microbiology of food products.
4. Describe the process of manufacture of various food products.
5. Recognize various methods of preservation of food.
6. Express the possible arena of entrepreneurial activity related to food products.

**Unit I - CEREAL, PULSES AND OIL SEEDS TECHNOLOGY**

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies - Pasta products - Tortilla - Method of manufacture.

**Unit II - FRUITS AND VEGETABLE PROCESSING**

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

**Unit III - DAIRY PROCESSING**

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipments - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products - Icecream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk.

#### **Unit IV - MEAT, POULTRY AND FISH PROCESSING**

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing .

#### **Unit V - PLANTATION PRODUCT TECHNOLOGY**

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

#### **SUGGESTED READINGS:**

1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3<sup>rd</sup> Edition. 2010.
2. Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1<sup>st</sup> Edition. 2003.
3. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23<sup>rd</sup> impression. 2016.

**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 basic concepts of food and nutrition.
- To define the overall classification, function, and source of carbohydrates, lipids and proteins.
- To recite the availability, source, deficiency and physiological role of fat and water soluble vitamins.
- To outline the role of health and nutritional importance of micro and macro minerals.
- To discuss the recent trends and developments in nutrition.

**Course outcomes****Upon successful completion of this, students will be able to**

1. Recognize the basics in the area of nutritional assessment in health and disease
2. Evaluate the biological functions of various macromolecules in terms of food and health.
3. Select the balanced diet for healthy life to avoid or prevent the deficiency disorders.
4. Choose an appropriate diet, products that prevent vitamin deficiency disorders.
5. Identify the proper foods rich in minerals to live a healthy life.
6. Design the diet with the recent concepts of human nutrition to prevent / treat the dreadful diseases.

**UNIT I - HUMAN NUTRITION**

Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

**UNIT II - BIOMOLECULES**

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

**UNIT III - VITAMINS**

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. *f* Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

**UNIT IV - MINERALS**

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

**UNIT V - RECENT TRENDS IN NUTRITION**

Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods,

health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

#### **SUGGESTED READINGS:**

1. Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3<sup>rd</sup> edition 2018. (ISBN-13: 9780199489084)
2. Charis Galanakis. Nutraceutical and Functional Food Components. Academic Press, 1<sup>st</sup> Edition, 2017. (ISBN: 9780128052570)
3. Ashley Martin. Nutrition and Dietetics. Syrawood Publishing House. 1<sup>st</sup> Edition, 2016. (ISBN:9781682860588)
4. Robert E. C. Wildman. Handbook of Nutraceuticals and Functional Foods. CRC Press, 2<sup>nd</sup> Edition, 2016. (ISBN-10: 9781498770637)
5. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6<sup>th</sup> Edition. 2017. (ISBN-13: 9789386418883)

**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,**

- Outline the current status of snack food Industry
- Describe the production, processing and marketing trends of potato and tortilla chips
- Outline the overall processing of popcorn
- Explain the production and processing of fruits involved in snack food preparation
- Summarize the sensory analysis methods and packaging techniques of snack foods

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

1. List the various manufacturing process in snack food industries
2. Acquire knowledge about current production and marketing status of Snack foods
3. Elucidate the advantages of Sensory Evaluation
4. Packaging technologies in Snack Food Industries
5. Demonstrate the equipments involved in the snack production processes
6. Use flavorings in the popcorn industries

**UNIT I- SNACK FOOD INDUSTRY**

Introduction-History-Past innovations- Outline of snack food industry- Nutrition- Total Quality Management of Technology-Domestic Snack Food Market-Global Market-Snack Food Association Future Considerations

**UNIT II-POTATO AND TORTILLA CHIPS PROCESSING**

Potato Production- Potato snack Ingredients- Potato Analysis and Composition- Potato chip manufacturing process-Unit Operations-Other value added products from Potato.

Tortilla chips - Raw Materials- Processing steps-Equipment involved-Reconstitution of Dry Maize Flour-Unit operations.

**UNIT III-POPCORN PROCESSING**

Introduction- Raw popcorn selection and preparation-Popping Methods-Home preparation of Popcorn-Equipments-Industrial manufacturing process- Flavorings and Applicators-Popcorn Packaging- Relative Nutrition- Marketing.

**UNIT IV-FRUIT BASED SNACKS**

Introduction-production and processing of fruit crops – fruit purees – fruit powders – canned fruit snacks – alcoholic preservation of fruit snacks – fruit candies – fruit bars – exotic fruits.

**UNIT V SENSORY EVALUATION AND PACKAGING**

Introduction- Analytical methods-Sensory methods- Sensory Aspect of Processing- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning Case Packing-Current Issues in Snack Foods Packaging

### **SUGGESTED READINGS:**

1. Lusas, E. W and Rooney, L. W. Snack Foods Processing. CRC Press, 1<sup>st</sup> Edition 2001.
2. Panda, H. The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi. 2<sup>nd</sup> Edition 2013.
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd. 2008.



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

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

- To categorize the types of agricultural wastes
- To outline the production and utilization of biomass
- To explain the various parameters considered to be important in the designing of biogas units
- To discuss the methods employed in the production of alcohol from agricultural wastes / byproducts
- To summarize the overall aspects involved in the production of paperboards and particleboards from agricultural wastes

**Course Outcomes****Upon successful completion of this, students will be able to**

1. List and classify the types of agricultural wastes
2. Collect and generate number of value added products from agricultural wastes
3. Recall the techniques involved in the production and utilization of biomass
4. Assess the various parameters considered to be important in the designing of biogas units
5. Illustrate the various methods employed in the production of alcohol from the byproducts of agricultural wastes
6. Choose the appropriate materials to produce paperboards and particleboards from agricultural wastes

**UNIT 1-TYPES OF AGRICULTURAL WASTES**

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

**UNIT 2-BIOMASS PRODUCTION AND UTILIZATION**

Biomass Gasifier, Technology used for the utilization of agricultural wastes: Biomass Gasifier, Nimbkar Agricultural Research Institute (NARI) Gasifier, Rice-Husk Based Gasifier, Heat and Steam from Sugarcane Leaf and Bagasse.

**UNIT 3-BIOGAS DESIGN AND PRODUCTION**

Biogas: Definition, composition, history of biogas, Production of biogas; types of biogas plant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), Selection and Design of biogas plant.

**UNIT 4-PRODUCTION OF ALCOHOL FROM WASTE MATERIALS**

Production of Alcohol from waste materials: Introduction, Production methods, Cellulolysis (biological approach): Pretreatment, Cellulolytic processes (Chemical and Enzymatic hydrolysis), Microbial fermentation, Gasification process (thermochemical approach).

## **UNIT 5-PRODUCTION OF PAPERBOARDS AND PARTICLEBOARDS FROM AGRICULTURAL WASTE**

Production and testing of Paperboards and Particleboards from Agricultural Waste: Introduction, History, Terminology and classification, Raw materials, Production steps- Pulping, Classifications of pulp, Bleaching, Plies, Coating, Grades.

### **SUGGESTED READINGS:**

1. Efthymia Alexopoulou. Bioenergy and Biomass from Industrial Crops on Marginal Lands. Elsevier, 1<sup>st</sup> Edition, 2020. (ISBN: 9780128188644)
2. Navanietha Krishnaraj Rathinam, Rajesh Sani. Biovalorisation of Wastes to Renewable Chemicals and Biofuels. Elsevier, 1<sup>st</sup> Edition, 2019. (ISBN: 9780128179529)
3. Simona Ciuta, Demetra Tsiamis, Marco J. Castaldi. Gasification of Waste Materials. Academic Press, 1<sup>st</sup> Edition, 2017. (ISBN: 9780128127162)
4. Nicholas E. Korres, Padraig O’Kiely, John A.H. Benzie, Jonathan S. West. Bioenergy Production by Anaerobic Digestion: Using Agricultural Biomass and Organic Wastes. Routledge, 1<sup>st</sup> Edition, 2013. (ISBN-13: 9780415698405)
5. Albert Howard, Yashwant Wad. The Waste Products of Agriculture. Benediction Classics, 1<sup>st</sup> Edition, 2011. (ISBN-13: 9781849025454)

**20BEEEOE04****RENEWABLE ENERGY RESOURCES****L T P C 3 0 0 3****OBJECTIVES**

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

**INTENDED OUTCOMES**

At the end of the course student understands about all types of energy sources and utilization.

**UNIT I INTRODUCTION****9**

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

**UNIT II SOLAR ENERGY****9**

Introduction to solar energy: solar radiation, availability, measurement and estimation – Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

**UNIT III WIND ENERGY****9**

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

**UNIT IV HYDRO ENERGY****9**

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

**UNIT V OTHER SOURCES****9**

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

### TEXT BOOKS

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Rai.G.D	Non-conventional sources of energy	Khanna publishers	2011
2	Khan.B.H	Non-Conventional Energy Resources	The McGraw Hills, Second edition	2009

### REFERENCES

S. No.	Author(s) Name	Title of the Book	Publisher	Year of Publication
1	Rao.S. & Parulekar	Energy Technology	Khanna publishers, Eleventh Reprint	2013
2	Godfrey Boyl	Renewable Energy: Power sustainable future	Oxford University Press, Third edition	2012
3	John W Twidell and Anthony D Weir	Renewable Energy Resources	Taylor and Francis – 3 <sup>rd</sup> edition	2015

### WEBSITES

[www.energycentral.com](http://www.energycentral.com)  
[www.catelectricpowerinfo.com](http://www.catelectricpowerinfo.com)

**OBJECTIVES**

To enable the students to get aware of available tools and databases for performing research in bioinformatics.

To provide the thorough understanding of protein structure in detail..

**INTENDED OUTCOMES**

At the end of the course,

The students will understand the importance of Bioinformatics in various sectors.

The students will be exposed to biological database management and microarray technology.

**UNIT I OVERVIEW OF BIOINFORMATICS (9)**

The scope of bioinformatics; bioinformatics & the internet; useful bioinformatics sites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene & protein expression data; protein interaction data. Databases – contents, structure & annotation: file formats; annotated sequence databases; miscellaneous databases.

**UNIT II RETRIEVAL OF BIOLOGICAL DATA (9)**

Data retrieval with Entrez & DBGET/ LinkDB; data retrieval with SRS (sequence retrieval system). Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

**UNIT III PHYLOGENETICS (9)**

Phylogenetics, cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

**UNIT IV STRUCTURAL BIOINFORMATICS (9)**

Conceptual models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing & analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure: CATH & SCOP; introduction to protein structure

prediction; structure prediction by comparative modeling; secondary structure prediction; advanced protein structure prediction & prediction strategies.

## UNIT V – MICROARRAY DATA ANALYSIS

(9)

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharmainformatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; database management.

### TEXTBOOK

S. No.	Author (s) Name	Title of the book	Publisher	Year Publication
1	Dan E. Krane, Michael L. Rayme	Fundamental Concepts of Bioinformatics	Pearson education	2004
2	Andreas D. Baxeavanis, B. F. Francis Ouellette	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins	Wiley-Interscience	2004
3	David W. Mount	Sequence and Genome Analysis	Cold Spring Harbor Laboratory	2004

### REFERENCE BOOKS

S. No.	Author (s) Name	Title of the book	Publisher	Year Publication
1	Michael J. Korenberg	Microarray Data Analysis: Methods and Applications	Springer Science & Business Media	2007

**20BECOE02****MULTIMEDIA AND ANIMATION****3 0 0 3****Course Objectives:**

- To study the graphics techniques and algorithms.
- To study the multimedia concepts and various I/O technologies.

**Learning Outcomes:**

- To enable the students to develop their creativity
- To impart the fundamental concepts of Computer Animation and Multimedia.

**UNIT I      Introduction (9)**

What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.

**UNIT II      Creating Animation in Flash (9)**

Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers - Action script.

**UNIT III      3D Animation & its Concepts (9)**

Types of 3D Animation – Skeleton & Kinetic 3D Animation – Texturing & Lighting of 3D Animation – 3D Camera Tracking – Applications & Software of 3D Animation.

**UNIT IV      Motion Caption (9)**

Formats – Methods – Usages – Expression – Motion Capture Software's – Script Animation Usage – Different Language of Script Animation Among the Software.

**UNIT V      Concept Development (9)**

Story Developing – Audio & Video – Color Model – Device Independent Color Model – Gamma and Gamma Correction - Production Budgets- 3D Animated Movies.

**Total Hours: 45**

**TEXT BOOK:**

Computer Graphics, Multimedia and Animation-Malay K. Pakhira, PHI Learning PVT Ltd,2010

**REFERENCES:**

- Principles of Multimedia – Ranjan Parekh, 2007, TMH. (Unit I, Unit V)
- Multimedia Technologies – Ashok Banerji, Ananda Mohan Ghosh – McGraw Hill Pub.
- Encyclopedia of Multimedia and Animations-Pankaj Dhaka, Anmol Publications-2011



**20BTCEOEO3****INDUSTRIAL WASTEWATER TREATMENT****3 0 0 3 100****COURSE OUTCOME**

After completion of the course, students are able to

- Examine the constituents of waste water and its effects.
- Separate the contaminants from the effluent for treatability.
- Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
- Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries.
- Develop process flow diagram for water reuse and sludge disposal

**UNIT I - INTRODUCTION TO WASTE WATER ENGINEERING**

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics. (7)

**UNIT II - OPERATIONS AND UNIT PROCESS**

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization (11)

**UNIT III - FUNDAMENTALS OF BIOLOGICAL TREATMENT**

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation, Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons. (9)

**UNIT IV - WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES**

Dairy, Sugar, Pulp and Paper, Textile and Pharmaceutical Industries. (9)

**UNIT V - WATER REUSE**

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening, degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration. (9)

### **SUGGESTED READINGS:**

- Metcalf Eddy, Wastewater Engineering -Treatment and Reuse, Fourth Edition, Tata, McGraw Hill, New Delhi, 2002.
- Mark J. Hammer, Water and Wastewater Technology, Seventh Edition, Prentice Hall of India Pvt Limited, New Delhi, 2012.
- James M. Montgomery, Water Treatment Principles and Design, First Edition, A Wiley• Interscience publication, New York,1985

**LIST OF VALUE ADDED COURSES OFFERED BY FOOD TECHNOLOGY**

<b>S. No</b>	<b>Name of the Value Added Course</b>	<b>Duration</b>
1.	Chromatographic Techniques in food analysis	30 Hours
2.	Application of Bioinformatics in Food Technology	30 Hours
3.	Analysis of Shelf Life of Packaged Foods	30 Hours
4.	Nutraceuticals as alternative for pharmaceuticals	30 Hours
5.	Basic Proximate analysis for food products	30 Hours
6.	Dairy industry and Dairy products in India	30 Hours
7.	Millet based food products	30 Hours
8.	Technology for processing of fruits and vegetables into value added products	30 Hours
9.	Good Manufacturing Practices in Food Industries	30 Hours
10.	Recent Developments in Food Colours: Natural and synthetic	30 Hours

**THRUST AREAS FOR TECHNOLOGY BUSINESS INCUBATOR (TBI)**

<b>S. No</b>	<b>Thrust areas</b>
1	Value added food products
2	Food preservation techniques
3	Nutraceuticals
4	Food processing methods
5	Food analysis